

ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION INDUSTRY. JUST A BRIEF INTRODUCTION TO COMPLEXITY OF AN ISSUE OF FUTURE CHALLENGES

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What is artificial intelligence?

It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.

McCarthy, 2007

Purpose: The article was written for review purposes in order to bring the definition of artificial intelligence closer and briefly present the possibilities of its use in management and economic sciences, as well as in higher education.

Design/methodology/approach: In order to obtain the desired information, the author conducted a research of the scientific papers on the relationship between higher education and artificial intelligence and extracted the most important conclusions and theories.

Findings: The review of the literature allowed the author to determine that there are many applications for artificial intelligence in higher education, but it should be noted that it should always be under human control and verification.

Originality/value: Apart from a brief attempt at the definition of AI and its use in higher education, the author also presents a critical perspective and possible threats, as well as proposes solutions that can regulate the ways of using artificial intelligence not only in higher education, but also in other areas of industry and social life.

Keywords: artificial intelligence, university, studying, science, future, ethics

1. Introduction

Artificial Intelligence (AI) represents a highly promising yet immensely challenging field, with vast implications for the future of society. As we move towards the Fourth Industrial Revolution, enterprises are poised for a significant transformation, utilizing integrated data to better serve customers and gain a competitive edge. Against this backdrop, AI has emerged as a critical topic of research, driving dynamic interest among scholars and practitioners alike (Chiu et al., 2023).

The revolutionary change that the ubiquity of artificial intelligence can bring about raises many hopes, but also concerns. For the first time in the history of human thought, the human mind may not be the only one possessing the ability to analyze and critically evaluate situations. This may lead to significant improvement in the quality of human life by avoiding human errors, but it also poses the risk of shifting the locus of decision-making from humans to machines.

On the other hand, vast collections of data enable the analysis of past experiences and anticipation of future needs, which could prove crucial for the survival and growth of an enterprise (Verma et al., 2021). Artificial intelligence presents a unique opportunity for a rapid acceleration of economic and social growth through the dynamism of innovation in all facets of human activity. By influencing educational processes, it can help expedite the attainment of desired outcomes and contribute to an individualized approach that considers the needs and capabilities of each participant in the learning process.

However, significant risks arising from the computational and analytical capabilities of artificial intelligence cannot be ignored. It is imperative to strive for appropriate legal and customary regulations to ensure that the primacy of decision-making always remains in human hands.

This paper was written to briefly characterize artificial intelligence and present its capabilities that may be used to optimize work in various fields, e.g. in management sciences, economics and higher education. Both the advantages and disadvantages of the use of artificial intelligence were presented, as well as ways to reduce the negative scenarios related to its development.

2. The essence of artificial intelligence

One of the seminal and oft-cited definitions of artificial intelligence was initially put forth by American scientist John McCarthy during the landmark Dartmouth Conference of 1956. In its original formulation the definition of artificial intelligence reads as follows:

‘AI is the science and engineering of making intelligent machines’ (McCarthy et al., 1955). This formulation not only recognizes the field as an interdisciplinary endeavor but also underscores the centrality of intelligence, both natural and artificial, to the development and implementation of AI technologies.

Artificial intelligence is an interdisciplinary field that encompasses a broad range of sciences, from mathematics to philosophy, as it involves complex cognitive tasks such as learning and problem-solving using novel technologies like neural networks and machine learning (Zawacki-Richter et al., 2019). This highlights the interdisciplinary nature of artificial intelligence, as it draws from various fields to achieve its goals.

However, the first pioneering work on artificial intelligence was initiated by Alan Turing, as he announced during a lecture in 1947. In his paper ‘Computing Machinery and Intelligence’ in 1950, he deliberated on the question of whether machines can be intelligent, pointing out that there are grounds to claim that this is a true assertion (Turing, 1950; McCarthy, 2007).

The initial considerations of researchers also concerned the scope in which ‘artificial intelligence’ can operate. One of the important ones was ‘(...) the question of how man’s own organization functions in adapting the message to the exigencies of the symbols and of the apparatus’ (...) (Wiener, 1950). In his book, Norbert Wiener described the concept of artificial intelligence as a process of communication between humans and machines and discussed the concept of the “black box” as a mathematical model in which the machine is treated as a black box that receives input data and generates output data, but is unknown in itself (Wiener, 1950).

In his book “Artificial Intelligence”, Kevin Knight and Elaine Rich, leading researchers in the field of AI, proposed an AI definition as “Artificial Intelligence is the study of how to make computers do things at which, at the moment, people are better” (Rich, Knight, 1991). This simplified but still profound definition touches the fundamentals of an AI, what is to strive to creation of the machines that can perform tasks that are currently possible for humans. That action is not possible without deep understanding of the human cognition that must be in some way replicated in machines.

Other authors, like Stuart Russell and Peter Norvig, define AI as "the study of agents that receive percepts from the environment and perform actions" (Russel, Norvig, 2010), what directly refers to the idea of an intelligent agent that interacts with its environment. Also, decision making processes can be assisted by AI (Rouhani et al., 2016).

A few years later, a much broader view of the issue was coined: “Computers which perform cognitive tasks, usually associated with human minds, particularly learning and problem-solving”. In this view, the artificial intelligence is rather the environment than a technology and covers wide range of newest technologies that help to behave like a human being, or over much more than that (Baker, Smith, Anissa, 2019).

As the computing power of computers increased, massive datasets were generated and processed in the so-called cloud, while neural networks enabled the creation of what is known as artificial intelligence. The main goal was to create a machine that could not only mimic

human behavior but also perceive reality, analyze gathered data, predict future events, and autonomously react to and solve problems (Spector, Polson, Muraida, 1993; Kumar, Thakur, 2012).

The aim was for artificial intelligence to match or surpass human intelligence. It is estimated that in the near future machines will be guided by common sense, akin to that of humans. Other features of the human brain, such as self-learning, will also be within the reach of artificial intelligence (Kumar, Thakur, 2012).

In simpler terms, artificial intelligence can be seen as a complex system or technology that simulates the way humans perceive the world by analyzing stimuli and evaluating them in a manner that exhibits the characteristics of human intelligence (Akerkar, 2014).

It is important to note that artificial intelligence systems are created through the intellectual efforts of humans. Simply put, they learn from people. Therefore, technological solutions for the interface that connects humans and machines are also crucial. This is because the aim is to achieve the most complete and understandable communication between both parties in the process (Thomaz, Breazeal, 2008).

Artificial intelligence enables us to go beyond the limits of the physical capabilities of human intelligence through algorithmic machine learning and autonomous decision-making. Due to its versatility, artificial intelligence can be applied in practically every sector of the economy, as well as in the social sphere, creating a space for innovation and development everywhere (Dwivedi et al., 2021).

3. The Role of AI in Management Sciences and Economy

It is a trivial truth that artificial intelligence may and with almost certainty, will have a strong even revolutionary influence on not only every part of human's life, but also on all the sciences. The management sciences will not be an exception. The plethora of potential opportunities of change come by enabling better decision-making through the analysis of large amounts of data. Using predictive analytics with natural language processing makes the machine learning faster. But, to fully realize the potential of AI in management sciences, the further collaborative and interdisciplinary approach is needed (Gandomi, Haider, 2015).

Furthermore, artificial intelligence creates enormous possibilities for practical business applications. The creation of new tools or processes provides a chance to develop a completely new quality of network connections, thereby creating the foundation for the emerging digital environment (Sułkowski, Kaczorowska-Spychalska, 2021). Artificial intelligence can be extremely useful in creating marketing budgets, planning, or conducting environmental analysis. Efficient market analysis and customer-oriented targeting are elements that bring real change to the current business practices (Rai, 2020; Fayed, 2021).

Artificial intelligence, or machine learning, is becoming an increasingly important part of complex business processes. In essence, it changes the form and manner of human-machine communication, while simultaneously creating almost unlimited cognitive possibilities and generating a new space for competitive advantage (Lee, Shin, 2020).

It is worth mentioning the faster and more complete response to customer expectations and needs as one of the applications of artificial intelligence and its ability to collect and analyze real-time data (Wirth, 2018). Artificial intelligence enables efficient analysis and prediction of customer behaviors, decisions, and purchasing habits (Chatterjee et al., 2019). It can also be useful in influencing customer satisfaction levels, not only by attempting to predict their choices but also by suggesting them (Tjepkema, 2016).

Machines that autonomously analyze data allow for efficient building of strategies in the context of product or service positioning, as well as assessing the value of a given customer in terms of their importance to the company. Creating a personalized and relational path enables the creation of truly profitable relationships with customers (Huang, Rust, 2017).

Interestingly, this is not a common practice. There are managers who deliberately delay the implementation of artificial intelligence in their managed companies, mainly due to a lack of conviction about its ability to support the company's operations (McCarthy, Chui, Bughin, 2017).

As it turns out, artificial intelligence can suggest many solutions, but it required knowledge from the people who use it. This knowledge should not only include an understanding of how the machine analyzes data, but also knowledge and skills related to avoiding unnecessary expenses or applying an algorithm by the artificial intelligence that may not be suitable for the specific nature of the enterprise (Canhoto, Clear, 2020).

It is obvious that to effectively utilize technological advancements, including artificial intelligence, widespread knowledge is necessary. Correct implementation and understanding of how to use these advancements is essential for organizations to reap the benefits (Swanson, 1988). Perhaps a recommendation for management practitioners would be to expand their qualifications and knowledge of machine operations and, consequently, artificial intelligence (Solon, 2018). This simply shows that managers seek technological support in the areas of knowledge management and information processing and strive to utilize them in the practice of managing their organizations (Dereń, Skonieczny, Łukaszczykiewicz, 2022). Another issue is the number of possible solutions, which in the case of artificial intelligence can be almost infinite, and the difficulty may lie in making the right choice (Davenport, Beck, 2002).

However, attention must be paid to the issue of the interaction between human intelligence and artificial intelligence. It is necessary to take a broader look at the problem that just through data analysis and beyond data engineering. This will help in a better understanding of artificial intelligence by those managing the organization. It is also worthwhile to develop competencies for every employee and the entire organization, preparing for future collaboration with artificial intelligence and its method of data analysis and thus – understanding the world (Bérubé,

Giannelia, Vial, 2021). The issue of the interaction between artificial intelligence and humans is being scientifically explored under the concept of ‘artificial intelligence human reasoning’ and the impact on humans during interactions with such machines (Harika et al., 2022).

The development of artificial intelligence creates a foundation for a completely new stage in the process of knowledge transfer. Intelligent tools can provide excellent support for all participants in the educational environment. The ability of artificial intelligence to learn on its own creates an opportunity to expand cognitive horizons in the areas of different cultures or the further development of every individual. It is not surprising that this topic is becoming the subject of interest for an increasingly wider group of subject researchers (Hwang et al., 2020).

The possibilities of utilizing artificial intelligence are practically limitless. They provide a basis for significantly expanding human cognitive abilities. In the case of managing organizations, they will most likely soon become an integral tool for managing a company.

The impact of artificial intelligence on the way an organization functions can be overwhelming. It can be said that it fulfills the term "disruption" or "disruptive disorder" as understood by Clayton M. Christensen, about the possible threat to the organization from a completely unexpected side (Harvard Business Review, 2020). However, attempts can be made to efficiently use artificial intelligence or a potential threat as a huge opportunity (Gans, 2016).

Anyway, several decades ago, Stanisław Lem pointed out that “the point is not to construct a synthetic humanity (...). Technology will signify complete power of man over himself, over his own organism” (Lem, 2020).

4. Artificial Intelligence in Higher Education

The idea of using artificial intelligence in 2023 is no longer as innovative. Academic research on this matter has been ongoing for over 30 years. It has been viewed as a useful tool in traditional learning processes due to its interdisciplinary approach and adaptive learning environments (Luckin, Holmes, Griffiths, Mark, Forcier, 2016). The first publications related to the use of such new technologies in education appeared as early as 1983 (O’Shea, Self, 1983).

This idea was boldly developed, pointing to the possibilities offered by computer technology in supporting learning or assessing acquired knowledge. Despite the primacy of humans in education, significantly higher effectiveness and lower costs are indicated by the application of new technologies (Koedinger, Corbett, 2006).

The field of artificial intelligence began to be explored scientifically after the year 2004, with a handful of publications emerging annually since then. Various approaches and potential applications of artificial intelligence tools were analyzed for different forms of collaborative learning (Tan, Lee, Lee, 2022). As the topic of artificial intelligence has sparked the interest of

researchers, it has often been linked with areas such as digital transformation, industry 4.0, and the internet of things, thus indicating higher education's interest in various directions of possible transformation within the realm of new technologies (Yavuz, 2022).

When evaluating the decade 2010-2020, three areas of research can be identified (Zhai et al., 2021):

- classification, matching, recommendations, and deep learning,
- feedback analysis, adaptive learning, and reasoning, and
- application areas such as role playing, gamification, and deep learning.

The International Artificial Intelligence in Education Society (IAIED), with over 25 years of experience, consisting of more than 1000 researchers from over 40 countries in various scientific fields, provides evidence of the importance of artificial intelligence in the education process. Its mission is to promote and support the application of artificial intelligence in education on a global scale (The International Artificial Intelligence in Education Society, n.d.). Artificial intelligence can have various applications, such as stimulating imagination, utilizing emotions to expand knowledge, and interacting with human senses through text, films, images and sounds (Price, Flach, 2017).

Therefore, technology is a set of artifacts that enhance educational communication. It is a means of improving educational forms by actively developing individual learning paths (Della Ventura, 2017). At the same time, there is a noticeable synergy between the use of new technologies and student engagement, resulting in significantly better results for the latter (Chen, Lambert, Guidry, 2010).

The beginnings of the impact of technological changes on the education process were closely related to the popularization of computer techniques. The ability to collect and process data, as well as integrate many different devices, led to the creation of artificial intelligence. This, in turn, has applications in academic administration, as well as significant support for the educational process. In addition to platforms that support education, robots are also used to facilitate contact with interested parties by imitating human behavior. Furthermore, artificial intelligence enables the personalization of educational materials and the adjustment of the level of education to the abilities and perception of students (Chen et al., 2020).

It is evident that universities strive to provide their students with the latest scientific advancements with the support of the most up-to-date technologies. This applies to both the quality of the knowledge imparted and the use of tools that support the educational process. This is in line with changing expectations of students and the evolving role of academic teachers in the entire knowledge transmission process (Scott, 2000).

It is well-known that students have different ways of assimilating knowledge, and by using various technological aids, the knowledge transfer process can be improved and better understood whether they prefer active participation, passive learning, systematic work, sporadic work, or rely on their existing knowledge or intuition (García et al., 2007).

Additionally, it often happens that students are subject to different requirements if they started their studies on different semesters. They usually independently choose many different subjects (courses). This emphasizes the importance of an individual approach and the use of tools that artificial intelligence enables (Haderer, Ciolacu, 2022).

In general, it should be acknowledged that a crucial task of the higher education system is to educate students in the skills of efficient and effective use of artificial intelligence (Luckin et al., 2022). This requires not only knowledge but also communication skills. By incorporating the topic of artificial intelligence into individual subject programs, awareness, and knowledge of the possibilities of this tool can be increased (Su, Zhong, Ng, 2022).

One excellent example of using artificial intelligence is engaging over 6000 students from a university in active learning to familiarize them with various technological tools for future work. This serves as a background and is utilized in educational programs across different subjects, allowing users to become accustomed to the interdisciplinary nature of artificial intelligence and its specialized knowledge, as well as its specific forms of communication (Southworth et al., 2023).

It is not possible to narrow down the application of artificial intelligence in education solely to pure technology. Implementing such applications requires the efficient integration of many complex areas related to the process of knowledge transfer, such as the pedagogical and cultural aspects, as well as considering the economic and social context of the applied actions (Castañeda, Selwyn, 2018).

When it comes to the use of artificial intelligence in education, it is crucial not to overlook the significant ethical, social, cultural, and even pedagogical issues that arise. The importance of education must be emphasized, and the significance of this issue cannot be limited only to algorithms or even complex data processing (Selwyn, 2016). Furthermore, new technologies create a space for discussions in the field of the philosophical perspective of education, which also poses additional risks to the quality of education (Hwang et al., 2020).

Moreover, ethical threads seem to be particularly important in the education process at the higher education level. Artificial intelligence systems should support the creative abilities of students rather than serve excessive control. Developing intelligent support systems for students, considering the individual needs of each, may be a remedy for problems associated with massification of higher education institutions (Zawacki-Richter et al., 2019).

It is worth noting that more and more higher education institutions are recognizing the benefits of incorporating artificial intelligence into the education support process. It should be noted that its use increases student motivation and through interaction, feedback, and learning from mistakes, it contributes to the improvement of skills including computational ones (Bernius, Krusche, Bruegge, 2022; Martín-Núñez et al., 2023).

The advantages of artificial intelligence are enticing. It can enable completely new ways of conveying knowledge. It's difficult to overlook the possible effects of using artificial intelligence in terms of equalizing educational opportunities and access to knowledge,

including that available in different languages. The perception of the teacher's work may also change, as well as the methods of assessing student work (Tuomi, 2018).

In the case of teachers as well, artificial intelligence can even replace their work by simulating or imitating their knowledge or experience. As a result, students can receive knowledge that is more tailored to their individual cognitive abilities (Pai et al., 2021; Xiao, Yi, 2021). This aspect proves to be extremely important because many researchers see the future of artificial intelligence solely in terms of concentrating on benefits for students through personalized knowledge gathered based on available data and considering the perspective of the knowledge recipient (Ouyang, Jiao, 2021).

However, there are concerns about the challenges posed to work in higher education. Predicting various possible scenarios of technological development in the field of artificial intelligence, some see a threat to the work of teachers, which can be replaced by more efficient machines (Lacity, 2017).

The Educause Horizon Report for 2021 has identified six pivotal technologies and practices that are poised to exert a significant impact on the landscape of higher education in the foreseeable future. These technologies and practices have been carefully selected based on rigorous research and analysis, and are expected to have a transformative effect on the way that higher education institutions operate and deliver education to their students (Pelletier et al., 2021):

1. Artificial Intelligence defined here as „computer systems that undertake tasks usually thought to require human cognitive processes and decision-making capabilities” (Allison-Hope, Park, Rohwer, 2018).
2. Blended and Hybrid Course Models – new, redesigned programs and courses to meet the students and society needs, with a spotlight on learner as well as faculty development. The online education should be “humanized” and oriented towards mental and social health of both, instructors, and students.
3. Learning Analytics – through analysis of the learning process supports the management of education, such as in creating or modifying teaching plans.
4. Microcredentialing – defined as the actions that helps to “verify, validate, and attest those specific skills and/or competencies have been achieved” (Micro-Credentials at SUNY, n.d.). More than 700 thousand various microcredentials are being offered currently worldwide.
5. Open Educational Resources – a multitude of educational content is freely available on the internet, which, thanks to its flexibility and accessibility from any device, becomes an alternative to traditional forms of learning.
6. Quality Online Learning – understood as a focus on providing high-quality online education by adopting appropriate strategies for creating programs, as well as motivating students to learn and preparing instructors to work in a changed, remote environment devoid of the individual, personal “student-master” relationship.

Therefore, it should be accepted that, in terms of its potential and the role it may play in the future, the thesis about the overwhelming influence of artificial intelligence on the processes of knowledge transmission and absorption is true (Loeckx, 2016; Seldon, Abidoeye, 2018).

The use of artificial intelligence tools does not have to be limited solely to the educational process. Algorithms also allow for streamlining the processes of managing the university itself and, for example, predicting the percentage of potential student dropouts from their studies. Moreover, artificial intelligence also enables effective prevention of this unfavorable phenomenon (Kotsiantis, Pierrakeas, Pintelas, 2003).

Given the current state of technology development, it is difficult to make a definitive judgement about the impact of artificial intelligence on educational processes. Nevertheless, a positive aspect is the fact of acquainting students with the development of artificial intelligence. It can be assumed with a high degree of probability that their professional future will be based on these technologies to a significantly more advanced degree than at present (Laupichler et al., 2022).

5. Threats from artificial intelligence

Despite everything, the latest technologies in the field of artificial intelligence should be approached with caution. There are reasons to believe that it may be used not only for ethical purposes. Using photos or videos and processing them by giving them a changed context in terms of space, frequency, time, or place is known as "deep fake". At the same time, there are tools that allow effective recognition of such practices (Chamot, Geradts, Haasdijk, 2022; Liu, Wang, Wang, 2022).

The significance of the issue is evidenced by the European Commission's 'White Paper' on artificial intelligence. The potential benefits of its widespread use have also been recognized, particularly in three main dimensions (European Commission, 2020):

- for citizens – which means better public, transportation, or health services,
- for businesses – which means innovation in areas such as the electromechanical industry, agriculture, green economy, healthcare, tourism, and media,
- for the public interest – through more effective waste management, supporting sustainable development, transportation, and education.

However, there is a widely expressed concern about safety and individual rights in situations of informational asymmetry. Artificial intelligence can be useful for protecting them, but it can also pose a serious risk of misuse of that data. This creates the need for appropriate regulatory frameworks aimed at minimizing these threats. There are known examples of artificial intelligence algorithms that may exhibit a tendency to discriminate based on gender

or race, as well as preferences for people with lighter skin (Buolamwini, Gebru, 2018; Tolan et al., 2019). Adequate legal regulations are also necessary of a self-driving vehicle controlled by artificial intelligence.

The possibilities of artificial intelligence to generate ready-made texts (ChatGPT) also pose a threat to the ethics and transparency of research and scientific works. Not only in terms of possible plagiarism or problems with establishing authorship, as well as issues regarding scientific liability, but also in terms of the veracity of the presented facts. ChatGPT bases its knowledge on information published on the Internet and does not always process it correctly. It may happen that the created statements sound logical, but their content is not true. Mindless duplication, without proper verification, may therefore be a threat to the reliability of science. All the more that the sources of chatbot knowledge are not clear or known (Eke, 2023; Peres et al., 2023; Rahimi, Talebi Bezmin Abadi, 2023).

However, it is essential that regulatory frameworks do not in any way limit the dynamic development of technology, which can prove to be a significant impetus for development, while ensuring proper protection for those involved in the creation and use of technology – people.

6. Conclusion

When assessing the positive impact of artificial intelligence on higher education, on the support of the teaching and research process, one must keep in mind the priority of humans over machines, even those that emulate their personality. It should be remembered that artificial intelligence can never replace human creativity, ingenuity, and intuition. As in the statement: ‘first and foremost, require control by humans. Even the smartest AI systems can make very stupid mistakes. (...). AI systems are only as smart as the data used to train them’ (Kaplan, Haenlein, 2019).

It is assumed that the ability to navigate in the environment of artificial intelligence will soon become a skill that everyone should possess. Some authors even propose to expand education to include digital skills and proficient use of the benefits of artificial intelligence in personal and professional life (Ng et al., 2021).

Artificial intelligence creates almost limitless possibilities in higher education. It is expected to be intricately woven into the entire educational process at every stage. It will serve as an excellent tool to support the work of the teacher-lecturer, while also becoming a tutor that communicates with the students in a language that is accessible and understandable to their perception.

It should be emphasized that current attempts to anticipate the role of artificial intelligence in the higher education system and knowledge transmission processes are fraught with risk. The frameworks for human-machine interactions are still in the process of development, and it remains to be seen in which direction the future developments will take us. It is to be hoped that in the relationship between human and artificial intelligence, the former will maintain an unshakeable primacy, although even this is not entirely free of uncertainty.

References

1. Akerkar, R. (2014). *Introduction to artificial intelligence*. New Delhi: Prentice-Hall.
2. Allison-Hope, D., Park, J., Rohwer, M. (2018). 7 Things You Should Know About Artificial Intelligence. Available at: <https://www.greenbiz.com/article/7-things-you-should-know-about-artificial-intelligence>.
3. Baker, T., Smith, L., Anissa, N. (2019). Educ-AI-tion rebooted? Exploring the future of artificial intelligence in schools and colleges. *Retrieved May, 12*(February), p. 2020. Available at: https://media.nesta.org.uk/documents/Future_of_AI_and_education_v5_WEB.pdf.
4. Bernius, J.P., Krusche, S., Bruegge, B. (2022). Machine learning based feedback on textual student answers in large courses. *Computers and Education: Artificial Intelligence*, 3(March), p. 100081. doi:10.1016/j.caeai.2022.100081.
5. Bérubé, M., Giannelia, T., Vial, G. (2021). *Barriers to the implementation of AI in organizations: Findings from a Delphi study*. Proceedings of the Annual Hawaii International Conference on System Sciences, 2020-Januar, pp. 6702-6711. doi:10.24251/hicss.2021.805.
6. Buolamwini, J., Gebru, T. (2018). Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification. *Proceedings of Machine Learning Research*, 81, pp. 1-15.
7. Canhoto, A.I., Clear, F. (2020). Artificial intelligence and machine learning as business tools: A framework for diagnosing value destruction potential. *Business Horizons*, 63(2), pp. 183-193. doi:10.1016/j.bushor.2019.11.003.
8. Castañeda, L., Selwyn, N. (2018). More than tools? Making sense of the ongoing digitizations of higher education. *International Journal of Educational Technology in Higher Education*, 15(1), p. 22. doi:10.1186/s41239-018-0109-y.
9. Chamot, F., Geradts, Z., Haasdijk, E. (2022). Deepfake forensics: Cross-manipulation robustness of feedforward- and recurrent convolutional forgery detection methods. *Forensic Science International: Digital Investigation*, 40, p. 301374. doi:10.1016/j.fsidi.2022.301374.

10. Chatterjee, S. et al. (2019). Are CRM systems ready for AI integration? *The Bottom Line*, 32(2), pp. 144-157. doi:10.1108/BL-02-2019-0069.
11. Chen, P.-S.D., Lambert, A.D., Guidry, K.R. (2010). Engaging online learners: The impact of Web-based learning technology on college student engagement. *Computers & Education*, 54(4), pp. 1222-1232. doi:10.1016/j.compedu.2009.11.008.
12. Chen, X., Xie, H., Hwang, G.-J. (2020). A multi-perspective study on Artificial Intelligence in Education: grants, conferences, journals, software tools, institutions, and researchers. *Computers and Education: Artificial Intelligence*, 1, p. 100005. doi:10.1016/j.caeai.2020.100005.
13. Chiu, T.K.F. et al. (2023). Systematic literature review on opportunities, challenges, and future research recommendations of artificial intelligence in education. *Computers and Education: Artificial Intelligence*, 4, p. 100118. doi:10.1016/j.caeai.2022.100118.
14. Davenport, T.H., Beck, J.C. (2002). *The Attention Economy: Understanding the New Currency of Business*. Brighton: Harvard Business Review Press.
15. Dereń, A.M., Skonieczny, J., Łukaszcykiewicz, S. (2022). E-Learning as an Instrument for Managing Knowledge in the Field of Sustainable Development in a Chemical Company in Poland. *Sustainability*, 14(14), p. 8351. doi:10.3390/su14148351.
16. Dwivedi, Y.K. et al. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management*, 57, p. 101994. doi:10.1016/j.ijinfomgt.2019.08.002.
17. Eke, D.O. (2023). ChatGPT and the rise of generative AI: Threat to academic integrity? *Journal of Responsible Technology*, 13(February), p. 100060. doi:10.1016/j.jrt.2023.100060.
18. European Commission (2020). Biała Księga . W sprawie sztucznej inteligencji Europejskie podejście do doskonałości i zaufania, pp. 1-31. Available at: https://ec.europa.eu/info/sites/default/files/commission-white-paper-artificial-intelligence-feb2020_pl.pdf.
19. Fayed, A.E. (2021). Artificial Intelligence for marketing plan: the case for e-marketing companies. *Marketing and Management of Innovations*, 1, pp. 81-95. doi:10.21272/mmi.2021.1-07.
20. Gandomi, A., Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management*, 35(2), pp. 137-144. doi:10.1016/j.ijinfomgt.2014.10.007.
21. Gans, J.S. (2016). *Keep Calm and Manage Disruption*. Available at: <https://sloanreview.mit.edu/article/keep-calm-and-manage-disruption/>, 10 March 2023.
22. García, P. et al. (2007). Evaluating Bayesian networks' precision for detecting students' learning styles. *Computers & Education*, 49(3), pp. 794-808. doi:10.1016/j.compedu.2005.11.017.
23. Haderer, B., Ciolacu, M. (2022). Education 4.0: Artificial Intelligence Assisted Task- and

- Time Planning System. *Procedia Computer Science*, 200, pp. 1328-1337. doi:10.1016/j.procs.2022.01.334.
24. Harika, J. et al. (2022). *A Review on Artificial Intelligence with Deep Human Reasoning*. 2022 International Conference on Applied Artificial Intelligence and Computing (ICAAIC). IEEE, pp. 81-84. doi:10.1109/ICAAIC53929.2022.9793310.
 25. Harvard Business Review (2020). *The Essential Clayton Christensen Articles*. Available at: <https://hbr.org/2020/01/the-essential-clayton-christensen-articles>. 10 March 2023.
 26. Huang, M.-H., Rust, R.T. (2017). Technology-driven service strategy. *Journal of the Academy of Marketing Science*, 45(6), pp. 906-924. doi:10.1007/s11747-017-0545-6.
 27. Hwang, G.-J. et al. (2020). Vision, challenges, roles and research issues of Artificial Intelligence in Education. *Computers and Education: Artificial Intelligence*, 1, p. 100001. doi:10.1016/j.caeai.2020.100001.
 28. Kaplan, A., Haenlein, M. (2019). Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons*, 62(1), pp. 15-25. doi:10.1016/j.bushor.2018.08.004.
 29. Koedinger, K.R., Corbett, A. (2006). Cognitive Tutors: Technology Brining Learning Science to the Classroom. In: K. Sawyer (Ed.), *The Cambridge Handbook of Learning Sciences, January 2006*, pp. 61-77. doi:10.1017/CBO9781107415324.004.
 30. Kotsiantis, S.B., Pierrakeas, C.J., Pintelas, P.E. (2003). Preventing Student Dropout in Distance Learning Using Machine Learning Techniques, pp. 267-274. doi:10.1007/978-3-540-45226-3_37.
 31. Kumar, K., Thakur, G.S.M. (2012). Advanced Applications of Neural Networks and Artificial Intelligence: A Review. *International Journal of Information Technology and Computer Science*, 4(6), pp. 57-68. doi:10.5815/ijitcs.2012.06.08.
 32. Lacity, M.C. (2017) *Robotic Process Automation and Risk Mitigation: The Definitive Guide*. Ashford: SB Publishing.
 33. Laupichler, M.C. et al. (2022). Artificial intelligence literacy in higher and adult education: A scoping literature review. *Computers and Education: Artificial Intelligence*, 3, p. 100101. doi:10.1016/j.caeai.2022.100101.
 34. Lee, I., Shin, Y.J. (2020). Machine learning for enterprises: Applications, algorithm selection, and challenges. *Business Horizons*, 63(2), pp. 157-170. doi:10.1016/j.bushor.2019.10.005.
 35. Lem, S. (2020) *Summa Technologiae*. Kraków: Wydawnictwo Literackie.
 36. Lindsay Tjepkema (2016). *What is Artificial Intelligence (AI) Marketing? A Complete Guide*. Available at: <https://emarsys.com/learn/blog/artificial-intelligence-marketing-solutions/>, 10 March 2023.
 37. Liu, Z., Wang, H., Wang, S. (2022). Cross-Domain Local Characteristic Enhanced Deepfake Video Detection, pp. 3412-3429. Available at: <http://arxiv.org/abs/2211.03346>.
 38. Loeckx, J. (2016). Blurring Boundaries in Education: Context and Impact of MOOCs.

- The International Review of Research in Open and Distributed Learning*, 17(3). doi:10.19173/irrodl.v17i3.2395.
39. Luckin, R. et al. (2022). Empowering educators to be AI-ready. *Computers and Education: Artificial Intelligence*, 3, p. 100076. doi:10.1016/j.caeai.2022.100076.
 40. Luckin, R., Holmes, W., Griffiths, Mark, Forcier, L.B. (2016). *The Open University's repository of research publications and other research outputs*. London: Pearson Education.
 41. Martín-Núñez, J.L. et al. (2023). Does intrinsic motivation mediate perceived artificial intelligence (AI) learning and computational thinking of students during the COVID-19 pandemic? *Computers and Education: Artificial Intelligence*, 4, p. 100128. doi:10.1016/j.caeai.2023.100128.
 42. McCarthy, B., Chui, M., Bughin, J. (2017) *A Survey of 3,000 Executives Reveals How Businesses Succeed with AI*. Available at: <https://hbr.org/2017/08/a-survey-of-3000-executives-reveals-how-businesses-succeed-with-ai>, 10 March 2023.
 43. McCarthy, J. et al. (1955). A proposal for the Dartmouth summer research project on artificial intelligence. Available at: <https://www-formal.stanford.edu/jmc/history/dartmouth/dartmouth.html>.
 44. McCarthy, J. (2007). What is artificial intelligence? Available at: <https://www-formal.stanford.edu/jmc/whatisai.pdf>.
 45. *Micro-Credentials at SUNY* (n.d.). Available at: <https://system.suny.edu/academic-affairs/microcredentials/>, 10 March 2023.
 46. Ng, D.T.K. et al. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence*, 2, p. 100041. doi:10.1016/j.caeai.2021.100041.
 47. O'Shea, T., Self, J. (1983) *Learning and Teaching with Computers: Artificial Intelligence in Education*. Prentice-Hall.
 48. Ouyang, F., Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, 2, p. 100020. doi:10.1016/j.caeai.2021.100020.
 49. Pai, K.-C. et al. (2021). An application of Chinese dialogue-based intelligent tutoring system in remedial instruction for mathematics learning. *Educational Psychology*, 41(2), pp. 137-152. doi:10.1080/01443410.2020.1731427.
 50. Pelletier, K. et al. (2021). *Horizon Report 2021, EDUCAUSE Review*. Available at: <https://www.educause.edu/horizon-report-teaching-and-learning-2021>.
 51. Peres, R. et al. (2023). On ChatGPT and beyond: How generative artificial intelligence may affect research, teaching, and practice. *International Journal of Research in Marketing*, pp. 1-7. doi:10.1016/j.ijresmar.2023.03.001.
 52. Price, S., Flach, P.A. (2017). Computational support for academic peer review. *Communications of the ACM*, 60(3), pp. 70-79. doi:10.1145/2979672.
 53. Rahimi, F., Talebi Bezmin Abadi, A. (2023). ChatGPT and Publication Ethics. *Archives of*

- Medical Research*, 54(3), pp. 272-274. doi:10.1016/j.arcmed.2023.03.004.
54. Rai, A. (2020). Explainable AI: from black box to glass box. *Journal of the Academy of Marketing Science*, 48(1), pp. 137-141. doi:10.1007/s11747-019-00710-5.
55. Rich, E., Knight, K. (1991) *Artificial Intelligence*. New York: Mcgraw Hill Higher Education.
56. Rouhani, S. et al. (2016). The impact model of business intelligence on decision support and organizational benefits. *Journal of Enterprise Information Management*, 29(1), pp. 19-50. doi:10.1108/JEIM-12-2014-0126.
57. Russel, S.J., Norvig, P. (2010). *Artificial Intelligence. A Modern Approach*. New Jersey: Pearson Education.
58. Scott, P. (2000). Globalisation and Higher Education: Challenges for the 21st Century. *Journal of Studies in International Education*, 4(1), pp. 3-10. doi:10.1177/102831530000400102.
59. Seldon, A., Abidoye, O. (2018). *The Fourth Education Revolution Reconsidered: Will Artificial Intelligence Enrich or Diminish Humanity?* London: Legend Press.
60. Selwyn, N. (2016). *Is Technology Good for Education?* London: Polity.
61. Solon, O. (2018). *Google's robot assistant now makes eerily lifelike phone calls for you*. Available at: <https://www.theguardian.com/technology/2018/may/08/google-duplex-assistant-phone-calls-robot-human>, 10 March 2023.
62. Southworth, J. et al. (2023). Developing a model for AI Across the curriculum: Transforming the higher education landscape via innovation in AI literacy. *Computers and Education: Artificial Intelligence*, 4, p. 100127. doi:10.1016/j.caeai.2023.100127.
63. Spector, J.M., Polson, M.C., Muraida, D.J. (1993) *Automating Instructional Design: Concepts and Issues*. Englewood Cliffs: Educational Technology Pubns.
64. Su, J., Zhong, Y., Ng, D.T.K. (2022). A meta-review of literature on educational approaches for teaching AI at the K-12 levels in the Asia-Pacific region. *Computers and Education: Artificial Intelligence*, 3, p. 100065. doi:10.1016/j.caeai.2022.100065.
65. Sułkowski, Ł., Kaczorowska-Spychalska, D. (2021). Determinants of the adoption of AI wearables - practical implications for marketing. *Human Technology*, 17(3), pp. 294-320. doi:10.14254/1795-6889.2021.17-3.6.
66. Swanson, E.B. (1988). Information System Implementation: Bridging the Gap Between Design and Utilization. *Computer Science* [Preprint].
67. Tan, S.C., Lee, A.V.Y., Lee, M. (2022). A systematic review of artificial intelligence techniques for collaborative learning over the past two decades. *Computers and Education: Artificial Intelligence*, 3, p. 100097. doi:10.1016/j.caeai.2022.100097.
68. *The International Artificial Intelligence in Education Society* (n.d.). Available at: <https://iaied.org/about>, 10 March 2023.
69. Thomaz, A.L., Breazeal, C. (2008). Teachable robots: Understanding human teaching behavior to build more effective robot learners. *Artificial Intelligence*, 172(6-7), pp. 716-

737. doi:10.1016/j.artint.2007.09.009.
70. Tolan, S. et al. (2019). *Why Machine Learning May Lead to Unfairness*. Proceedings of the Seventeenth International Conference on Artificial Intelligence and Law. New York, NY, USA: ACM, pp. 83-92. doi:10.1145/3322640.3326705.
71. Tuomi, I. (2018) *The Impact of Artificial Intelligence on Learning, Teaching, and Education*. Luxembourg: Publications Office of the European Union. doi:10.2760/12297.
72. Turing, A.M. (1950). Computing Machinery and Intelligence. *Mind*, 59(236), pp. 433-460. Available at: <http://www.jstor.org/stable/2251299>.
73. Della Ventura, M. (2017). Creating Inspiring Learning Environments by means of Digital Technologies: A Case Study of the Effectiveness of WhatsApp in Music Education. *EAI Endorsed Transactions on e-Learning*, 4(14), p. 152906. doi:10.4108/eai.26-7-2017.152906.
74. Verma, S. et al. (2021). Artificial intelligence in marketing: Systematic review and future research direction. *International Journal of Information Management Data Insights*, 1(1), p. 100002. doi:10.1016/j.jjime.2020.100002.
75. Wiener, N. (1950). *Cybernetics: or the Control and Communication in the Animal and the Machine*. Cambridge: The MIT Press.
76. Wirth, N. (2018). Hello marketing, what can artificial intelligence help you with? *International Journal of Market Research*, 60(5), pp. 435-438. doi:10.1177/1470785318776841.
77. Xiao, M., Yi, H. (2021). Building an efficient artificial intelligence model for personalized training in colleges and universities. *Computer Applications in Engineering Education*, 29(2), pp. 350-358. doi:10.1002/cae.22235.
78. Yavuz, M. (2022). Digital Transformation and Productivity in Higher Education.
79. Zawacki-Richter, O. et al. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1), p. 39. doi:10.1186/s41239-019-0171-0.
80. Zhai, X. et al. (2021). A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. *Complexity*. N. Cai (ed.), pp. 1-18. doi:10.1155/2021/8812542.