

# THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE DEVELOPMENT OF EDUCATION

Maja Mitevaska-Poceva

---

## ABSTRACT

The development of technology and the creation of Artificial Intelligence (AI - Artificial Intelligence) progressed. It is a gradual process, which is upgraded with time and technological progress. The continuous research and the development of new methods, algorithms, and techniques lead to achieving machines' desired levels of intelligence. Artificial Intelligence AI is a broad branch of computer science that deals with building smart machines capable of performing tasks that normally require human intelligence. It is a highly innovative area of research and development that permeates many aspects of our society, including education. In recent years, the application of AI in education has seen significant growth and has the potential to change the way we learn and teach knowledge. It can change the way learning is carried out, improving and personalizing the educational process. In this paper, we will look at the role of artificial intelligence in education and some of its most significant aspects. Learning with artificial intelligence aims to improve student learning and teaching. Artificial intelligence in education seeks to reduce the barrier that currently exists between the formal teaching (in class) and the autonomous and independent learning of students. The goal is to promote common methodologies in knowledge building and the stimulation of autonomy. For the purpose of this, personal communication systems (Internet, mobile devices, etc.) are used outside the traditional spaces where the learning process was developed. Artificial intelligence can contribute to the continuous assessment system by monitoring student performance in real-time and predicting possible difficulties that may arise during education.

**Keywords:** artificial Intelligence, learning, education, intelligence

## INTRODUCTION

The development of technology is a dynamic process that takes place continuously throughout human history. Technology refers to the application of scientific knowledge, skills and instruments to solve practical problems and to meet human needs.

The development of technology in modern society is something that takes place at an unwanted speed and deeply affects all aspects of human life. Over the last decades, technology has brought enormous changes in several areas, among which we would mention communication, education, health, production and industry, mobility, energy, entertainment and culture, social changes, etc.

Technology has enabled people from all walks of life to have access to a variety of resources. It is also used to equip people who need some type of assistance to improve their quality of life and help them take advantage of opportunities that would otherwise be unavailable.

Technology has witnessed an impressive evolution in the past few decades, which in turn has transformed our lives and helped us evolve with it. From roads, railways and planes for smooth travel to making communication effortless from any part of the world, technology has contributed more than anything to help mankind live a luxurious and comfortable life. Moreover, because of technology we know our world and space better. Every field owes its progress to technology, and this clearly indicates its importance in every aspect of our lives.

Technology has become an indispensable part of our daily life. Everything we do from start to finish of the day involves some kind of technology. One of the reasons why technology, no matter what field, is a focus area for the scientists and other professionals and stakeholders is that it adds convenience to our daily activities while saving us time and improving our quality of life.

Right from our smartphones that are useful to us in more ways than we can imagine to various kitchen appliances, computer systems, means of communication, transportation system and online shopping have changed the way we live our lives compared to a decade ago. The enormous benefits that technology contributes to our lives, both on a smaller and larger scale, serve as the driving force for the continuous work towards further advancement in technological innovation.

Technology includes all those tools that require scientific knowledge for their development. For this reason, technology can be defined as a set of scientific knowledge that aims to satisfy the human needs related to economic and social progress; they also make it possible to improve the aspects of everyday life.

## LITERATURE REVIEW

The application of new technology in education, facilitated by e-books, online lectures, distance learning and interactive educational tools have allowed a wider and more accessible educational opportunity for people all over the world.

In today's era, technology holds significant importance for the students as it facilitates seamless learning and online education, granting access to up-to-date information.

Technology enhances the learning experience for the students by providing them with the tools and resources necessary for success. From online resources that help simplify complex concepts to interactive learning experiences that keep the students engaged, technology gives the students the support they need to thrive in the classroom and beyond.

Here are reasons why technology is important in education. These include more engaged students, support for multiple learning styles, better collaboration, more instant feedback for the teachers and preparing for the future. It enhances creativity and innovation. Technology has opened up a world of opportunities for the students to be creative and innovative. Via access to a wealth of information and resources at their fingertips, the students can experiment, explore and bring their ideas to life.

This type of hands-on learning is much more engaging and enjoyable for the students and helps them to foster critical thinking skills. For example, students can use graphic design software to create posters, animations, or videos to present their ideas. They can use 3D printing to design and prototype their inventions. They can even use virtual and augmented reality to bring their ideas to life and make them more interactive.

In the publication "The role of Artificial Intelligence in Personalized Education" presents one of the greatest benefits of technology in education, which is personalized learning. By means of the online resources and educational software, students can find information that is tailored to their needs, interests and learning style. They can work at their own pace, repeat lessons if they need to and access information relevant to their studies. This type of individualized learning can help students stay motivated and achieve better results.

The reason for the emergence of artificial intelligence is very rapid development of technology and the improvement of the computer system, through which it is possible to perform various algorithms. The journey of artificial intelligence started with humble roots and has evolved exponentially over the years, becoming an integral part of our daily lives.

The emergence of AI does not happen in one moment, but it develops over decades with technological advances and different scientific conceptions. The very concept of artificial intelligence can be traced back to ancient civilizations, where myths and stories depicted intelligent beings and automatons. Nonetheless, it was not until the middle of the 20th century that artificial intelligence emerged as a scientific discipline. The term "Artificial Intelligence" was coined by the American computer scientist John McCarthy in 1956 during the Dartmouth Conference, which is considered the birth of artificial intelligence as a field of study.

Early research into artificial intelligence focused on symbolic reasoning, with the goal of creating a machine that could mimic human thought processes. The researchers believed that human intelligence could be broken down into a series of logical rules and represented using symbols. The General Problem Solver (GPS), developed by Allen Newell and Herbert A.

In the 1960s and 1970s, the artificial intelligence research faced significant challenges. Initial enthusiasm waned as early AI systems struggled to meet the high expectations set by the researchers. The limitations of computing power and the complexity of human intelligence have posed significant obstacles. This period became known as the “AI winter” as funding and interest in AI research declined.

The development of AI was facing new challenges and opportunity for progress. Artificial intelligence experienced resurgence in the 1980s with the emergence of new algorithms and technologies. The expert systems, which encode human knowledge into a set of rules for solving specific problems, have gained popularity. AI applications have begun to find their way into various industries, such as medicine, finance, and manufacturing. Furthermore, in the 1980s, the neural network simulation method became popular, which stimulated research in the field of deep learning (Deep Learning). Significant advances have been made in language and vision processing, applications that are still of great importance in education and other fields today.

The 1990s marked a significant shift in AI research with the emergence of machine origins. Instead of explicit programming rules, researchers began developing algorithms that allow machines to learn the data and choose their options over time. Neural networks, inspired by the structure of the human brain, have gained strength in solving complex problems.

The 21st century has witnessed a renaissance in artificial intelligence, fuelled by the convergence of big data, powerful computing, and breakthroughs in deep learning. Deep learning, a subfield of machine learning, is revolutionizing artificial intelligence by empowering machines to process vast amounts of data and recognize patterns with unprecedented accuracy. This has led to significant advances in computer vision, natural language processing and speech recognition.

Today, AI continues to advance at an incredible pace, incorporating advanced algorithms, large data sets, and powerful computing resources. Substantial progress has been achieved in areas such as expert systems, data analysis, computer vision, and natural language, introducing AI into every aspect of our lives, including education.

Education around the world is changing at an incredibly rapid pace. Software and devices are as common in classrooms and lecture theatres as whiteboards and projectors once were. The new generation of students is digitally native, swiftly embracing and adopting new technologies.”.

The educational institutions globally face three major challenges: Providing quality education, often at scale; making education accessible to all, including in emerging markets, rural communities and children with special needs; and reducing delivery costs to ensure affordable education.

Teachers are burdened with administrative tasks that consume valuable time from teaching. These tasks encompass planning lesson materials for large classes of mixed-ability students; assessment and grading and homework; and fact and source checking for submitted assignments. School administrators and admissions staff, meanwhile, struggle with selecting the best students from a large number of applications and communicating effectively with the students, the staff and the parents.

All of this results in an education system that is under-resourced and inefficient. And where all too often, students can be forgotten and left behind.

A multitude of edtech solutions are emerging every day, but undoubtedly one of the most exciting technologies that has the potential to have the biggest impact on education is Artificial Intelligence (AI). As a result of the increasing sophistication of artificial intelligence techniques such as natural language processing, voice and speech recognition, and machine learning; teaching and education administration can be transformed.

The appeal of educational technology is easy to understand. Classroom teaching is an expensive process full of contradictory theories and frustratingly uneven results. Educators, inspired by the contribution of the machines to modern life, have been using technology to facilitate learning for centuries.

Artificial intelligence (AI) is a revolutionary field of computer science that seeks to create intelligent machines capable of performing tasks that normally require human intelligence and has been developing at an unprecedented pace in recent decades. It has enormous potential to transform various aspects of human society, including education ("Artificial Intelligence in Education: 18<sup>th</sup> International Conference, AIED 2017, Wuhan, China, June 28 - July 1, 2017, Proceedings" by Zhigo Gong, et al.). AI can change the way learning is done, improving and personalizing the educational process ("Artificial Intelligence in Education: Promises and Implication for Teaching and Learning" by Erik Duval, et al).

Artificial intelligence (AI) represents a technological advance with great potential for the transformation of various aspects of modern society, including education. While traditional education is based on universal standards and curricula, AI enables flexibility and change in the educational process. With the help of AI, the students can learn at their own pace and focus on areas in which they have the greatest interest and potential.

AI also contributes to the development of new educational platforms and tools. Virtual reality, present in some educational systems, enables interactive and experiential learning in real scenarios, which improves students' creativity and innovation.

## RESEARCH METHODOLOGY

Artificial intelligence (AI) is the science and technology that enables machines and computer systems to perform tasks that require forms of intelligence. The spectrum of its application is wide, from analysing data and recognizing shapes, to training autonomous vehicles and entrepreneurial tools.

AI enables the improvement of learning through personalized and individualized approaches. AI technologies can analyse data about each student and identify their strengths and weaknesses, interests and learning style. According to these analyses, AI systems can create personalized lesson plans and suggest customized learning content, which increases effective learning and motivates the student.

In addition, AI provides support to teachers in their teaching work. With automated assessment tools, AI can quickly analyse and grade large numbers of tests and assignments, freeing up teachers' time to better interact with the students and adapt the teaching methods to their needs.

Despite all its advantages, the development of AI in education is also met with challenges. Ethical issues related to the privacy and security of students' data, as well as the possibility of dependence on technology, are some of the aspects that need to be bridged.

This scientific paper involves a survey conducted among students and teachers in order to see their awareness of artificial intelligence and its application in education. The research was conducted among the students and the teachers from primary schools. 130 students aged 13 and 14 and 100 teachers from 5 schools from the Republic of North Macedonia were included.

Content analysis combined with qualitative methodology will be used as the method of this scientific paper. By applying content analysis, we will perceive and analyse students' awareness of artificial intelligence as well as its application. Data sources will be from interviews, notes from field research or conversations.

The methodological approach in research is important in terms of focus. In order to explain more reliably and capture the purpose of the research, a combined research method was used. The qualitative method was used, i.e. delivery of questionnaires to the students, followed by analysis of the questionnaires from which relevant data for this scientific paper was obtained.

The research was conducted in the period April - June. The student questionnaire contains 8 questions through which students had the opportunity to express their opinion regarding their knowledge of artificial intelligence. The questionnaire itself gave them freedom to think and express themselves, as the questions were open and no answers were offered. This allowed the students to express themselves independently about the extent to which they are familiar with artificial intelligence, where they have encountered it, and as one of the perhaps more important questions for them, whether and how they would apply it in their education.

The questionnaire designed for teachers comprised eight open-ended questions, allowing them to articulate their opinions on the application of AI in education and which digital tools or platforms they are familiar with, whether they would apply AI in their teaching practices, and whether they would like to be involved in preparation or training for the successful use of AI in education.

The purpose of this survey was to see to what extent are the knowledge and application of AI in education as well as their attitude towards AI. The obtained results will help us in the further steps towards encouraging both the teachers and the students for the correct application of digital tools or platforms in the teaching process and the mastering of teaching content among students.

## FINDINGS / RESULTS

Based on the results obtained from the students' questionnaire, we can conclude the following: A small part of the students knew what is meant by the term artificial intelligence (as a term), but about 50% of them had heard about ChatGPT, and some of them already had used the same one and it is simple, easy to use and gives relatively accurate answers. When asked if they thought that the use of artificial intelligence was useful for them, more than 65% agreed that it would be useful for them, and most of them chose the field of education (for preparing compositions for written works, answering questions for homework and fig.).

The attitude of the teachers is different than the attitude of the students. They are familiar with the artificial intelligence, but they believe that its application would be harmful to the students themselves. They believe that the application of the artificial intelligence by the students would lead them to a stage of not thinking and applying a finished product. With the very application of AI, teachers lose control in the school environment to a certain extent. They also believe that they are not familiar with enough tools through which they would direct the students to simultaneously apply AI and be able to think critically. It can be said that the lack of awareness about the application of AI is the reason for the appearance of scepticism and a negative attitude towards it. If teachers are not given enough training and resources to successfully use AI, it can lead to some frustrations and negative attitudes. If a teacher adheres to a conservative teaching style and is accustomed to traditional work methods, the very application of AI in teaching will disrupt their accustomed routine in the school environment.

In order to overcome these negative attitudes and to support the successful application of AI in teaching, it is important to provide adequate training for the teachers, to explain ethical and safety aspects, and to enable change in the education.

In order to protect the students from the negative impact of artificial intelligence, education is needed. It is important for the students to understand how these technologies work as a way to understand the opportunities, but also the limitations and risks, that artificial intelligence brings.



## DISCUSSIONS AND CONCLUSIONS

The impact of the artificial intelligence (AI) in education is significant and brings significant changes that allow it to transform and change the way it is taught, learned and communicated in schools. The evolution of AI will contribute to changing the way we are educated, and new and innovative methods will be applied in the learning process itself. The very introduction of AI technologies has introduced numerous benefits, improving the learning experience for both the students and the teachers. The artificial intelligence has the potential to improve both learning and teaching, helping the education industry while evolving to benefit both students and teachers.

As technology advances, researchers are finding new ways to use the artificial intelligence to improve the learning experience and provide the students with personalized attention and support. Although many educational experts believe that the presence of the teachers cannot be replaced by this technology, it will completely transform the way curricula are organized and implemented.

Artificial intelligence in education seeks to reduce the barrier that currently exists between the formal teaching (in class) and the autonomous and independent learning of the students. The aim is to minimize redundancy in the tasks given to young people, to promote common methodologies in building knowledge and stimulate autonomy. In the following text, we will get to know how artificial intelligence is currently used in education, as well as what are the potential benefits and challenges of this technology.

### Automation of routine tasks

As artificial intelligence is used to automate routine tasks in various industries, the same application will be found in the education sector. This technique is applied to facilitate or completely replace the performance of tasks that are uniform, routine and repetitive, often with the aim of increasing the efficiency, precision and time economy of work processes.

Instead of spending time and energy on organizational and administrative tasks, the teachers will be able to automate them (grading tests, reviewing homework, submitting documentation, compiling a student progress report, organizing teaching materials, managing and sharing teaching materials), and they will have more time and energy to focus on imparting knowledge, rather than administrative routine tasks.

### Personalized learning

Personalization is one of the most prominent educational trends. Students now have a customized way of learning programs that focus on their different experiences and interests, thanks to the artificial intelligence applications. The AI can adapt to each learner's level of expertise, learning speed and desired goals to ensure they get the most out of their learning. Furthermore, AI systems can examine students' previous educational histories, detect gaps and recommend courses more suitable for approval, enabling a highly personalized learning experience.

Artificial intelligence (AI) can ensure that educational software is personalized for individuals. There are already adaptive learning software, games and programs for students. This use of the artificial intelligence is probably one of its most significant in education.

Personalized learning is an educational approach that centres on addressing the unique needs, interests, and learning styles of each student. This methodology is based on the idea that students are not the same and that each student has a different pace of learning and understanding, as well as various ideas about teaching topics.

This system emphasizes the needs of each student, highlighting specific topics in which students are weak and repeating subjects they have not mastered. Artificial intelligence can personalize the education system by enabling the adaptation of learning materials according to the level of knowledge of each student, preparing personalized texts for each student as well as additional resources for students who want to delve deeper into a certain topic, and providing help with tailored materials for topics not well mastered.

This will create an environment where the teachers offer support and help only when students need it.

The basic goals of personalized learning include: fully meeting students' needs, improving interest and motivation, achieving better academic results, developing critical thinking and independent learning, as well as establishing positive relationships between the teachers and the students.

The benefits of personalized learning include improved academic performance, increased student engagement and motivation, and increased critical thinking and problem-solving skills. By meeting the individual strengths and needs, personalized learning can better prepare the students for future success and lifelong learning.

Nevertheless, implementing personalized learning can also present challenges, such as the need for professional development for the teachers to adapt to this approach and concerns about privacy and data security when using technology in education.

Overall, personalized learning is a learner-centered approach that aims to optimize the educational experience for each student, ensuring they receive the support, challenges and resources needed to reach their full potential.

### Flexible learning

Flexible learning refers to an educational model that allows students to have more control over the time, pace and place of their learning. This model focuses on personalized learning and adapts to the needs and preferences of the students. Flexible learning can be realized through various educational tools and technologies, including online education, hybrid learning models, e-textbooks, video lessons, and the like.

Some of the features and advantages of the flexible learning include: Individualized learning, Work on your own time, Adaptability of learning location: With flexible learning, students can study from home, from a coffee shop, at work or anywhere else where there is an internet connection, various educational materials, improvement of communication.

However, flexible learning is not without its challenges. Some of the challenges include the need for self-discipline and motivation among students, the challenges of communication in an online environment, and the need for effective educational tools and technologies.

In any case, the flexible learning has significant potential to transform the education and to facilitate the learning and the access to knowledge for students of all ages and from all parts of the world.

Benefits of the flexible learning: the flexible learning promotes greater engagement and motivation, can lead to better learning outcomes as students receive targeted support and opportunities to master concepts,. It promotes lifelong learning, reduces achievement gaps, increases student satisfaction.

### Updated learning content

With the introduction of the artificial intelligence, curricula will no longer have fixed content throughout the school year. Learning content will be able to be regularly updated with the help of artificial intelligence. In this manner, the teachers will be sure that all the information they share with the students is current and verified. Artificial intelligence can help the teachers to create smart content so as to make teaching and learning more engaging for students.

Updated or adapted learning content is a modified and improved version of existing material used in the educational process. New information, methods, and techniques that are significant for the students are included here. The application of this type of content is that they allow a better understanding and acquisition of the material, as well as being in line with the modern scientific discoveries, this content is available in teaching through textbooks, online courses or other types of resources. The adaptation of the contents can be made possible through different learning formats, visual illustrations, various levels of difficulty of the teaching content itself depending on the student's capabilities, the individualization of the content for each student depending on their interest, etc.

### 24/7 study help

One of the new sensations in the artificial intelligence is the increasing use of chatbots (software applications that can automatically conduct conversations and communications with people via text messages).

Traditionally, students get solutions to their problems only when they meet their teachers or professors and have a chance to ask them questions in the classroom. Fortunately, this problem is solved by chatbots that are available to help the students at any time of the day.

24/7 learning support is a resource or system that allows students to receive learning support and information at any time, regardless of days and hours. This concept of constant availability of educational resources and assistance is made possible thanks to modern technologies, especially the Internet and artificial intelligence.

Some chatbots are specifically built for the education sector. They work as student assistants around the clock to provide answers to their questions at any time.

The artificial intelligence has negative impacts and challenges related to its implementation in education and also in society in general. The increased use of AI can lead to a decrease in teacher-student interaction, as well as between students themselves. This interaction is of particular importance for the development of emotional and social development.

Relying heavily on the artificial intelligence for teaching and learning can lead to a situation where the students become dependent on technology, reducing critical thinking and problem-solving skills.

While AI can improve education, it can lead to a shift away from traditional teaching methods that have proven effective over time, potentially excluding the students who benefit from these methods. In some cases, AI can replace the traditional skills like reading, writing and critical thinking. This can lead to the loss of important aspects of education. AI-driven assessments may not accurately measure all aspects of a student's knowledge, skills, and abilities. They may struggle to assess qualities such as creativity and critical thinking.

Dependence on the technology can result in technical problems or outages. For example, if the AI system crashes, the students may be left without access to the course content. Not all students have the same technical equipment and internet access. This can cause an imbalance among the students and widen the gap between the rich and the poor.

AI systems can dictate learning paths and outcomes for students, limiting their autonomy to explore and learn at their own pace. AI may collect and analyse students' personal information. This can create a risk of compromising data privacy and security. AI can contribute to bias and discrimination if algorithms are trained on invalid or incorrect data. This can affect students' grades, learning decisions and career opportunities.

The even bigger fear lies in the level of information that the artificial intelligence will use as a means to develop to an advanced level. The one who controls the information and data – they will also control the artificial intelligence, and this can lead to unauthorized use of information for improper purposes.

To mitigate these negative impacts, it is important that educators, policy makers, and developers implement AI in a thoughtful and responsible manner. This includes addressing privacy concerns, ensuring equity of access, regularly evaluating the quality and effectiveness of AI tools, and providing adequate training to the learners for effective integration.

AI is a growing trend in education that promises an exciting future for us all. Of course, we need to figure out how to navigate the potential challenges, but the benefits of using AI in the classroom are undeniable. Looking ahead, we see it as the next frontier of learning that will strengthen education and drive its progress.

There are a number of AI tools available to the teachers who want to use AI to enhance the student learning. Examples of tools that can be used in the classroom in STEM (science, technology, engineering and mathematics) subjects include PhotoMath, a free app for teaching mathematics with the help of the artificial intelligence, and Seek by iNaturalist, an app that helps identify species through photography. Language classes can use Verse by Verse, which allows the students to write poems with

the help of the artificial intelligence and to learn about American poets, and Duolingo, for learning foreign languages. Social studies classes and art classes can use Newspaper Navigator, a search tool for millions of historical newspaper photos, as well as MuseNet, for music research and creation. Tools like Socratic and Brainly can be used across all subjects.

## CONCLUSION

Artificial intelligence (AI) has the potential to transform the world, but it also has the potential to cause significant harm to society. As artificial intelligence becomes more integrated into our lives, it is important to consider the negative effects it can have, such as job loss, bias and discrimination, privacy concerns, and lack of accountability. By understanding these potential negative effects, we can take steps to mitigate them and ensure the benefits of AI are enjoyed by all members of society.

But according to experts, it is not just about understanding artificial intelligence. An important feature is learning how to deal with it. This includes developing skills such as critical thinking and creativity, which could complement artificial intelligence.

The fact is that artificial intelligence is part of our lives. It has become an inevitable part of most industries and it is only a matter of time before it is implemented in every aspect of our daily lives. We need to teach children never to rely too much on artificial intelligence in their decision-making. Understanding artificial intelligence will become increasingly important in the process of forming responsible, educated citizens, with the ability to make decisions and advocate for themselves in an increasingly automated world.

Children and young people need to understand that artificial intelligence has limitations and can make mistakes. It can be biased and even prejudiced. That is why it is important to teach children to think critically and decide how and how much they can rely on artificial intelligence. It is the only way to take advantage of the technological advances in today's world without succumbing to its downsides.

AI has the potential to transform education and improve learning and teaching. The application of AI in education requires advancement in technology and education as a whole, but with proper management and attention to ethical and social aspects, we can create a more beautiful and better education for future generations.

The application of artificial intelligence (AI) in education represents a significant opportunity to refine and improve the learning experience. Artificial intelligence offers the potential to personalize education, adapt to the individual needs of the students, and provide innovative teaching methodologies. AI offers a lot of opportunities for individualized and customized learning, which can bring significant advantages for students and teachers. Its data analysis capabilities can help identify learning patterns, allowing teachers to adjust their approach and effectively support each student's progress. It allows the students to learn according to their abilities so that each student will progress according to his abilities.

So as to be able to apply artificial intelligence properly, it is necessary to perceive all the advantages and challenges. We should always know that it should not be a substitute for teaching methods, but rather a complement to traditional teaching methods in order to ensure quality teaching for students. Thus, quality teaching will be ensured for the students and the learning and achievements of each student will be improved. As AI is increasingly incorporated into the educational process in schools, it creates a flexible learning environment, allowing access to education beyond any physical limitation.

By simply using the resources offered on online platforms, it is possible for them to make education accessible to all students. But the integration of AI in education requires careful consideration of all challenges. The combination of AI with traditional learning methods is of great importance to preserve human interaction and holistic educational values. However, let's not forget that the potential of AI to change the educational system is huge. Its ability to adapt, analyze and personalize the learning experience will enable a more efficient and engaging education.

The application of AI in education requires advancement in technology and education as a whole, and with proper management and attention to ethical and social aspects, we can create a more beautiful and better education for future generations.

## REFERENCES

1. "Artificial Intelligence in Education: Promises and Implications for Teaching and Learning" edited by David Lynch, Council of Europe, November 2022
2. 23 Advantages and Disadvantages of Technology - John Stephens, January 2021, <https://mk.warbletoncouncil.org/ventajas-desventajas-tecnologia-2854#menu-2>
3. The power of artificial intelligence fascinates, but also frightens - Mirjana Joveska, February, 2023, <https://mk.bloombergadria.com/tehnologija/inovacii/21186/mokjta-na-vestackata-inteligencija-voodusevuva-no-i-zaplasuva/news>
4. Why we need the psychology of artificial intelligence - Vladimir Davchev, Skopje, 2019, [http://periodica.fzf.ukim.edu.mk/psnp/psnp5\(2019\)/PsNP05-06.04%20Davchev,%20V.pdf](http://periodica.fzf.ukim.edu.mk/psnp/psnp5(2019)/PsNP05-06.04%20Davchev,%20V.pdf)
5. What awaits us in the era of artificial intelligence with ChatGPT? – January, 2023 <https://faktor.mk/shto-ne-ochekuva-vo-erata-na-veshtackata-inteligencija-so-chatgpt>
6. Artificial Intelligence: A Modern Tool of the Digital Age for the Development of Societies and Civilization – June, 2022 <https://meta.mk/veshtacka-inteligencija-moderna-alatka-na-digitalnoto-vreme-za-razvoj-na-opshtestvata-i-civilizacijata/>
7. Intelligent Tutoring Systems: How AI Can Improve Student Learning - Adrien Beaulieu, 2023 <https://product.house/intelligent-tutoring-systems-how-ai-can-improve-student-learning/>

8. Teaching Machines: Learning from the Intersection of Education and Technology (Tech.edu: A Hopkins Series on Education and Technology) Illustrated Edition - Bill Ferster  
<https://www.amazon.com/Teaching-Machines-Intersection-Education-Technology/dp/1421415402>
9. Artificial Intelligence, Global Edition, A Modern Approach - Stuart Russell , Peter Norvig, 2021  
<https://elibrary.pearson.de/book/99.150005/9781292401171#item-1>
10. What is artificial intelligence?  
<https://bs.eyewated.com/sta-je-vestacka-inteligencija/>
11. Artificial intelligence – the way to the future  
<https://semosedu.com.mk/%D0%9F%D0%BE%D1%87%D0%B5%D1%82%D0%BD%D0%B0/%D0%97%D0%B0%D0%BD%D0%B0%D1%81/%D0%91%D0%BB%D0%BE%D0%B3/TECHTalks/%D0%92%D0%B5%D1%88%D1%82%D0%B0%D1%87%D0%BA%D0%B0%D0%B8%D0%BD%D1%82%D0%B5%D0%BB%D0%B8%D0%B3%D0%B5%D0%BD%D1%86%D0%B8%D1%98%D0%B0.aspx>
12. Artificial Intelligence and Developing Countries – March, 2023  
<https://novamakedonija.com.mk/mislenja/kolumni/veshtachkata-inteligencija-i-zemjite-vo-razvoj/>
13. Artificial Intelligence - Wikipedia  
<https://mk.wikipedia.org/wiki/%D0%92%D0%B5%D1%88%D1%82%D0%B0%D1%87%D0%BA%D0%B0%D0%B8%D0%BD%D1%82%D0%B5%D0%BB%D0%B8%D0%B3%D0%B5%D0%BD%D1%86%D0%B8%D1%98%D0%B0>
14. How Technology Is Transforming The Education Sector – August, 2023  
<https://www.outlookindia.com/website/story/feature-how-technology-is-transforming-the-education-sector/396082>
15. The Role of Artificial Intelligence in Shaping the Future of Education: The Potential and Challenges of a New Era of Learning – March. 2023  
<https://www.alltechbuzz.net/mk/the-role-of-ai-in-shaping-the-future-of-education-the-potential-and-challenges-of-the-new-learning-era/>
16. 5 Ways Artificial Intelligence Can Improve Education – February, 2022  
<https://inovativnost.mk/2022/02/18/5-%D0%BD%D0%B0%D1%87%D0%B8%D0%BD%D0%B8-%D0%BA%D0%B0%D0%BA%D0%BE-%D0%B2%D0%B5%D1%88%D1%82%D0%B0%D1%87%D0%BA%D0%B0%D1%82%D0%B0-%D0%B8%D0%BD%D1%82%D0%B5%D0%BB%D0%B8%D0%B3%D0%B5%D0%BD%D1%86%D0%B8%D1%98/>
17. Artificial intelligence of great benefit to students - Dorina Stefanovska, March, 2022  
<https://goce.mk/veshtachkata-inteligencija%D1%98a-od-golema-korist-za-studentite/>

## APPENDICES

### Annex 1

#### Questionnaire for students

1. How familiar are you with the term “artificial intelligence” (AI)?
2. Can you give a brief explanation of what artificial intelligence is?
3. What areas or applications do you think artificial intelligence is being used in?
4. Do you know of any examples of artificial intelligence in everyday life?
5. Have you had the opportunity to use applications or tools that use artificial intelligence in your studying?
6. Do you think that the artificial intelligence can help students improve their academic performance?
7. Have you talked to the teachers about the use of the artificial intelligence in learning?
8. Do you want to learn more about the artificial intelligence and its application in education?

### Annex 2

#### Questionnaire for teachers

1. What is your general idea of what artificial intelligence is?
2. What ways do you think AI can be used in education in?
3. Have you had the opportunity to use tools or resources that include the artificial intelligence in your teaching process?
4. Do you have knowledge about different platforms or applications that are based on AI and what are their capabilities?
5. How do you think AI can impact student success and your teaching practice?
6. Have you become familiar with some of the advantages or risks of using AI in education?
7. Do you think that the educational institutions should integrate AI tools and technologies in the educational process?
8. Would you be interested in participating in preparation or training for the successful use of AI in your teaching context?



**AUTHOR:**



**MAJA MITEVSKA – POCEVA**

Maja Mitevska – Poceva is a class teacher at “Brakja Miladinovci” OU in Probishtip, North Macedonia. She worked for two years on the UNICEF project for the education of mothers from rural areas and was a coordinator and trainer of large projects, such as language literacy in primary classes, inter-ethnic integration, media literacy, etc. In 2018/2019, she was chosen as the best teacher of the year.