European Journal of Open Education and E-learning Studies
ISSN: 2501-9120
ISSN-L: 2501-9120
Available on-line at: www.oapub.org/edu

DOI: 10.46827/ejoe.v9i1.5653 Volume 9 | Issue 1 | 2024

A REVIEW OF SCIENTIFIC LITERATURE ON ARTIFICIAL INTELLIGENCE AND ITS EXPLOITATION IN THE EDUCATIONAL FIELD

Georgia Spiliopoulou[i],
Gerasimos Koustourakis
Department of Educational Sciences,
and Early Childhood Education,
University of Patras,
Greece

Abstract:
This work aims, through an approach to recent scientific literature, to highlight the effect of the use of Artificial Intelligence (AI) in today's educational field. From the analysis of the content of the relevant scientific literature, it appears that AI can help teachers in designing appropriate learning programs focusing on the needs of their students at an individual and collective level. In this case, using AI, a variety of learning activities can be created by the teachers with the aim of creating a supportive learning environment for the students, which will help them to better understand, as well as deepen, the material of the various knowledge areas of the curriculum. The integration of AI in both live and distance education can offer significant benefits, such as the transformation of the traditional teaching methods applied, such as the lecture, with the aim of enhancing the learning experience. Furthermore, from the content of scientific studies, both the creation of social inequalities and the emergence of an ethical concern regarding the educational use of AI, which is linked to the violation of the privacy and personal data of the people who use it in the context of their learning effort, emerge. However, the future of education seems to be linked to the necessity of reshaping the educational content through a broad and multi-level utilization of AI in it. And this is in order to shape the conditions for "meeting" the individual learning needs of the students.

Keywords: Artificial Intelligence, education, advantages, concerns, perspectives

1. Introduction

Artificial Intelligence (AI) constitutes a contemporary technological "area" that has made its presence felt mainly during the previous two decades of the 21st century in various areas of social reality, among which is education. In particular, the rapid development of

[i] Correspondence: email geospil.spiliopoulou@gmail.com

AI technology and its multi-layered effects on the modern globalized world seem to have made it a key factor in the fields of Science, Technology, Engineering and Mathematics (Dai *et al.*, 2023; Touretzky *et al.*, 2019; Wong *et al.*, 2020). AI is based on machines and defines a set of algorithms through which it becomes possible, among other things, to solve problems, as well as to make predictions and diagnoses about issues that touch on contemporary social and educational becoming (Chassignol *et al.*, 2018, p. 17; Chen *et al.*, 2022, p. 28; Omehia & Mmejim, 2020, p. 221; Şeren & Özcan, 2021, p. 215).

The importance of AI has become evident in the educational community, especially in the third decade of the 21st century, as it contributes in a dynamic way to support different learning environments. The support of educational systems by AI can be used to analyze the dynamics of a school class and the involvement of students in the educational process in real-time, which enables the direct intervention of the teacher and his interaction with the students (Chassignol *et al.*, 2018, p. 17; Chen *et al.*, 2022, p. 28; Omehia & Mmejim, 2020, p. 221; Tsai *et al.*, 2020).

AI seems to be entering people's lives more and more, with the result that governmental and educational policies of countries around the world are putting a lot of emphasis on the development of its use in the field of education. AI technology appears to be driving significant changes in the learning methods used in schools to deliver lessons and implement the curriculum. Furthermore, the entire structure of education, at the level of administration, teaching and learning, is being reshaped through AI. These transformations, small and/or large, are found at all levels of education and are found both in real life and in the delivery of distance education (Chassignol *et al.*, 2018; Fullan *et al.*, 2024; Liu *et al.*, 2021, p. 891).

In the context of a review of the international scientific literature, it is found that the forms of utilization of AI in the field of education, from primary to higher education, as well as its effects on the level of teaching and learning, are of great concern to the scientific community (see: Chen *et al.*, 2022; Dai *et al.*, 2023; Liu *et al.*, 2021; Omehia & Mmejim, 2020; Pisica *et al.*, 2023). Also, a number of scientific papers highlight the advantages and disadvantages arising from the use of AI in education (see: Chassignol *et al.*, 2018; Chaushi *et al.*, 2024; Hatim *et al.*, 2023).

This work seeks, through a review of the recent scientific literature, to highlight some important aspects concerning the effect of the utilization of AI in the educational field. The content of this study, after the chapter giving a brief definition of the term Artificial Intelligence is divided into thematic units based on the categorization of the findings of the relevant scientific works and is completed with a chapter containing concluding findings.

2. An attempt to conceptualize Artificial Intelligence

The American John McCarthy is considered the pioneer and creator of the term Artificial Intelligence. He introduced this term for the first time in 1956 at the Conference at Dartmouth College and is recognized as the "father" of research in the field of AI.

According to him, it is the science and engineering that shape intelligent machines (Heeg & Avraamidou, 2023, p. 126; Sutton, 2020). Regarding the European "landscape" and the entry of the term Artificial Intelligence, its first appearance came from the English Mathematician and logic theorist Alan Turing, who laid the foundations of computer science and AI. Turing's main contribution to AI is the imitation game, which he invented in the 1950s and which is popularly known as the "Turing test". According to him, if a machine is capable of "fooling" humans into thinking it is a human, then that machine must have human-like intelligence (Akman & Blackburn, 2000; Muggleton, 2014; Tao *et al.*, 2019, p. 33).

The term AI gathers a number of conceptualizations, as these are captured in the review of the recent scientific literature. In a more general context, AI, which refers to the ability of machines or computers to think and act like humans, represents attempts by computing systems to "mimic" the human mind and human actions (Gocen & Aydemir, 2000, p. 13; Wartman & Combs, 2018). From this perspective, a basic definition of AI can be the skillful imitation of human behavior or the human mind through "tools" or programs (Gocen & Aydemir, 2000, p. 13; Mohammed & Watson, 2019).

According to Fauzan (2000, as cited in Aristanto *et al.*, 2023, p. 64), the term AI refers to a computing engine that helps machines "work" as if they have human intelligence. In this perspective, these machines can make decisions, solve problems and make predictions. Due to the fact that AI has almost the same capabilities as humans, it is called "Extraordinary Intelligence".

Chassignol *et al.* (2018, p. 17) identify AI as a dual conceptualization: both as a field and as a theory. Specifically, these researchers define AI as a field dealing with computer science that aims to solve cognitive problems associated with human intelligence, such as learning, problem-solving, and pattern recognition. Also, AI is the theory that aims to develop computer systems that carry the ability to perform actions that are prerequisites to acquiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.

Pokrivcakova (2019, p. 138) gives a definition for the content of AI-oriented to the educational field, identifying it as the result of several decades of research and development "bringing together" a number of specialized professionals and scientists. These are system designers, statisticians, linguists, psychologists, as well as education specialists, who seek to develop educational systems that possess a level of intelligence, as well as the ability to perform a range of functions, including the provision of support by teachers for learners to acquire knowledge and flexible skills in an ever-changing environment.

3. Applications of Artificial Intelligence in education: types and categories

“Intelligent Teaching Systems" utilize AI methods to provide personalized instruction in the field of education. These systems offer training - and more specifically guidance, feedback and support - which is tailored to each learner's learning pace and capabilities.

Thus, AI is applied to personalized curricula, thereby enhancing the content of the learning process (Heeg & Avraamidou, 2023, p. 127; Şeren & Özcan, 2021).

Two main types of application of AI in education are as follows (Şeren & Özcan, 2021, pp. 219-220):

a) *Face-to-face classroom training using AI:* This type refers to training that is implemented in real time in the classroom where all students are present. In this case, the teacher is virtual. That is, the specific role is played by a robot that simulates a human or by a system that enables communication with students through the use of a screen. This system can be configured through two different methods based on supervised or unsupervised deep learning.
b) *Online education in a virtual learning environment:* This type is presented in the form of augmented reality and is a case of non-distance education applied in a simulation environment. Training using AI in simulation environments can be applied to two different system cases. In the first case, individuals participate in the simulation environment regardless of device use, while in the second case, the help of a mediating "tool" such as virtual reality glasses is included. In fact, the people participating in the specific type of training remain in the environment of the applicable location. Therefore, they receive their education in their existing spatial learning context.

AI can be applied and expressed through the following three categories (Şeren & Özcan, 2021, pp. 219-220):

a) *Artificial intelligence supported by face-to-face training: Human to Human and Natural environment.* The specific type of educational application of AI focuses on learning environments where its utilization can lead to the formation of teaching techniques and methods that will contribute to the learning support of students. In this case, the part of productivity and strengthening the learning process is promoted by assigning the students a series of special tasks, where they will rely on AI to carry them out.
b) *Face-to-face training leveraging artificial intelligence: Machine to Human and Natural Environment.* This type is related to the application of face-to-face training where animation is used through a screen or a talking humanoid robot.
c) *Simulation Training Using Artificial Intelligence: Human Machine and Virtual Environment.* This particular type of AI utilization, in which the environment is simulated, can be considered a type of distance education. It can also be considered a kind of augmented reality. In this case, the learners remain in their own personal space and are involved in a simulation environment with the help of a mediating "tool". This "tool" can be virtual reality glasses, gloves and interactive clothing that are introduced into the simulation process to help facilitate the learning process.

4. Key aspects of using Artificial Intelligence in the context of teaching and learning

4.1. Teaching resources and learning environment

Changes in the teaching resources and the teaching environment, with the use of the modern technological means offered, can be the cornerstone for reshaping teaching in the school classroom. From this perspective, a remodeled learning environment can better "meet" the needs of each student in the context of the modern digital educational reality. With the development of AI technology, a large number of companies have created a wide variety of "smart" teaching and learning "tools" and devices, a number of digital educational platforms (such as Moodle), educational robots (such as BeeBot and LEGO Mindstorms) as well as various programming languages (such as Java and JavaScript). AI, embedded in robots or computers, can improve the learning experience of every student, starting in preschool. In fact, Timms (2016) claimed that the various applications of robots in collaboration with teachers can be used effectively to teach students "routine" tasks, including spelling and pronunciation. In this case, the learning process seems to be adapted to the needs and abilities of each student (Chen *et al.*, 2020, p. 75265; Gómez-Zermeño & Franco-Gutiérrez, 2018; Kalaitzidou & Pachidis, 2023; Liu *et al.*, 2021, p. 894). The utilization of technologically upgraded teaching and learning "tools" can facilitate teachers and students in carrying out educational work by applying modern approaches to teaching and learning. In this perspective, teachers and "smart" devices can coexist harmoniously in the classroom. Here, AI offers the possibility to "build" a "smart" learning environment where the innovation of teaching "tools" and resources, as well as the upgrading of teaching methods with the help of digital technology, are expected to contribute to the creation of conditions for a more effective learning path for trainees (Bilad *et al.*, 2023; Liu *et al.*, 2021, p. 894).

4.2. Methods and forms of teaching and learning

Regarding the formation of teaching methods, AI can help teachers prepare the content of the course they are going to teach, where if they make use of modern technologies, they can design and shape appropriate learning programs for their students. Also, AI technology allows teachers to monitor the teaching process in real-time and precisely plan their teaching in order to achieve optimal learning outcomes (Liu *et al.*, 2021, p. 895).

Teachers can be helped by the utilization of Big Data in the educational process because they can approach the learning process and effort of their students at any time. Also, teachers can be helped to resolve any technical difficulties that may arise during the educational project. Furthermore, they may enable teachers to communicate with students for more time, create innovative teaching materials make their course more modern, as well as shape course content in a more creative way (Liu *et al.*, 2021, p. 895; Luan *et al.*, 2020).

It is worth underlining the possibility of utilizing video conferencing systems (such as Webex and Zoom) for the realization of the educational project in real-time with the use of AI, a fact that allows learners to participate in it from the geographical space

in which they are located. In this case, the provision of education can continue in emergency conditions, such as the period of the COVID-19 pandemic (Aduba & Mayowa-Adebara, 2021; Dash *et al.*, 2022; Mikropoulos & Natsis, 2011).

Furthermore, the educational use of AI can contribute to changing the role of teachers as well as to the transformation of traditional learning models by moving from the transfer of knowledge to the "construction" of knowledge by learners. In this case, the task of the teacher is not to "implant" knowledge in the student, but to help him discover it, as well as to develop as a personality, to become an observer of the phenomena of social becoming and to realize the values that life itself carries (Liu *et al.*, 2021, p. 895; Luan *et al.*, 2020).

In relation to providing learning to students, through "building" a "smart" environment, it is important to emphasize how to guide students towards knowledge acquisition. Through the creation of different types of learning activities, a supportive educational environment is formed that can help students acquire new knowledge, and deepen their knowledge through their "intelligent" guidance with the use of various modern educational "tools". Hence, students are able to better understand aspects of themselves, discover further inner aspects of themselves and, by extension, improve themselves (Liu *et al.*, 2021, p. 895).

5. Benefits of using Artificial Intelligence in education

The integration of AI into the educational process seems to create substantial benefits because it can contribute to the transformation of traditional teaching methods into more modern ones and can enhance the general learning experience of the learners. The use of AI, which can be expressed, among other things, through the use of "smart" digital devices (such as mobile devices), provides an opportunity to reshape the content of the lesson, taking into account the needs of each student and his learning preferences. This approach encourages the creation of a more effective and efficient learning environment, "supporting" different learning styles and different learning "paces" in the context of delivering a modern digital educational project (Chaushi *et al.*, 2024, p. 53; Sarrab *et al.*, 2013; Talan, 2020; Yuskovych-Zhukovska *et al.*, 2020, p. 345).

AI in the field of education presents a series of theoretical innovations and technological achievements, as well as positive effects at the pedagogical level through the use of "smart" mobile devices, such as tablets, which facilitate the implementation of the learning process. These mobile devices also act as a useful and effective educational "tool" that supports the delivery of distance education (Chassignol *et al.*, 2018, p. 17; Chen *et al.*, 2022, p. 28; Kalogiannakis *et al.*, 2014, p. 490).

In addition, AI can improve efficiency in education through the automation of a series of "routines". In particular, automated grading systems, automations that can be made in the way administrative matters are processed, as well as the analysis of data through the use of modern technological digital media tend to contribute to saving time for teachers. This means that teachers are able to devote themselves more to the learning

support of their students, offering them more focused instructional "directions" in the context of the learning process (Chaushi *et al.*, 2024, p. 53; Yuskovych-Zhukovska *et al.*, 2020, pp. 345, 347-348).

Educators can transform their classrooms into effective learning “environments” by providing their students with enhanced educational support if they decide to leverage AI-connected platforms. They can also teach their students through the formation of "mixed" ability classes. In addition, teachers can monitor and supervise their students online, with the possibility of continuous feedback, and share their evolving learning journey through targeted assignments and projects that can be carried out during the school year (Hatim *et al.*, 2023, pp. 126, 128).

Moreover, the integration of AI in education allows students to have an active role in the learning process through collaborations with their classmates in individual groups under their sharing framework since the educational work is carried out remotely using video conferencing systems. Also, in the event that intelligent adaptive online systems are used during the implementation of the educational project, conditions can be created to enrich the educational experience of the students. It is worth noting that educational platforms such as TED-Ed, can be utilized by promoting collaboration between educators, learners and animators and aiming at the formation of educational courses that will incorporate modern and innovative ideas and facilitate the realization of the educational project. In this case, the trainees are given the opportunity to act independently and expand their knowledge (Hatim *et al.*, 2023, pp. 128-129; Peredo *et al.*, 2011).

6. Points of concern arising from the use of Artificial Intelligence in education

The use of AI in various areas of social life, including education, involves a "cultural" dimension and raises serious concerns as it is linked to choices promoted and imposed by powerful socio-economic and political factors. Thus, an issue raised by the necessary use of AI in everyday life is linked either to the worsening of pre-existing social inequalities or to the creation of new inequalities, which in a sense will be a form of digital divide. In this case, there will be a separation of citizens between those who will be able and those who will not be able to effectively utilize AI applications in their daily activities (Joyce *et al.*, 2021; Liu, 2021; Vinichenko *et al.*, 2021; Zajko, 2022).

Focusing more on the educational field, the ever-increasing dependence on technology carries the risk of creating educational inequalities, potentially leaving students exposed to the challenge of having to "navigate" a world that requires a balance between digital and interpersonal skills, which many of them do not have the opportunity to acquire. From the study of the scientific literature, it follows that the integration of AI in education must be done with special care as long as a necessary regulatory framework of ethical rules is established and implemented. With the activation of such a framework, it will be necessary to seek and ensure that the use of technological means during the realization of the educational project will be auxiliary

and complementary. That is, in this case, it must be ensured that the limitation of human interactive relationships between the teacher and the students will not occur. Also, various studies reveal that there is a feeling of fear among teachers and educational administrators that they may be replaced by "automated" systems that will operate using appropriate AI applications (Bilad *et al.*, 2023; Chaushi *et al.*, 2024, p. 54; Davies *et al.*, 2021; Hatim *et al.*, 2023, p. 128; Williamson & Eynon, 2020).

The use of AI is also linked to ethical issues concerning the respect for the privacy and personal data of the people who use it for educational purposes and actively participate in the educational process. In addition, concerns are raised regarding the reduction or even the absence of a meaningful interaction between teachers and learners when the use of AI becomes dominant in the realization of educational work. However, it seems that computer systems are not yet able to "assess" the creative work of students, whose thinking goes beyond responding to conventional questions and answers (Bilad *et al.*, 2023; Chaushi *et al.*, 2024, p. 54; Hatim *et al.*, 2023, p. 128; Osetskyi *et al.*, 2020, p. 581).

7. Trends and perspectives regarding the future educational use of Artificial Intelligence

The future of education brings to the fore the necessity to change and reshape the contents of the learning process and educational work in the context of a broad and multi-prism application of AI. In particular, prospects are being formed for the use of "smart" teaching systems in teaching, which will aim to promote personalized learning in an effective way. In this way, it will seek to meet the educational and learning needs of each student while contributing to the remodeling and modernization of their educational experience through the appropriate use of AI applications (Chassignol *et al.*, 2018, pp. 20-21; Chaushi *et al.*, 2024, pp. 55-56).

The use of new technologies, such as augmented and virtual reality, in the educational process, could offer new learning experiences and promote interactive forms of learning. Furthermore, AI-supported digital reality technologies appear to be a dynamic and promising evolving "tool" for the delivery of education due to their unique technological characteristics. Educational platforms that are used as educational "tools" to support the learning process (such as Moodle), but also the introduction of more and properly configured educational platforms in the future are appearing, in order to adapt the educational contents to be taught to the individual needs of the students and to the particular "step" with which they can approach them, strengthening and promoting the achievement of personalized learning in today's educational "landscape" (Chaushi *et al.*, 2024, p. 56; Gómez-Zermeño & Franco-Gutiérrez, 2018; Mikropoulos & Natsis, 2011, p. 769).

In some countries, such as Japan, South Korea and Finland, educational applications that incorporate AI are already operating and developing and evolving the systems associated with the learning and testing process. Thus, they enable the members of the educational community to focus more on important issues, such as monitoring and

improving the school progress of students, as well as preparing them for the socio-economic challenges they are expected to face in the future. In addition, there are educational applications that can identify the parts of the curriculum that are difficult for some students and can adapt and reformulate them in a simplistic way, making them more comprehensible to them. In this case, the specific applications can also adjust the content of the corresponding feedback tests linked to the verification of the learners' understanding of the difficult points of the material of the various courses. Thus, the effort to create conditions that promote personalized learning by adapting school knowledge to the perceptual abilities of each student is strengthened. Furthermore, there are educational applications that integrate AI and can "read" the written answers of the learners and automatically grade them (Hatim *et al.*, 2023, p. 128; Osetskyi *et al.*, 2020, p. 579).

In addition to this, the future of AI in education seems to "open up" horizons for transformational improvements for the benefit of the learning process. More specifically, the enhanced "supply" of teachers with digital skills linked to AI applications, as well as the continuous pursuit of their professional development that will keep pace with the evolving technological "landscape" and adapt to the new conditions created by it, can benefit students on multiple levels. This is because with the necessary introduction and utilization of AI applications in the educational sector in the immediate future, the need is created for the corresponding modernization and adaptation to a digital level of the educational "setting" (Chaushi *et al.*, 2024, p. 56).

8. Concluding observations

According to what we approached above, we come to the following conclusions:
In the field of education, "Intelligent Teaching Systems" are used, which use AI methods to provide personalized teaching, which is an attempt to adapt to the learning pace of each student. AI appears to be applied in education through the following two types: a) face-to-face classroom training using AI, and b) online training in a virtual learning environment. Also, AI can be used in education through the following three categories: a) AI-supported face-to-face training: Human to Human and Natural environment. b) Face-to-face training using AI: Machine to Human. And c) Simulation training using AI: Human Machine and Virtual Environment (Heeg & Avraamidou, 2023; Şeren & Özcan, 2021).

The rapid entry of AI into education, especially in recent years, seems to have led to the reshaping of the content of teaching and learning. The significant changes that have been made both in teaching resources and in the teaching environment can form the basis for the transformation of teaching in the school classroom. Regarding the field of teaching work, AI can help educators design appropriate learning programs tailored to the needs of their students. Also, by integrating AI into their work, teachers can monitor the teaching process in real-time, as well as plan it precisely in order to achieve optimal learning outcomes for students. Furthermore, by "building" an "intelligent" environment

using modern educational "tools", students can be properly guided and engaged in the learning process in order to acquire more and more knowledge (Chen *et al.*, 2020; Liu *et al.*, 2021).

The use of AI in education presents a number of positive points which are found, among others, in the transformation of traditional teaching methods into more modern ones, in the improvement of efficiency through the automation of a series of "routines" (such as automated grading systems), as well as in guiding students in order to acquire a more active role in the educational process. This, in the case of the provision of distance education, where a video conferencing system is used, can be achieved by dividing the learners into individual groups in order to achieve cooperation between them in carrying out an educational activity (Chaushi *et al.*, 2024; Hatim *et al.*, 2023; Yuskovych-Zhukovska *et al.*, 2020).

On the other hand, the use of AI in the educational field raises questions regarding the issue of social and educational inequalities. Also, from the content of various scientific papers, the formulation of a more general concern about the use of AI in education emerges, which is linked to ethical issues regarding respect and ensuring the privacy of those involved in the educational process. In addition, a more general reflection is formulated regarding the degree of limitation and/or absence of an essential social interaction between the participants in the learning process in the event that AI acquires a dominant role in shaping and providing the educational project (Chaushi *et al.*, 2024; Hatim *et al.*, 2023; Osetskyi *et al.*, 2020).

Regarding the formation of the educational future, opinions are expressed on the necessity of reshaping the content and the way educational work is carried out in the school classroom through the introduction of supporting applications that will be based on AI. More specifically, it is argued that through the use in the educational process of "smart" digital devices, which will be adapted to the learning needs of each student, the goal of achieving personalized learning can be promoted, thus contributing to the enrichment of knowledge and educational experience (Chassignol *et al.*, 2018; Chaushi *et al.*, 2024).

Concluding this paper, we believe that it would be of scientific interest to carry out both large and small-scale studies, which focus their interest on the social and pedagogical results garnered from the use of educational "tools", which will integrate AI applications, for the provision of both live and distance education at the various educational levels.

Conflict of Interest Statement

The authors declare no conflicts of interest.

About the Authors

Georgia Spiliopoulou is a kindergarten teacher. She also holds a master's degree in "Educational Sciences" and a PhD in "Educational Sciences" from the Department of

Educational Sciences and Early Childhood Education of the School of Humanities and Social Sciences, University of Patras, Greece.
E-mail: geospil.spiliopoulou@gmail.com
ResearchGate: https://www.researchgate.net/profile/Georgia-Spiliopoulou-2
ORCID: https://orcid.org/0000-0002-5588-0557
Gerasimos Koustourakis is Professor in Sociology of Education and School Knowledge at the Department of Educational Sciences and Early Childhood Education of the School of Humanities and Social Sciences, University of Patras, Greece. He is also a tutor in the Postgraduate Studies Programme master's in education at the School of Humanities of the Hellenic Open University teaching Open and Distance Learning.
E-mail: koustourakis@upatras.gr
ResearchGate: https://www.researchgate.net/profile/Gerasimos-Koustourakis
ORCID: https://orcid.org/0000-0001-8499-5399

References

Aduba, D. E., & Mayowa-Adebara, O. (2021). Online Platforms Used for Teaching and Learning during the COVID-19 Era: The Case of LIS Students in Delta State University, Abraka. *International Information & Library Review, 54*(1), 17-31. https://doi.org/10.1080/10572317.2020.1869903

Akman, V., & Blackburn, P. (2000). Editorial: Alan Turing and Artificial Intelligence. *Journal of Logic, Language, and Information, 9*, 391-395. https://www.jstor.org/stable/40180233

Aristanto, A., Supriatna, E., Panggabean, H. M., Apriyanti, E., Hartini, H., Sari, N. I., & Kurniawati, W. (2023). The role of Artificial Intelligence (AL) at school learning. *CONSILIUM Journal: Journal Education and Counseling, 3*(2), 64-71. https://doi.org/10.36841/consilium.v3i2.3437

Bilad, M. R., Yaqin, L. N., & Zubaidah, S. (2023). Recent Progress in the Use of Artificial Intelligence Tools in Education. *Jurnal Penelitian dan Pengkajian Ilmu Pendidikan: e-Saintika, 7*(3), 279-314. https://doi.org/10.36312/esaintika.v7i3.1377

Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial Intelligence trends in education: a narrative overview. *Procedia Computer Science, 136*, 16-24. https://doi.org/10.1016/j.procs.2018.08.233

Chaushi, B. A., Ismaili, F., & Chaushi, A. (2024). Pros and Cons of Artificial Intelligence in Education. *International Journal of Advanced Natural Sciences and Engineering Researches, 8*(2), 51-57. https://as-proceeding.com/index.php/ijanser/article/view/1696

Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. *IEEE Access, 8*, 75264-75278. https://ieeexplore.ieee.org/abstract/document/9069875

Chen, X., Zou, D., Xie, H., Cheng, G., & Liu, C. (2022). Two Decades of Artificial Intelligence in Education: Contributors, Collaborations, Research Topics,

Challenges, and Future Directions. *Educational Technology & Society, 25*(1), 28-47. https://www.jstor.org/stable/48647028

Dai, Y., Liu, A., Qin, J., Guo, Y., Jong, M. S.-Y., Chai, C.-S., & Lin, Z. (2023). Collaborative construction of artificial intelligence curriculum in primary schools. *Journal of Engineering Education, 112*(1), 23-42. https://doi.org/10.1002/jee.20503

Dash, S., Samadder, S., Srivastava, A., Meena, R., & Ranjan, P. (2022). Review of Online Teaching Platforms in the Current Period of COVID 19 Pandemic. *Indian Journal of Surgery, 84*(1), 512-517. https://doi.org/10.1007/s12262-021-02962-4

Davies, H. C., Eynon, R., & Salveson, C. (2021). The mobilisation of AI in education: A bourdieusean field analysis. *Sociology, 55*(3), 539-560. https://doi.org/10.1177/0038038520967888

Fullan, M., Azorín, C., Harris, A., & Jones, M. (2024). Artificial intelligence and school leadership: challenges, opportunities and implications. *School Leadership & Management, 44*(4), 339-346. https://doi.org/10.1080/13632434.2023.2246856

Gocen, A., & Aydemir, F. (2000). Artificial Intelligence in Education and Schools. *Research on Education and Media, 12*(1), 13-21. https://intapi.sciendo.com/pdf/10.2478/rem-2020-0003

Gómez-Zermeño, M., & & Franco-Gutiérrez, H. (2018). The use of educational platforms as teaching resource in Mathematics. *Journal of Technology and Science Education, 8*(1), 63-71. http://hdl.handle.net/2117/116442

Hatim, M., Jamil, S. I., & Khan, S. A. (2023). Understanding artificial intelligence and its influence on education. *Jamshedpur Research Review, 6*(61), 124-131. https://www.researchgate.net/publication/376478542_UNDERSTANDING_ARTIFICIAL_INTELLIGENCE_AND_ITS_INFLUENCE_ON_EDUCATION

Heeg, D. M., & Avraamidou, L. (2023). The use of Artificial intelligence in school science: a systematic literature review. *Educational Media International, 60*(2), 125-150. https://doi.org/10.1080/09523987.2023.2264990

Joyce, K., Smith-Doerr, L., Alegria, S., Bell, S., Cruz, T., Hoffman, S. G., & Shestakofsky, B. (2021). Toward a sociology of artificial intelligence: A call for research on inequalities and structural change. *Socius, 7*, 2378023121999581. https://journals.sagepub.com/doi/pdf/10.1177/2378023121999581

Kalaitzidou, M., & Pachidis, T. P. (2023). Recent Robots in STEAM Education. *Education Sciences, 13*(3), 272. https://doi.org/10.3390/educsci13030272

Kalogiannakis, M., Papadakis, S., & Zaranis, N. (2014). Use of portable technologies in Preschool Education. Tablets as an educational tool. In P. Anastasiadis, N. Zaranis, V. Oikonomidis & M. Kalogiannakis (Eds.), *Proceedings of the 9th Panhellenic Conference with International Participation "Information & Communication Technologies in Education"* (pp. 490-496). University of Crete.

Liu, Z. (2021). Sociological perspectives on artificial intelligence: A typological reading. *Sociology Compass, 15*(3), e12851. https://compass.onlinelibrary.wiley.com/doi/pdf/10.1111/soc4.12851

Liu, Y., Saleh, S., & Huang, J. (2021). Artificial Intelligence in Promoting Teaching and Transformation in Schools. *International Journal of Innovation, Creativity and Change, 15*(3), 891-902. https://www.ijicc.net/images/Vol_15/Iss_3/15369_Liu_2021_E_R1.pdf

Luan, H., Geczy, P., Lai, H., Gobert, J., Yang, S. J. H., Ogata, H., Baltes, J., Guerra, R., Li, P., & Tsa, C.-C. (2020). Challenges and future directions of big data and artificial intelligence in education. *Frontiers in Psychology, 11*, 1-11. https://doi.org/10.3389/fpsyg.2020.580820

Mikropoulos, T. A., & Natsis, A. (2011). Educational virtual environments: A ten-year review of empirical research (1999–2009). *Computers & Education, 56*(3), 769-780. https://doi.org/10.1016/j.compedu.2010.10.020

Mohammed, P. S., & Watson, E. N. (2019). Towards inclusive education in the age of artificial intelligence: perspectives, challenges, and opportunities. In J. Knox, Y. Wang & M. Gallagher (Eds.), *Artificial Intelligence and Inclusive Education. Perspectives on Rethinking and Reforming Education* (pp. 17-37). Springer. https://doi.org/10.1007/978-981-13-8161-4_2

Muggleton, S. (2014). Alan Turing and the development of Artificial Intelligence. *AI Communications, 27*(1), 3-10. https://content.iospress.com/articles/ai-communications/aic579

Omehia, A., & Mmejim, I. C. (2020). Pros and Cons of Artificial Intelligence in 21st Century Library and Information Service Delivery. *International Journal of Scientific Research in Education, 13*(2), 220-227. https://www.ijsre.com.ng/assets/vol.%2C-13(2)-omehia---mmmejim.pdf

Osetskyi, V., Vitrenko, A., Tatomyr, I., Bilan, S., & Hirnyk, Y. (2020). Artificial intelligence application in education: Financial implications and prospects. *Financial and credit activity problems of theory and practice, 33*, 574-584. https://doi.org/10.18371/fcaptp.v2i33.207246

Peredo, R., Canales, A., Menchaca, A., & Peredo, I. (2011). Intelligent Web-based education system for adaptive learning. *Expert Systems with Applications, 38*(12), 14690-14702. https://doi.org/10.1016/j.eswa.2011.05.013

Pisica, A. I., Edu, T., Zaharia, R. M., & Zaharia, R. (2023). Implementing Artificial Intelligence in Higher Education: Pros and Cons from the Perspectives of Academics. *Societies, 13*(5), 118. https://doi.org/10.3390/soc13050118

Pokrivcakova, S. (2019). Preparing teachers for the application of AI-powered technologies in foreign language education. *Journal of Language and Cultural Education, 7*(3), 135-153. https://doi.org/10.2478/jolace-2019-0025

Sarrab, M., Al-Shihi, H., & Rehman, O. (2013). Exploring major challenges and benefits of m-learning adoption. *British Journal of Applied Science & Technology, 3*(4), 826-839. https://doi.org/10.9734/BJAST/2013/3766

Şeren, M., & Özcan, Z. E. (2021). Post pandemic education: Distance education to artificial intelligence based education. *International Journal of Curriculum and Instruction*

(Special Issue), *12*(1), 212-225. https://ijci.globets.org/index.php/IJCI/article/view/568/237

Sutton, R. S. (2020). John McCarthy's Definition of Intelligence. *Journal of Artificial General Intelligence, 11*(2) 66-67. DOI: 10.2478/jagi-2020-0003

Talan, T. (2020). The Effect of Mobile Learning on Learning Performance: A Meta-Analysis Study. *Educational Sciences: Theory and Practice, 20*(1), 79-103. https://eric.ed.gov/?id=EJ1241462

Tao, H. B., Diaz, V. R., & Guerra, Y. M. (2019). Artificial intelligence and education: Challenges and disadvantages for the teacher. *Arctic Journal, 72*(12), 30-50. https://www.scribd.com/document/717215529/FULLARTICLEARTIFICIALINTELLIGENCE

Timms, M. J. (2016). Letting artificial intelligence in education out of the box: Educational cobots and smart classrooms. *International Journal of Artificial Intelligence in Education, 26*(2), 701-712. https://doi.org/10.1007/s40593-016-0095-y

Touretzky, D., Gardner-McCune, C., Breazeal, C., Martin, F., & Seehorn, D. (2019). A year in K–12 AI education. *AI Magazine, 40*(4), 88-90. https://doi.org/10.1609/aimag.v40i4.5289

Vinichenko, M. V., Narrainen, G. S., Melnichuk, A. V., & Chalid, P. (2021). The influence of artificial intelligence on human activities. In A.V. Bogoviz, A.E. Suglobov, A.N. Maloletko, O.V. Kaurova & S.V. Lobova (Eds), *Frontier Information Technology and Systems Research in Cooperative Economics* (Vol. 316, pp. 561-570). Springer, Cham. https://doi.org/10.1007/978-3-030-57831-2_60

Wartman, S. A., & Combs, C. D. (2018). Medical education must move from the information age to the age of artificial intelligence. *Academic Medicine, 93*(8), 1107-1109. DOI: 10.1097/ACM.0000000000002044

Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. *Learning, Media and Technology, 45*(3), 223–235. https://doi.org/10.1080/17439884.2020.1798995

Wong, G. K., Ma, X., Dillenbourg, P., & Huan, J. (2020). Broadening artificial intelligence education in K–12. *ACM Inroads, 11*(1), 20-29. https://doi.org/10.1145/3381884

Yuskovych-Zhukovska, V., Poplavska, T., Diachenko, O, Mishenina, T., Topolnyk, Y., & Gurevych, R. (2022). Application of Artificial Intelligence in Education. Problems and Opportunities for Sustainable Development. *BRAIN. Broad Research in Artificial Intelligence and Neuroscience, 13*(1), 339-356. https://brain.edusoft.ro/index.php/brain/article/view/1272

Zajko, M. (2022). Artificial intelligence, algorithms, and social inequality: Sociological contributions to contemporary debates. *Sociology Compass, 16*(3), e12962. https://compass.onlinelibrary.wiley.com/doi/pdfdirect/10.1111/soc4.12962