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Education and school in the era of AI. Educationist's dilemmas

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Abstract: For at least several decades, the school environment has been under strong pressure from technology. New ICT tools bring educational hopes, but they also raise many doubts. This paper concerns the presence of Artificial Intelligence (AI) in the teaching-learning process. AI in education (AIED) provides enormous opportunities for individualising the teaching-learning process, adapting the entire process to the schoolchild's capabilities and motivation level. It also allows for more effective education management. It can predict trends, but also profile the education path of individual schoolchildren based on previous educational achievements. It also allows for support for teachers, especially in those aspects of education that can be standardised in some respects (e.g. assessment). However, the presence of AI in the education system brings specific challenges and difficulties that demand taking action so as not to squander the educational opportunities associated with new technologies. Firstly, Artificial Intelligence collects huge amounts of data in its activities, including sensitive data related to children's privacy. It is necessary to take care of their protection so that they are not used to the detriment of children or processed for commercial purposes. The presence of AI in schools also requires a redefinition of the role of the teacher. Undoubtedly, the emphasis in their work will have to be distributed differently and their position defined more precisely. To a large extent, this is related to another threat, which may be deficits in interpersonal communication. Until now, the teaching-learning process was based on interpersonal relations between the teacher and schoolchildren and was strongly vectored. The message had a specific direction. In the case of AI, interpersonal communication disappears and the message becomes more spontaneous and interactive. It is difficult to determine today whether AI will bring only benefits or whether the threats will outweigh them. The example of smartphones shows that not every new technology has a positive impact on the development and level of education of children. It seems that due to the dynamic development of AI models and their commonness as general-purpose technologies, we will not wait longer than a decade to make a substantive evaluation of the presence of AI in the education system.

Keywords: education, AI, new technologies in education, ethics

Introduction

Every new communication technology that appeared in the 20th century brought with it certain educational hopes. In many cases, this was one of the basic goals that were set for it. Even when they were not directly related to the education system, the media were a tool for "enlightenment". The very way the media operated assumed the implementation of an educational function. For many decades, this reflected the functioning of television, which was focused on transmitting messages, clearly vectored and strongly hierarchical (Casetti, Odin, 1994). The next breakthrough was the popularisation of the computer network and websites, which were to constitute a kind of information highway and build a true knowledge society. However, it was Artificial Intelligence that brought a real revolution in terms of both the reach and the speed of change. For ChatGPT, two months after its launch were enough to reach 100 million users (Lichfield, 2023). According to data from the report The Dawn of the AI Era, 51 percent surveyed American teenagers use models such as ChatGPT or Google Gemini. Almost half of them use AI to help with homework assigned at school (Madden et al., 2024).

It should be emphasised that artificial intelligence (AI), like other new technologies, was originally associated with great expectations in the field of education. Consequently, researchers working on the fundamental aspects of AI have often emphasised its educational potential (Lee, 2019; Lennox, 2020; Lee, Qiufan,

2022; Suleyman, Bhaskar, 2023). Nevertheless, two dominant currents are emerging in the research that deals intensively with AI applications in education.

The first focuses on the possibilities arising from the personalisation of the learning process, which offers an opportunity to optimise the teaching process (Chen et al., 2022; Gillani et al., 2023; Mittal et al., 2024). In addition, selected AI models can serve as a tool to support the development of teachers' communicative competence by providing training material (Song et al., 2022; Tubino, Adachi, 2022).

The second major research stream focuses on analysing the risks inherent in the implementation of AI in education. Indeed, the process of using AI-based systems involves the collection of significant amounts of sensitive data (Huang, 2023; Nemorin, 2022). This raises questions about the role of the teacher in an automated educational process and the future and nature of human interaction (Carter, 2022; Davis, 2023; Kim, 2023). The implementation of AI in the education sector therefore generates a growing number of ethical dilemmas that require in-depth analysis and the development of an appropriate regulatory framework (Carter, 2022; Fombona et al., 2025).

1. Uneven development

In January 2025, China surprised the world with a new, open AI model – DeepSeek. The model was surprising for at least two reasons. First, it was equal to such models such as those created, for example, by OpenAI, and second, the costs of its creation were disproportionately lower. This caused scare and even panic among both AI specialists and investors. The Chinese also made their model available for research and as a basis for construction and development, so they released it as an "open road" (open weight), (Gibney, 2025).

The race of various corporations creating AI models has accelerated quite recently. For ordinary AI users, this became noticeable in the early 2020s, when ChatGPT became popular in its subsequent versions (Marr, 2023). However, the history of Artificial Intelligence is much longer. For various reasons, it remained locked in scientific laboratories and the minds of transhumanists for decades.

John McCarthy, a professor at the Massachusetts Institute of Technology and Stanford University, is considered the father of Artificial Intelligence. In 1956, he organised a summer research project for computer scientists, the main topic of which was neural networks. In the invitation to cooperate, McCarthy included a new term "Artificial Intelligence" (AI), which was supposed to be a magnet for cooperation. However, after a few weeks of work, it turned out that there was far too little time to recreate the architecture of the human brain in a computer. The work was stopped, but the term "Artificial Intelligence" remained (Roberts, 2016).

After this first meeting in the mid-1950s, Artificial Intelligence hid in computer laboratories. There came something that Suleyman and Bhaskar called the "winter of Artificial Intelligence" (Suleyman, Bhaskar, 2023). This period lasted a very long time, until the end of the 20th century. In 1997, a computer created by IBM, Deep Blue, defeated chess grandmaster Garry Kasparov. Artificial Intelligence attracted attention at that time, but its wide application and potential economic benefits were still not seen (Greenemeier, 2017). Another breakthrough came 20 years later. The next computer, called AlphaGo, created by DeepMind, defeated the Chinese Go champion Ke Jie in May 2017. It seemed impossible, but the machine managed to beat the Chinese champion (Lee, 2019). It was already a time when people began to notice the potential applications of Artificial Intelligence on a huge scale and, equally importantly, the economic benefits that its use could bring.

In parallel with technological development, there was reflection on copying human intelligence or combining it with machine intelligence. The Transhumanist Declaration states that the future of humanity will be marked by strong pressure from science and technology due to the still untapped potential of humans (Sandberg, 2013). To understand transhumanism, one must consider its dual nature. Bostrom distinguishes two main aspects of this concept. The first, the theoretical aspect, involves the interdisciplinary exploration of the consequences, promises and potential dangers of using science and technology to overcome fundamental human limitations. It is therefore an area of academic reflection in which

the future of humanity is analysed in the context of technological progress. The second, the practical aspect, refers to transhumanism as an intellectual and cultural movement that actively advocates the possibility and necessity of a fundamental change in human existence (Bostrom, 2005). More believes that transhumanism is moving us towards a posthuman state. In his view, transhumanism has many elements in common with humanism, such as a respect for reason and science, an emphasis on progress and an appreciation of the role of humans. However, it differs from traditional humanism in expecting, even postulating radical changes in human nature and the possibilities available to it, offered by the dynamic development of various fields of science and technology (More, 1999).

Transhumanists are characterised by great optimism, even "technological romanticism" when it comes to the development of technology. This applies not only to aspects such as social robotics or affective computing, which would influence the development of a special relationship with machines, but also to a significant expansion of human biological capabilities. The development of robotics is to be a condition for improving the quality of human life (Bostrom, 2005; Minsky, 2006; Moravec, 2009).

The artificial intelligence market in education is showing significant and accelerated growth, although exact valuations and forecasts vary according to market analyses. For example, Business Research Insights has valued the market at USD 2.46 billion in 2024 and forecasts that it will reach USD 28.22 billion by 2032 (Business Research Insights, 2025). On the other hand, Consainsights offers a much higher base valuation of USD 23 billion in 2024, with this expected to rise to USD 95.20 billion by 2033 (Consainsights, 2025). Other forecasts estimate that the market for AI in education will reach USD 9.3 bn by 2034. In 2024, North America generated a 38,7 % share of the global AIED market. More than 50% of children use AI for homework and 60% of teachers say they incorporate AI into their daily practices for education (Shinde, 2025). The 2023 UNESCO report indicated that 63% of educational institutions worldwide have implemented some form of AI. However, indicators are globally mixed. For example, by 2023 47% of academic institutions in developed countries have implemented AI-based tools, in stark contrast to 8% of low-income countries (Lee, 2025; Li, Tolosa, Rivas-Echeverria, Marquez, 2025).

Since J. McCarthy's pioneering attempts to conceptualise artificial intelligence, numerous research efforts have focused on its definition and algorithmic description. However, due to the dynamic development and heterogeneity of this field, it is still difficult to formulate a single, generally recognised definition. The literature therefore favours the identification of key properties of AI systems rather than striving for a strict definition. The fundamental characteristics of AI systems include their autonomous learning and knowledge acquisition capabilities. Human intervention in this process manifests itself primarily in the provision of training data and the configuration of model parameters. Another important characteristic of AI systems is their ability to adapt to previously unknown operating conditions and to make decisions and act autonomously in new, unforeseen contexts (Kurp, 2023).

2. Areas of application of artificial intelligence in education

Basically, they can be reduced to three ones:

- personalisation of the teaching-learning process;
- support for teachers and tutoring;
- effective management of education.

Artificial Intelligence is gaining importance in education due to its potential to support teaching in various contexts. AI in education (AIED) allows the adaptation of the teaching process to the individual needs of the schoolchild, which allows for more effective lessons, adapts the teaching-learning process to the individual needs of schoolchildren, offering personalised educational paths (Fundació Bofill, 2022; Mittal et al., 2024). Educational Artificial Intelligence (AIED) is the process of integrating and applying Artificial Intelligence (AI) technologies in educational environments, mainly in classrooms but also in other learning contexts, to enrich the teaching

and learning experience. AIED is not just a minor addition to the teaching and learning process but represents a significant change. It brings both opportunities and challenges that education systems around the world will face in the near future (Vieriu, Petera, 2025).

AIED can support schoolchildren with special educational needs by offering them personalised tools and educational materials. AIED systems can help identify schoolchildren at risk in real time, which allows for quick intervention. They can do this both when children learn individually and in class teams (Chen et al., 2022).

AI algorithms enable effective assessment of complex skills and knowledge, supporting diagnostic processes. AI helps in grading written work, improving pronunciation, learning languages and developing reading skills. AIED can support creativity and innovation by generating music, images or texts. AIED platforms allow for the creation of personalised educational materials, which supports an individual approach to the teaching-learning process (Fundació Bofill, 2022).

AIED can support teachers in many different ways. A chatbot was used to train teachers to help them cope with difficult situations in class. Teachers working with an "unkind" chatbot had the opportunity to verify their level of effectiveness in dealing with difficult situations. Simulations with chatbots with different attitudes (including "unkind" one) allowed teachers to practice interacting with difficult schoolchildren in a safe environment, which is difficult to achieve in real conditions (Song et al., 2022).

AIED systems can significantly reduce the time that teachers have to spend on repetitive and standardised activities such as assessment. Teachers can not only save time, but also increase the precision of assessment. The same systems can help schoolchildren to self-assess in real time (European Commission, 2023).

Another way of involving AIED in the teaching-learning process is through intelligent tutoring systems. They adapt to the level of knowledge and skills of the schoolchild, offering personalised learning paths. The intelligent tutoring system offers what seems to be one of the most successful applications of AI in education, namely personalised learning paths. It can easily identify knowledge gaps and provide feedback. It also adapts tasks to the level and motivation of schoolchildren, and can become an intelligent and polite tutor (Gillani et al., 2023).

Generative models in education can take the form of not only applications or appropriate software, but also educational robots. Educational robotics assumes that the development of knowledge and skills takes place through interaction with robots. Children can transform abstract concepts into concrete objects. This type of education, with developed elements of manipulation and interaction, is particularly effective in preschool age and in teaching STEM subjects (science, technology, engineering, math) (Chen, et al., 2023; Tubino, Adachi, 2022).

AIED can play a role in planning schoolchildren's educational future. This applies to both everyday educational practice and broader life perspectives. A chatbot can remind about daily school duties. In terms of broader planning, AIED can help determine the appropriate educational path by proposing schools that match the schoolchild's level of knowledge, interests and motivations. Applications prepared by schools or universities will guide the schoolchild through administrative processes related to education (Gillani et al., 2023).

AIED also offers a number of opportunities to improve education management, from the class level, through the school to larger systems. AIED models can predict changes in demand for schools and adapt educational policies to them. In the school itself, they can automate tasks such as creating schedules, assigning rooms or organising exams. Reducing the administrative burden on teachers allows them to focus on teaching and interacting with schoolchildren (Fundació Bofill, 2022; Gillani et al. 2023).

The implementation of artificial intelligence (AI) models in the education system, through both formal institutional structures and informal channels, has brought with it a number of positive experiences, but should not obscure fundamental questions and concerns about the dynamic development of these systems. According to the thesis of Suleyman and Bhaskar (2023), technology is inherently a form of power characterised by an asymmetrical distribution of potential. Consequently, in the field of education,

a disruption of the balance between technological progress and the primacy of humanistic values can lead to negative effects on social stability and undermine the prospects for future sustainable global human development.

3. Between technology and the humanities

AIED was originally intended to support teachers. However, the focus of AIED technology has begun to shift from a teacher's assistant to an autonomous collaborator of the schoolchild. As a result, questions have arisen as to whether implementing AI in education is really appropriate and whether any new technology is suitable for use in the teaching-learning process (Homes et al, 2023).

The problems with AI in education can be reduced to three areas:

- privacy and protection of personal data;
- the role of the teacher in the new system;
- deficits in interpersonal communication.

In order to function effectively, AI systems require access to large sets of data, including personal data. Collecting and analysing this data raises concerns about its security. Problems with data can be very different, ranging from simple data leakage, through its deliberate collection for commercial purposes, loss of control over data, to the lack of appropriate regulations (Huang, 2023). There is a great risk that implementing AI in education will involve a fight between corporate interests in the perspective of expected profits. Hence, there is a justified concern whether this will not happen at the expense of the well-being of schoolchildren (Nemorin, 2022). Therefore, it is important that the processes related to AIED are transparent and understandable to all interested parties. Children in particular require special care, for whom these processes may be too abstract. It is difficult for a child to understand how the system makes decisions and what factors influence its results.

The problem of violation of personal rights concerns not only personal data, but also monitoring schoolchildren's' emotions and behaviours. The possibility of obtaining various data additionally complicates the introduction of appropriate security and protection mechanisms. All the more so because the reality of AI changes dynamically, practically from week to week. Educational planning takes place over longer periods of time. Protecting schoolchildren's' privacy and data in the AI era requires a multidimensional approach, including legal regulations, ethics, education and self-regulation of the IT industry (Hung, 2023).

The position of a teacher in a school full of various AIED proposals is becoming a serious challenge. Teachers do not have to be convinced of new technologies in education. A similar problem concerned, for example, the Internet or distance learning. In the case of the latter, huge progress was made under the pressure of the global COVID-19 pandemic. But at the same time, the imperfections of such solutions have been revealed, for example in the sphere of interpersonal communication. Teachers are also concerned about whether schoolchildren will have enough discipline to learn independently using technology, whether they will not be encouraged to cheat and plagiarise. Learning based on AIED therefore requires an appropriate level of schoolchildren's motivation. There is also a fear that the implementation of AI may deepen inequalities if not all schools and schoolchildren have equal access to technology. As with any technology, there will be technical problems, as well as difficulties related to learning how to use new systems by teachers and schoolchildren (MacKenzie, 2024). A number of ready-made tools are being created that help teachers use AI to organise work in the classroom and design individual lesson units (e.g. *to teach_*). However, too far-reaching automation of the teaching-learning process can lead to a decrease in schoolchildren's engagement and the loss of important social and emotional aspects of education. There are also concerns that AI will also affect children's rights, especially the right to education, dignity, autonomy and privacy (Fundació Bofill, 2022).

Kim (2023) sees three possibilities for shaping the relationship between AI and teachers:

- teachers as passive recipients of AI;
- teachers as active users of AI;
- teachers and AI as constructive partners.

In the third case, i.e. Teacher-AI Collaboration (TAC), it is clear that the issue of using AI in education is no longer just a matter of technology, but also of far-reaching changes in the approach to education itself. Teachers are on a certain continuum between passively accepting solutions and actively participating in the process of integrating AI with the teaching-learning process.

A teacher in the education system is not only an animator of the teaching-learning process, but also a partner in the social development of the schoolchild. Technology has always tended to limit the time devoted to interpersonal relationships. Using voice in communication with technology and, on the other hand, simulating emotions through it can further deepen such tendencies. Saturating the child's environment with AI models can cause serious deficits in interpersonal communication and make it difficult to develop communication skills typical of humans. Although AI allows for individualisation of the teaching-learning process, we are not dealing here with contact with another human being but with a machine. Contact with a human teacher naturally introduces elements of interpersonal communication and creativity (Lee, Qiufan, 2022). AI can significantly help schoolchildren in learning, but it is the teacher who is essential in shaping communication skills and relationships. Perhaps with the increasing presence of AI in schools, the center of gravity of the teacher's work will shift in this direction. In the environment created by AI in schools, interpersonal relationships will become more important than ever before (Davis, 2023). It seems crucial to implement AI in a responsible and ethical manner, taking into account the rights and needs of all interested parties. It is also important to remember that technology is just a tool and the key to success is how people use it appropriately (Carter, 2022; Fombona, et al., 2025).

Conclusion

The rapid development of AI requires an equally rapid response from the education system. This is largely because AIED reaches schools in multiple directions. Teachers are beginning to be interested in the possibilities it offers in terms of constructing the teaching-learning process, and the education management system sees AI as a chance to increase the efficiency of its activities. Here, however, the use of algorithms will largely depend on convincing leaders managing education at the school level and teachers themselves (Marrone, et al., 2024). The least predictable thing is the way in which schoolchildren will use AI. The first data show that in addition to the many positive effects of using AI in education, dangerous trends will appear that will be difficult to control. Teachers mention here, among others, the use of AI by schoolchildren to do homework, help with exams, or use for translations in foreign language lessons (Hamilton, Swanston, 2024).

The school environment is increasingly under AI pressure, just as it once was (and probably still is) with smartphones. But smartphones are a good example that technology does not always serve the developmental well-being of children and improve the level of education. Recent studies have clearly shown a negative correlation between the presence of a smartphone in school and the level of education (Ana et al., 2024; Teivainen, 2024). It is predicted that artificial intelligence will not lead to the abolition of teachers in the coming years, but will rather help to redefine their role in the teaching process. It will be possible to relieve teachers of repetitive and administrative tasks so that they can focus on designing advanced learning activities that stimulate students' creativity and provide social-emotional support. The role of the teacher will continue to be critical in modelling and promoting the principles of responsible and ethical use of algorithms in education. AIED's algorithms offer the potential for an accelerated shift in the educational process towards greater individualisation and adaptation to the different needs and abilities of students. In this context, there is a direct interaction between the experiences of

students, teachers and the AIED algorithms, the operation of which can be calibrated according to the specific educational establishment or stage of education. However, it should be emphasised that the implementation of AI-based solutions generates significant challenges, including significant costs, the need to provide adequate technological infrastructure and the need to systematically and comprehensively prepare teaching staff for their new roles in technologically advanced educational environments. The potential for overcoming such barriers is illustrated by the lessons learned from the remote learning period implemented in response to the COVID-19 pandemic.

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