



Post pandemic education: Distance education to artificial intelligence based education

Mehmet ŞEREN ^a, Zeynel Ersin ÖZCAN ^b

^a *AKEV University, Antalya 07100, Turkey*

^b *Ministry of Education, Turkey Niğde 51100, Turkey*

Abstract

The concept of distance education has become even more substantial in the days when humanity is having difficult times with pandemic. Besides, there is an idea that education will have transformed when the life after pandemic starts. Aim of this research is to discuss artificial intelligence-supported or artificial intelligence-based education, which is a type of distance education and to contribute to people's manifesting different perspectives on education, which has differentiated under emergency cases such as pandemics or natural disasters and in technological advances as well. To reveal methods that can contribute to increase efficiency of distance education is aimed within the scope of the research. Whether the human education may be left to machines or not, and what kind of situations will be encountered if such a system is used is discussed within the scope of the research. Results indicate that artificial intelligence-based education should be discussed in depth by stakeholders in all areas and should be arranged for the benefit of human beings.

© 2016 IJCI & the Authors. Published by *International Journal of Curriculum and Instruction (IJCI)*. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (CC BY-NC-ND) (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Distance education, Education, Pandemic, Artificial Intelligence, Virtual Education.

1. Introduction

Emergence of the Covid-19 virus, which first appeared in Wuhan, China in December 2019 and spread all over the world in a short time, has brought out the necessity of interrupting formal education and switching to distance education in many countries together with a pandemic declaration by the World Health Organisation (WHO, 2020). Lock down of formal education institutions during the pandemic process revealed that distance education is an alternative to and supporter of face-to-face education. Life during the pandemic has become more of an issue as it has potential to affect the world in political, socio-cultural, economic and some other unpredictable terms (Bozkurt, 2020), as well as its consequences that are already being faced. Such compulsory situations reveal that education-training options should be differentiated as in other areas of life (Murphy, 2020). Interruption of education and training has led countries to alternative systems for the survival of their education systems, and online distance education option, where quality and quantity depends on quality of infrastructure and access systems to such infrastructure, may be seen as a referred solution (Gilani, 2002). Yet, providing an effective digitization of universities is mainly claimed in countries including Turkey where transformation to distance education is carried out, but a significant portion of these claims appear to be simply advertising (Karadağ and Yücel, 2020). Over time, distance education may be regarded to maintain its importance as an alternative education method. Thus, it is necessary to show improvement in order to differentiate and increase the effectiveness of distance education methods.

2. Method

The aim of this research, for which literature review method was preferred, is to contribute to people developing different perspectives in the context of distance education in such compulsory cases and also at normal, non-compulsory times and to discuss artificial intelligence-assisted or artificial intelligence-based training, which may be seen as a type of distance education.

3. Artificial Intelligence

Many activities such as writing a human-specific computer program, dealing with mathematics, learning languages, or driving may all be regarded as requiring "intelligence" and some programs that could perform such and similar activities and that we can refer to as "artificial intelligence" have been put forward in previous years (Nillsen, 2014). Artificial intelligence may be called systems that automatically perform the tasks taught and the ones assigned in its program. Performing various algorithmic tasks, artificial intelligence can now learn on its own from large data sets, thanks to methods called machine learning and deep learning (Aggarwal, 2018). In other words,

deep and machine learning roughly refers to the ability of computers to train themselves. The computer named Watson, designed by IBM computer company, may be given as an example to this case. We previously experienced that computers could beat people in chess-like games involving a certain number of strategies. However, Watson's success in being the first in the word-based competition called Jeopardy (Ferruci, 2012; Zadrozny et al. 2015) by leaving two people behind has surprised people in a sense. In addition, Watson can now diagnose at a level of specialist in oncology (Ford, 2018). At the same time, Watson started to be used to provide educational support to teachers and administrators in the field of education. Similarly, the artificial intelligence called Alphago has managed to defeat a human player in the ancient GO game, which can contain millions or even an infinite number of moves (Aoun, 2017).

Some important terms used in the field of artificial intelligence are: algorithms, machine learning and artificial neural networks. Algorithms first emerged in 1996 when the Google founders were students at Stanford (Holmes et al., 2019). They simply consist of coding that describe the ways the computer will follow and what it has to do in solving problems. When we ask the light to be turned off by the computer when it is bright in the morning, roughly, it is sufficient to enter an algorithm such as (**start> check the light value> “turn off” if it is bright, if not “turn on”> back to top**). Machine learning term may be defined as computers not needing a command or instruction while performing some operations. In this case, computers have abilities to reach different results by making as many inferences as possible from a given algorithm and defined information. Another term in this area is artificial neural networks. They may be defined as computing units designed to imitate the human nervous system (Aggarwal, 2013). In this way, artificial intelligence systems can be created through machine learning and imitation of human neural networks. The project named BabyX may be shown as an example to this area. Known under the code name BabyX, this artificial intelligence is designed by Dr. Mark Sagar on the basis of his six-month-old baby and this system is able to categorize, recognize and react to objects shown to it thanks to its sensors and cameras (Lawler-Dormer, 2013). In light of these developments, machines can now learn and react.

At this point, it should be noted that although artificial neural networks were not possible in the past due to insufficient processing capacity, today this obstacle seems to have been overcome and is now called "deep learning" (Aggarwal, 2018). Thanks to deep learning (machine learning), machines have the capacity to analyze and synthesize big data. Although this capacity does not appear at levels that can compete with humans, it contains a certain potential. Therefore, as progress is made in the field of technology and deep learning, progress may be expected in providing education and training to individuals more effectively. This will increase the potential to implement the education-training methods mentioned earlier.

The autonomous vehicle research carried out by Google, a company specializing in internet technology fields, provide us with information about the progress levels of artificial intelligence systems. This technology is known as "Google Car". Google Car is a vehicle that can provide self-transportation without a driver. Purposes of Google Car are defined as preventing traffic accidents, reducing carbon emission and contributing to people's time management (Poctzer & Jankovic, 2014). Google Car is important in terms of autonomous operation, as it is one of the tools that work like decision makers connected to a host computer that reach results and react within its own data collection system and evaluate large-scale data.

When advances similar to those mentioned in the field of technology and in different ways are made and algorithms or artificial intelligence-based systems that can fulfil the teaching profession and educational activities, - which, even ascribed to holiness in many cultural contexts-and which are thought to be specific to humans, emerge, our experience with the situation awaiting humanity seems limited for now by simulation devices and a few training algorithms. Therefore, it may be useful to address possible educational transformations that may occur in the future.

3.1. Artificial Intelligence in Education

According to Naidou (2003), technology is changing what we are doing and what we will do and we have also started to experience this change in the field of education. We are now witnessing artificial intelligence standing out in many areas thanks to rapid development of technology nowadays (Ford, 2018). As a matter of fact, artificial intelligence has started to be used more and more day by day together with technology in the field of education. Such development of technologies has brought us to a point where we can implement algorithm-supported training programs from the times of overhead projector. It is highly foreseeable (Holmes et al., 2019) to think that after these developments, artificial intelligence will find itself a place in the field of education.

Table 1 compares proficiency levels of OECD adults in literacy, mathematics and problem solving, and their rate of meeting these competencies from humans and computers (Holmes et al., 2019). As can be seen, artificial intelligence displayed similar abilities with humans in Level 2-3 competencies, but it seems that it could not meet the expectations at Level 4 and 5. However, IBM Leaderboard predicts that these competencies may be fulfilled by computers before the 2030s.

Table1.Computers and Their Future Competence Prospects

Proficiency	OECD	Artificial
-------------	------	------------

Level	Adults	Intelligence
2 and below	53%	Yes
3	36%	Close
4 5	11%	No

Source:https://read.oecd-ilibrary.org/education/computers-and-the-future-of-skill-demand_9789264284395-en#page1; Holmes et al.

In the field of education, artificial intelligence may be used in fields such as personalized teaching systems, interview systems, group and individual teaching areas, librarianship, student affairs, data optimization and management, learning with games, artificial intelligence supported individual teaching, exams and spelling analysis, etc. Such areas are continuously expandable as the field of artificial intelligence is very flexible and can be developed.

Type of education considered within the scope of this research is the application of artificial intelligence in education. This phenomenon, which is for now used partially, may be expected to emerge as an important variable in human education in the near future. However, although it is thought that the use of artificial intelligence in education can be quite functional, it is open to discussion that it may have positive and negative aspects.

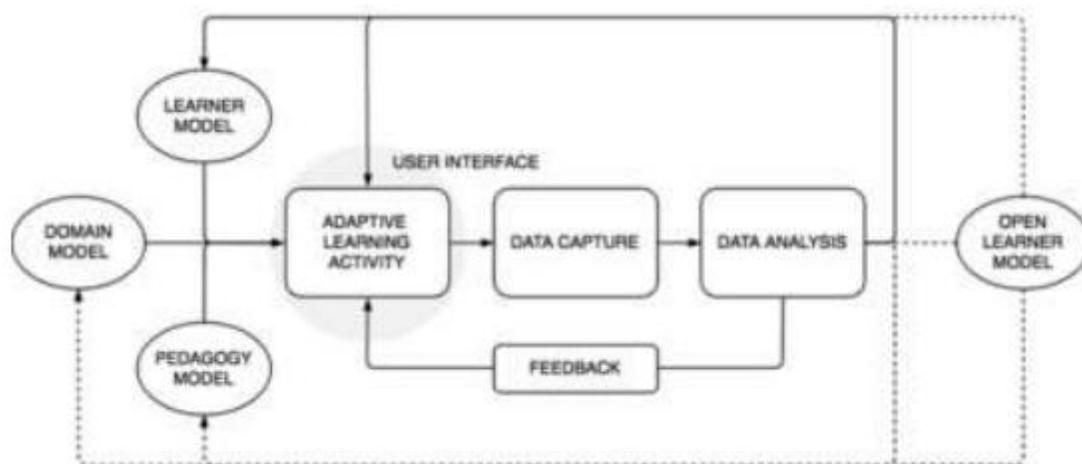
One of the most common methods in education with artificial intelligence is Intelligent Education Systems (IES) (Holmes et al., 2019). In such smart education systems, step-by-step teaching methods are applied in accordance with the needs and progress speed of the individuals. It is divided into domain model, pedagogy model and learner model.

IES, whose schema is created in Figure 1, simply starts with specialization in the field to be taught from the resource (domain) model. Then, learning activities influenced by learner and pedagogy models are carried out and the results are conveyed to the analysis to be determined.

If a feedback mechanism is required as a result of the analysis, it restarts the learning activities. If learning has been achieved, the process renews the system again by feeding the resource (domain), pedagogy and learner models. The point to be considered here is that the domain, learner and pedagogy models are taught to the system. Besides, adaptive activities are also defined by people. Data capture and analysis, on the other side, helps the computer to activate the decision-making mechanisms and find what to do.

What needs to be discussed a step further is a system in which all these modules are created by artificial intelligence. Namely, there is no human effect in this system. In other words, the computer decides what, how and in what context to teach.

Figure 1. A model of Intelligent Education System



Source: Holmes et al. 2019

3.2. Artificial Intelligence Education and Suggestions of Education Methods

A few designs will be discussed in this section about the ways in which education can be carried out with artificial intelligence. Basically three different types of education seem to be carried out through artificial intelligence;

1-Artificial intelligence supported face-to-face education

(Human>Human+Physical Environment)

2-Face-to-face education with artificial intelligence

(Machine>Human+Physical Environment)

3- Simulation education with artificial intelligence

(Machine>Human+Virtual environment)

Andriessen and Sandberg (1999) mention three different scenarios for artificial intelligence teaching methods: 1-Transfer, 2-Studio, 3-Negotiation.

These scenarios reveal possible methods of using IES. In addition, the way in which these teaching methods and techniques will be transferred to individuals is discussed within the scope of the research. In transmission scenario, goals and objectives are fixed. Even when the server is turned off, students work on specific goals. In the studio-based scenario, it is the system in which learning environments and learning materials can be used regardless of whether the server is on or off. There are no specific goals in the negotiation-based scenario. These goals may differ over time. Main point here is that the server is open and interactive (Andriessen & Sandberg, 1999).

Table2. Scenarios and tasks they include.

Mission	Transmission	Studio	Negotiation
Acquisition of knowledge and skills	Drill & practice, lectures and reading	Collaborative, project-based learning	Legitimate peripheral participation
Learning to learn	Generalization	Metacognition & reflection	Discursive practice
Learning to participate	Acquiring expertise	Social & practical skills	Negotiate and be responsible

Source: Andriessen & Sandberg, 1999; s.139

In light of the afore mentioned information, *the first* choice that can be preferred in the IES system is one where artificial intelligence will help people with education, teaching methods and techniques and system to be developed by machines or humans, that helps people on issues such as student support, productivity and analysis, and that offers suggestions or supports education by assigning special assignments to students and in similar ways. An example would be the situation that is currently applicable through Watson (Zadrozny et al., 2015). *The second* is face-to-face education conducted by artificial intelligence, that is, face-to-face education with animation from a screen or a human-like robot. In the *thirdway*, education is in a simulation environment with artificial intelligence. Two different methods may be used in the second and third type of education. The *first* of these methods is a controlled fixed algorithmic system working on a specific algorithm; and the *second* is a type of education to be carried out with artificial intelligence, which is completely dependent on *deep learning*.

The main point in here is to decide whether a supervised deep learning method of education or an unsupervised one will be adopted regardless of face-to-face or simulation education. In both forms of learning, it is necessary to ensure that artificial intelligence specializes in educational pedagogy, logic, mathematics, ethics, psychology, human history and cultures, science and similar subjects (this system in a way refers to a

transfer-based scenario). *In supervised learning based on algorithms and certain expectations*, briefly providing information depends on people. In other words, computers, which means artificial intelligence in here, are trained on human initiative. These systems were previously mentioned as IES. Artificial intelligence, consequently, runs algorithms that will provide effective and complete learning as a result of these learning and through determined curricula. Much debate will not arise at this point. That is to say, decision-making processes depend on people. In other words, decision-making processes go through pre-defined algorithms and these algorithms are prepared by education-related people such as policy makers, educators, experts, psychologists, or pedagogues. Ethical discussions will remain less of a concern as people are the basis for this situation.

Second situation is creation of an artificial intelligence through uncontrolled deep learning based on machine and deep learning, and realization of education by preparing personalized programs, skills, abilities and curricula for the individual to be trained by such an artificial intelligence that specialized in education by training itself. This situation fits with the negotiation-based scenario mentioned by Andriessen and Sandberg (1999). This type of education is the type of one where artificial intelligence will decide how to train human beings. While determining these curricula and education based on them, artificial intelligence can comprehensively include manpower needs, state policies, economic data, etc. At the source of debate to be put forward on learning with artificial intelligence, a human being trained by a machine is expectable to come to the fore.

3.3. Possible Learning Environments with Artificial Intelligence

Views that schools are not the only resource for learning (Cassell, 2005) and that education can take place anywhere seem to have attracted increasing attention in recent years. This has become a necessity during the pandemic period. In this context, the possibilities for conducting educational activities with artificial intelligence have been increasing, which is reported by some researches as smart lesson systems being very effective in increasing student motivation and learning (Beck et al. 1996).

Learning environments with artificial intelligence can be carried out in two ways: 1-Face-to-face training in the classroom with artificial intelligence and 2- Online training in a virtual environment. At this point, *a meeting-like training* to be held with a *real teacher* in a teleconference-like holographic classroom with or without artificial intelligence support has been excluded from our discussion as in such learning environments, both teachers and students consist of real people.

3.4. Face-to-Face education with Artificial Intelligence

Face-to-face training with artificial intelligence, training carried out in educational institutions can be called real-time training. It should be considered as a system where students come together in the classroom and certain lessons are taught in a real environment and on a formal basis. A human-like robot or a system that will enable communication through a screen may be imagined at this point. In short, learners and environments are real, teachers are virtual. The system that acts as a tutorial may have been created in two different ways, as mentioned before. In other words, the system may be based on supervised or unsupervised deep learning. Although it will not be discussed in depth how these algorithms operate, it can be assumed that these algorithms are capable of operating both individually and class-based.

3.5. Simulation Education with Artificial Intelligence

Education in a simulation environment can be considered as a type of distance education. It can also be expressed as a kind of augmented reality. Individuals do not need to leave their current location to be in such an environment and receive education. Chen and Hsu (2016) showed that different teaching systems based on augmented reality applications increased the learning performance of students. Therefore, learning systems that will be used appropriately can help students get better education.

Simulation training with artificial intelligence can also be carried out in two different systems. *The first of these* refers to individuals being involved in the simulation independently of a device but with the help of an intermediary tool. This tool can be thought of as virtual reality glasses, gloves and interactive clothing being included in the simulation to facilitate it. Such technologies are currently used in the computer game industry. This type of system can also create a sense of artificiality in individuals, and it may be considered more effective and efficient than the computer, tablet etc.

The second method, and one that we want to emphasize in our research, is an integration of individuals with computers and involvement in simulation by connecting computer and biological neural networks to each other. Although such a connection is not fully possible yet, the research called Neural Link (Kulshreshth et al., 2019) under leadership of an entrepreneur named Elon Musk can be seen as a starting point of this phase. Thanks to the development of technologies similar to the one called Neural Link, such kind of integration may be possible in the future. With such an integration, individuals involved in a simulation can be in an artificial classroom or feel as if they are in a social environment, or socialize without ever leaving their home or even their bed. It can do this within virtually created individuals or groups (bots) without the need for other people (Caswell, 2005).

These modules are, again, in the forms as found in the IES setups that Holmes et al. (2019) has stated. Artificial intelligence can offer individuals rich and realistic learning environments. Depending on their learning needs, for example, it can take a student on a trip to the Egyptian pyramids instantly, or include them in a training of a football team, allowing them to experience an instant football player experience, or show them monkeys in a zoo. Such situations can give us the opportunity to deliver a quality education that is not normally available.

4. Discussion

The subject of Artificial Intelligence and Smart Teaching Systems (STS) seem to have taken over the field of artificial intelligence in education for nearly twenty years (Andriessen& Sandberg, 1999). With such artificial intelligence, Efficiency may be expected to be achieved in education systems and in time, money, labour and similar issues while educating individuals. Artificial intelligence may provide lots of benefits, especially in scenarios that require abundant data and decision-making situations. Because in such systems, leaders and managers have reliable evidence for their decisions (Moye, 2019). However, a realistic simulated learning environment can reduce both the cost and risks of training (Beck et al., 1996). At the same time, a properly simulated educational environment may have a positive effect on students' learning levels. Yannier et al. (2020) reported that guided discovery, facilitated by artificial intelligence agent at the Intelligent Science Station, helped children formulate better and more scientific theories of physical events they experienced. Kaser and Schwartz (2020) reported that students' prediction success rates increased by 8% in game-based systems. Another research also reported a positive improvement in the emotions of students who used an artificial intelligence-supported game-based educational application (Taub et al., 2020).

Eliminating situations such as peer bullying and exclusion, which individuals may face in the classroom. Given that the artificial intelligence organizes the entire data flow, in-class discipline problems are likely to disappear in environments where the entire environment, which may be considered as a full simulation environment, is controlled by a computer. There may certainly be other students in the learning environment, who may be algorithms developed by simulation.

With a similar scenario, a host can train thousands or even tens of thousands of individuals at the same time, and even handle each one individually and determine the content of the training accordingly. In this way, it is likely that hundreds of thousands of teachers will be able to perform their work fully alone, and in some cases even more effectively. Because the digital technology revolution offers different and new ways of teaching in the classroom and challenges the notion of whether or not schools made of stone and brick should exist (McGrath and Fischetti, 2019). In addition to differentiating

classes, artificial intelligence may use behaviours learned from teachers while educating people. In terms of teaching, artificial intelligence may provide teaching with accuracy and efficiency to the extent that human teachers may have difficulty reaching. A future paradigm change may even bring out that teachers will no longer be inside the system (McGrath and Fischetti, 2019).

Whether a machine or a human being will be more effective in the education of human beings is debatable for now. The concept of "singularity", which was introduced by Vernon Vinge in 1993 and defined the capacity of an artificial intelligence or a robot to develop itself faster and more than the concept of "Artificial Intelligence", brought to minds the fear that computers could surpass human intelligence (Luckinet al., 2016). Ignoring the human aspects of systems to be developed may cause some negative consequences. As we are social beings, the problems we will possibly face if we, human beings, are educated only by a machine seem to be unclear. On the other hand, how human-specific characters will evolve should also be considered. People may live connected to a computer resulting from such possibilities. For this reason, education with artificial intelligence may have some negative effects for humanity.

One negative aspect may be considered as the fear and possibility of people being controlled by artificial intelligence, which is perhaps one of the most important problems causing an emergence of a situation in which artificial intelligence enslaves people. This situation is seen to be one of the biggest fears of humanity in projections about the future. In a research conducted in the USA, it was reported that the first of the greatest human-induced disasters that could happen to people was climate change, and the second was the domination of robots (Aoun, 2017).

Another of these negativities is the issue of privacy of one's life. Integration of the artificial intelligence system and the individual may cause individuals to become open to manipulation of systems. Although all ethical measures are provided, issues such as cyber-attacks or information piracy may come to the fore as issues that will put humanity into trouble. From a utopian point, people's mental health may even be at stake.

Another issue is that the simulation process with artificial intelligence may isolate people. Even if the psychological and sociological aspects are evaluated in detail, unexpected problems may arise. Another problem is that educators become unemployed and therefore a livelihood that people sustain their lives disappears. Social and individual changes caused by such a probable situation should also be taken into account.

Artificial intelligence-based education may also have some positive (Taub et al.2020, Yannier et al.2020) or negative psychological effects. Being involved in such a system can support the self-perception of an individual, as well as negatively affecting the individual's personality development. On returning from simulation environment to real life, people may experience adaptation problems to real life. Situations where the

individual can completely distinguish between real and virtual environments may be presented. For example, designing all objects in a virtual environment like animation may reduce the possibility of confusing real life with simulation. Even so, the perception of reality may deteriorate despite differentiation efforts and individuals may still confuse virtual and real life.

5. Conclusions

Although face-to-face education has maintained its importance every century, alternative systems continue to be put forward. Systems around the world are being talked about, reformed, and the structure and form of schooling systems are being changed (McGrath and Fischetti, 2019). In addition, people need to design the education system in different ways so that education is not interrupted in cases of pandemics, natural disasters, etc. At this point, distance education methods are likely to come to the agenda more frequently. Seeing that people encounter such situations more often, it is possible that different alternatives will come to the fore more. Andreissen and Sandberg (1999) suggest that education researchers should consider artificial intelligence-based education systems more. In this way, the use of artificial intelligence in education can find a wider area for research. In these cases, simulation and augmented reality based applications may come into question.

Although the computing power of computers in terms of technology and capacity has increased over time, they have not yet reached the mental capacity of humans. Even so, this situation has been a great improvement compared to fifty years ago. For this reason, approaching this capacity or at least reaching a certain level in the upcoming periods seems far from being utopia anymore. There is a need for humanity to be prepared, at least mentally, for such a future.

Luckin et al. (2016) argues that it is necessary to review benefits before starting to fear the development of artificial intelligence. Even though the idea that sees education of humans by humans necessary is always in our minds, the fact that education can be entrusted to computers for economic, social and individual reasons stands before us. This is because computers have started to perform many jobs that could not even be imagined before. These range from complex cargo systems to patient identification systems. Education is gradually taking its place among these fields. As education stakeholders become accustomed to technological developments and feel the benefits, they can become more open and enthusiastic to these systems. After all, education can become a business of machines, not humanity. Such possibilities make it necessary to discuss this issue seriously and in depth in every field, especially in philosophy.

References

- Aggarwal, C.C. (2018) *Neural Networks and Deep Learning: A Textbook*. Springer.
- Andreissen, J. & Sandberg, J. (1999). Where is education heading and how about AI? *International Journal of Artificial Intelligence in Education*, 10, 130-150.
- Aoun, J. E. (2017). *Robot Proof*. MIT Press.
- Beck, J., Stern, M., & Haugsjaa, E. (1996). Applications of AI in Education. *XRDS: Crossroads, The ACM Magazine for Students*, 3(1), 11-15. <https://doi.org/10.1145/332148.332153>
- Ferruci, D.A. vd. (2010). Building Watson: An Overview of the DeepQA Project. *AI Magazine*, 31 (3), 59-79. <https://doi.org/10.1609/aimag.v31i3.2303>
- Ferruci, D.A. (2012). This is Watson. *IBM Journal of Research and Development*, 56 (3.4), 1:1, 1:15. <https://doi.org/10.1147/JRD.2012.2184356>
- Gilani, I. (2020). Coronavirus pandemic reshaping global education system?. <https://www.aa.com.tr/en/education/coronavirus-pandemic-reshaping-global-educationsystem/1771350>
- Huang, T., Chen, M. & Hsu, W. (2016). Do learning styles matter? Motivating learners in an Augmented Geopark. *Educational Technology and Society*, 22 (1), 70-81.
- Holmberg, B. (1995). *Theory and Practice of Distance Education*. Routledge.
- Holmes, W., Bialik, M. & Fadel, C. (2019). *Artificial Intelligence in Education*. Center for Curriculum Redesign.
- Käser T. & Schwartz, D.L. (2020). Modeling and analyzing inquiry strategies in open-ended learning environments. *International Journal of Artificial Intelligence in Education*, 30, 504-535. <https://doi.org/10.1007/s40593-020-00199-y>
- Kovalchick, A. ve Dawson, K. (Eds.). (2004). *Education and Technology: AI* (Volume 1). Abc-Clio.
- Lawler-Dormer, D. (2013). BabyX: Digital artificial intelligence, computational neuroscience and empathetic interaction. Cleland, K., Fisher, L. & Harley, R. (Eds.) *Proceedings of the 19th International Symposium of Electronic Art, ISEA 2013, Sydney*.
- McGrath, J. ve Fischetti, J. (2019). What if Compulsory Schooling was a 21st Century Invention? Jules T.D. & Salajan, F.D. (Eds.) *The Educational Intelligent Economy: BIG DATA, Artificial Intelligence, Machine Learning and the Internet of Things in Education: Volume 3* içinde (87-105. ss). Emerald Publishing. <https://doi.org/10.1108/S1479-367920190000038017>
- Moye, J.N. (2019). "Prelims", A Machine Learning, Artificial Intelligence Approach to Institutional Effectiveness in Higher Education. *Emerald Publishing Limited*. <https://doi.org/10.1108/978-1-78973-899-520191009>
- Naidu, S. (2003). *Learning & Teaching With Technology*. Kogan Page.
- Nilsson, J. N. (2014). *Principles of Artificial Intelligence*. Morgan Kaufmann Publishers, Inc.
- Pocster, S.L. and Jankovic, L. M. (2014). The Google car: Driving toward A better Future? *Journal of Bussines Case Studies*, 10 (1), 7-14. <https://doi.org/10.19030/jbcs.v10i1.8324>
- Taub, M., Sawyer, R., Lester, J. & Azevedo, R. (2020). The impact of contextualized emotions on self-regulated learning and scientific reasoning during learning with a game-based learning environment. *International Journal of Artificial Intelligence in Education*, 30, 97-120. <https://doi.org/10.1007/s40593-020-00199-y>

- WHO.(2020). WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020, <https://www.who.int/dg/speeches/detail/who-director-general-sopening-remarks-at-the-media-briefing-on-covid-19--11-march-2020>,
- Woolf, P. B., Lane, H. C., Chaudhri, V. K. & Kolodner, J. L. (2013). AI Grand Challenges for Education. *AI Magazine*, 34 (4), 66-84. <https://doi.org/10.1609/aimag.v34i4.2490>
- Yannier, N., Hudson, S.E. & Kenneth R. K. (2020). Active learning is about more than hands-on: A mixed-reality AI system to support STEM education. *International Journal of Artificial Intelligence in Education*, 30, 74-96. <https://doi.org/10.1007/s40593-020-00194-3>
- Zadrozny, W., Gallagher, S., Shalaby, W. & Avadhani, A. (2015). *Simulating IBM Watson in the Classroom*. SIGCSE '15: Proceedings of the 46th ACM Technical Symposium on Computer Science Education
-

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the Journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (**CC BY-NC-ND**) (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).