Original scientific paper

UDC: 37.091.39:004.8

Received: April 14, 2024.
Revised: August 02, 2024.
Accepted: August 10, 2024.

10.23947/2334-8496-2024-12-2-259-272

Check for updates

The Application of Artificial Intelligence in Education – The Current State and Trends

Vladimir Milicević[1*] , *Limonka Koceva Lazarova*[2] , *Miroslava Jordović Pavlović*[1]

[1] The Faculty of Mechanical and Civil Engineering in Kraljevo of the University of Kragujevac, e-mail: milicevic.v@mfkv.kg.ac.rs, jordovicpavlovic.m@mfkv.kg.ac.rs
[2] Goce Delchev University Stip, e-mail: limonka.lazarova@ugd.edu.mk

Abstract: The aim of this paper is to discuss the application of contemporary AI tools and technologies in education. The paper will mainly focus on a close examination of relevant academic literature as well as the current situation and methods of AI implementation in different sectors, finally, in education. Particularly, it was crucial that there were identified the major directions of applying AI in learning with an emphasis on learners and educators being the basic aspects of AI use within modern educational approaches. Secondly, some benefits and drawbacks concerning AI implementations in education supported by experiences from industry leaders and specific satisfaction measures among existing users, are analyzed. The most significant part covers integrating findings that show facts about artificial intelligence being used in education for 2024 like top online learning statistics for 2024, top AI statistics for 2024, and best AI plagiarism checkers for teachers in 2024 respectively. This includes evaluating teacher or instructor preparation skills to employ artificial intelligence (AI) tools and technology as well as ways students can learn how to use them without misuse towards quality education improvement.

Keywords: *artificial intelligence, education, machine learning, personalized learning, adaptive learning*

Introduction

Artificial intelligence (AI) could be defined as a task executed by a program or a machine where otherwise human intelligence is required (Harkut and Kasat, 2019). For learning – concrete facts and knowledge on how the facts are to be used; reasoning, which defines business rules that come close to or equal to definite conclusions; self-adjustment. AI can be thought of as encompassing a multitude of processes and tools such as machine learning, natural language processing, computer vision, robotics, etc.

Simplifying, achieving AI can be defined as copying or mimicking human intelligence, solving complex problems, constructing machines, that can work, that need human intelligence to do it, and creating some system that can learn independently are some of the specific objectives of AI (Ghosh and Thirugnanam, 2021). Some of authors affirm that AI can be employed for very crucial activities including the diagnosis of diseases, treatment recommendations, discovery of drugs, patients' supervision, and healthcare systems (Tajidini and Kheiri, 2022). The application areas of AI include finance fraud, credit risk, algorithmic trading, intelligent customer service, digital financial advisory services as well. The authors pointed out that AI has been developing very fast and is implemented in various industries and processes, financial activity included (Bahoo et al., 2024).

As the amount of research on artificial intelligence (AI) in the educational process rises the authors pointed out that the role of teachers, schools, and education leadership will be different (Gocen and Aydemir, 2020). AI is used for demand forecasting, segmentation of customers, recommendation systems, inventory management, and chatbots for customer service. The authors have stated that different types of retailers can practically implement various AI applications in their organizations and respective undertakings (Jayakrishnan, 2022). AI can be used in L4 or L5 self-driving cars soon, for navigation, traffic

*Corresponding author: milicevic.v@mfkv.kg.ac.rs

control, prognosis, and planning tasks of route optimization. Also, these technologies can help to control the growth of large cities, enhance the economy, cut down energy consumption as well as increase the living conditions of the inhabitants (Bharadiya, 2023). AI and ML can greatly enhance manufacturing efficacy and efficiency, production rates, and sustainability within the near future that is acknowledged by the authors (Plathottam et al., 2023). Towards the near future of the next five to ten years Marketing AI has the possibility to become a very fast-growing field of study, as noted by Asi et al., (2023). Smart virtual assistants and chatbots will define the trends in the so-called customer-oriented companies of the post-COVID epoch. They are applied for commanding customer relations, offers, support issues, and operational processes (De Andrade and Tumelero, 2022). The uses of AI in security include threat identification, outliers, malwares, and security breaches. Thus, it can be concluded that some cybersecurity challenges could only be solved effectively if AI solutions were implemented (Das and Sandhane, 2021). It is and will be commonly applied in language translation, sentiment, and text analysis, speech recognition, and virtual assistance (Mah, 2022). E-government services in education were recognized by the authors too (Spalević, et al., 2023).

These are just some of the examples, but the uses of AI expand with development of the technology.

Thus, the objective of the paper is to substantiate the importance of using AI in the learning process and at the same time to outline possible weaknesses when depending solely on information and conclusions derived from the AI.

The use of artificial intelligence in the learning process can change the traditional learning process for students and the manner of teaching among teachers. Here is some keyways AI is being applied in education:

1. Personalized Learning: Personalization is based on AI techniques in which with the help of analysis of the level of understanding of the learner and preferred modes of learning, suitable contents for each learner are identified (Murtaza et. al 2022). AI will be able to understand the characteristics of each student: learning style, preferences, as well as peculiarities of knowledge acquisition, because of that AI will be able to provide suitable educational material and educational experience for every student. This kind of setting can aid the learning process of the students depending on their capabilities and techniques to achieve enhanced learning and knowledge acquisition.
2. Intelligent Tutoring Systems: Steenbergen-Hu and Cooper (2014) noted that use of AI and IT systems in sustainable education has a bearing on the outcome that makes it possible to present students with special learning styles that suit them. Tutoring systems that incorporate the use of artificial intelligence can offer students a certain level of friendly helpfulness that is comparable to the help of a tutor. These systems allow for monitoring students' progress, the detection of skills need for reinforcement, and the provision of information and support for the weak areas (Lin et al., 2023).
3. Automated Grading and Assessment: Different methods and approaches have been implemented in various studies for formative and summative assessments in the corresponding educational centers today (Aldriye et al., 2019). Teachers can employ the help of AI to mark assignments, quizzes and tests in the shortest time and with the highest efficiency. It thus relieves teachers from some of the routine grading work which in turn gives them more time to devote their attention to more substantive feedback on students' work.
4. Virtual Classrooms and Remote Learning: We are in an era of a highly digital knowledge-based economy and artificial intelligence (AI), that is, machine learning (ML), deep learning (DL) technologies are present in all aspects of people's lives, including learning. (Dogan et al., 2023). Machine learning, natural language processing, and many more technologies create and deliver virtual classes and online learning systems for distance education. Many of these platforms can have tools like videos with lectures and instructions, interactive simulations, as well as collaboration tools to improve the learning process for the students irrespective of their geographical location.
5. Data Analysis and Insights: The objective of big data using AI is to minimize the time and make it more effective and efficient in analyzing the data to provide values for the organizations and give edge over competitors (Gandomi et al., 2023). This system can also evaluate educational data, which comprises students' accomplishment, attendance, and learning results, and employ AI to discover trends. These findings can assist educators in making decisions that will benefit the student such as change of method of teaching, content that is taught and so on.

6. Natural Language Processing (NLP): Natural language processing or NLP is an actual branch of artificial intelligence which deals with natural language processing and computer interpretation. (Sodhar et al., 2020). AI facilities powered by NLP can be helpful to the students in learning languages, reading and writing skills where the students are given real-time feedback on grammatical errors and syntax and the usage of vocabulary. These tools can also enhance the means of communication between a student and a teacher, or a student with an electronic system through voice identification and chat boxes.
7. Adaptive Learning Platforms: There is a huge contribution of AI/ML in enhancing the e-learning platforms for personalization and making the educational process more effective. (GGligorea et al., 2023). Hybrid, intelligent space that enables learning can shift the content's difficulty and rate of delivery according to the learners' level of mastery as well as achievements. This means students are always being stretched appropriately, and the risk of apathy setting in due to the content's difficulty is eliminated.
8. Predictive Analytics for Student Success: In many higher education settings, there is emerging interest in implementing ways of developing models of prediction of course/program failure using the data sources that are available. (Cui et al., 2019). From such characteristics like academic achievement records, absenteeism or even active participation, it is possible for AI algorithms to determine the students' chances of success or their chances of dropping out (Jordovic Pavlovic et al., 2017). If such predictions are made early enough, educators will have an easy time supporting these learners to ensure that they do not drop out within the first few years of schooling.

Overall, it can be stated that education is one of the fields where AI implementation has a possibility to create more interesting, productive, and convenient learning processes for learners of different ages and with different learning background. However, it is crucial to check that these technologies will be ethical to implement and to use in the process of learning to support the teacher instead of replacing his authority and position. The following image illustrates the roles that AI should perform due to the intensification of its application in the education process.

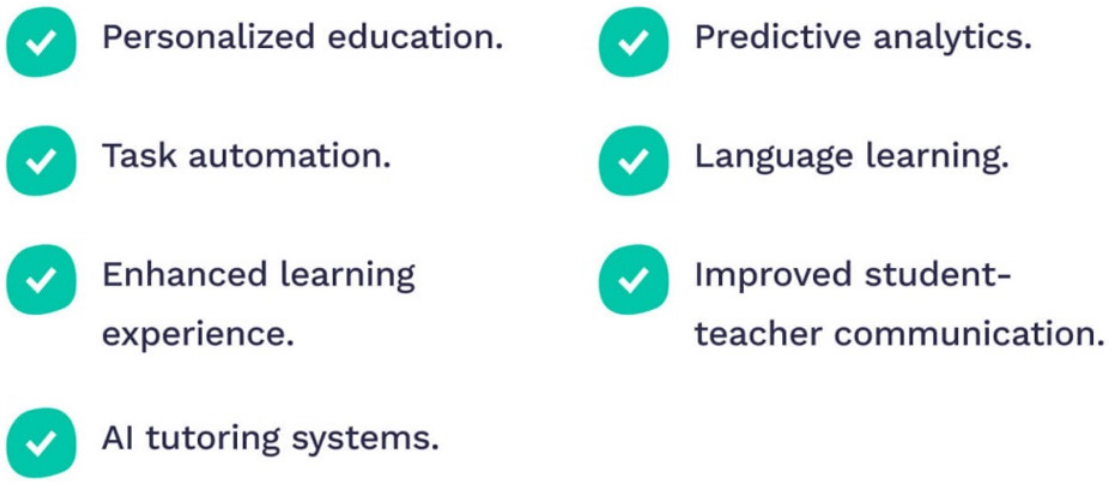

Figure 1. AI tasks in the education process, (https://studycorgi.com/blog/can-ai-change-the-way-we-study-in-the-near-future/, 2023)

As the main motivation, this study shall address four main research questions:

1. What are the key directions of AI applications in the educational process?
2. What are the benefits and drawbacks of AI applications in the educational process?
3. What is the state of AI in education facts in 2024?
4. To what extent can existing AI detectors such as Winston AI successfully detect AI-generated content for essays and projects?

Review Strategy and Design

1) Materials and Methods

The paper addresses the impact of AI on education. A retrospective analysis of data and previous research or studies on the mentioned topic was conducted. A qualitative research approach was chosen to provide in-depth insights and a nuanced understanding of the subject. This approach involved combining quality content analysis and thematic analysis while considering various methodologies to ensure a robust examination of the available literature.

2) Search Strategy

To identify relevant literature, a systematic search strategy was employed. Keywords and search strings were crafted to capture the broad spectrum of AI's impact on education. Databases such as Web of Science and Google Scholar were utilized to perform extensive searches. This approach ensured the inclusion of a wide range of articles from various reputable journals, thus enhancing the comprehensiveness of the review.

The keywords and search strings used included terms like "AI in education," "artificial intelligence and learning," "impact of AI on teaching," and "educational technology." Boolean operators were employed to refine the search results further, ensuring that the selected articles were highly relevant to the research questions.

3) Sampling: Exclusion and Inclusion Criteria

An initial pool of 250 articles published after 2017 was selected based on defined criteria. These criteria included matching search keywords, relevant search strings, and inclusion in peer-reviewed journals. This initial selection aimed to capture a broad range of studies to ensure a comprehensive review.

Each article underwent a thorough review and further analysis to identify those that specifically focused on the nature of AI and its impact on education. Articles were evaluated for their methodological rigor, relevance to the research questions, and contribution to the field. Additionally, the H-Index of the journals in which the articles were published was considered to ensure the selection of high-impact studies.

Thus, the selection was narrowed to thirty articles. This sample size was deemed sufficient to draw well-founded conclusions and inferences about the impact of AI on education from a retrospective perspective. The selected articles provided a balanced mix of theoretical insights, empirical findings, and case studies, thus enriching the overall analysis.

The implementation of artificial intelligence in education

In addition, it is equally important to analyze available information concerning the implementation of artificial intelligence in education derived from various sources and for various purposes.

Personalized learning is generally defined as the process of placing a client centered approach to education that addresses individualization of learning intervention for each learner (Tehseen, 2023). Numerous ways exist in which artificial intelligence techniques can enhance personalized learning:

- adaptive learning;
- interactive experience;
- data analysis and predictive analytics.

As classic examples of artificial intelligence applications for personalized learning, Khan Academy and Duolingo are often mentioned.

As for the Internet resources, Khan Academy is an innovative project which offers free courses in shape of the lessons, exercises, and tests on the given themes and subjects including, but not limited to, mathematics, sciences, history, and art, etc. Artificial intelligence helps Khan Academy in identification of the outcomes, the results of the corresponding exercises and tests, and other input data of the users, to offer program suggestions that may be of interest to the user's abilities and preferences.

Duolingo is an application for learning foreign languages which uses artificial intelligence for giving additional settings in learning according to the level of various users, their results of tests, and their preferences. The responses given by the users to the exercises given are measured and coped with algorithms that measure the levels of knowledge and determine the next lessons and exercises that will be more touching on the topic at hand.

The benefits that companies achieve using artificial intelligence tools and techniques are significant. These examples demonstrate how artificial intelligence can be integrated into educational platforms to provide personalized learning tailored to the needs and learning styles of everyone.

At the time of writing this, Duolingo is the second largest company with fewer than 1,000 employees and 21 million daily active users (blog.duolingo.com, 2024). It covers more than 100 courses in more than 40 different languages (www.washingtonpost.com/ 2024). This is the main reason why we must categorically aim to provide unstoppable educational resources that are high in quality and affordable to the resources allowances in order to gain the best education and make it every-where distributed rationale out. Duolingo asserts: „AI is not to replace the work of human experts but to assist us. It is our tool to boost productivity and efficiency, so we can generate more content and enhance the experience of our course in a shorter period " (www.washingtonpost.com/ 2024)).

AI intelligent tutoring systems are educational systems that are computer-based and apply AI in such a way as to simulate a human who is teaching without a teacher. AutoTutor, invented at the University of Memphis, generates tricky problems and helps students come up with solutions through an interactive dialogue with the computer (crowdmark.com, 2024). This tool is mostly used for math and science, although the focus of computer literacy was there from the beginning. AutoTutor can keep track of the student's mental processes and emotions and to give feedback that helps the student to adapt to a better way (www.memphis.edu, 2024).

Technology enhancements in the education sector benefit teachers in their teaching role as they can dedicate more time to planning lesson activities and giving individual feedback to students. Some efficient representatives for the Automatic Grading and Assessment category are:

- Gradescope;
- Canvas;
- Chat GPT;
- Quizgecko;
- Zipgrade;
- Quizizz, etc.

Automated grading, assessment efficiency, and time savings are obvious.

The trend of this digital environment will continue to grow across various industries. At present, the indication of students' acceptance and use of these schools is more in focus. Here are some online classrooms, which received a lot of positive reviews from the students of the future and their parents. The following list of examples includes (livestorm.co, 2024):

- Livestorm;
- Wooclap;
- Kahoot;
- Google Clasroom;
- Docebo Learn;
- Moodle;
- Adobe Captivate, etc.

With the help of artificial intelligence, it is possible to obtain very precise and useful analytical data that can subsequently be used to improve the education process, provide better access to students, and ensure careful preparation of teaching materials. The most important analytics are:

1. Online learner proficiency;
2. Student satisfaction rating;
3. Course engagement;
4. Learn progress;
5. Session times.

In order to implement the aforementioned, it is necessary to emphasize the use of adaptive learning platforms. Here are seven of the best adaptive learning platforms (whatfix.com, 2024.):

- Whatfix - user rating 4.6 / 5;

- EdApp - user rating 4.7 / 5;
- 360Learning - user rating 4.6 / 5;
- Adaptemy - user rating N.A;
- Knewton - user rating 4.6 / 5;
- Realizeit - user rating N.A;
- Pearson Interactive Labs - user rating N.A.

Numerous significant sources, including Devlin Pack, provide detailed data on the impact of artificial intelligence in the field of education. Online learning has exploded in popularity. It can be done anywhere, at any time, and, most importantly, is just as effective as in-person learning (devlinpeck.com, 2024).

Devlin Pack cites significant data encouraging the intensive application of tools and concepts in the field of contemporary education (devlinpeck.com, 2024), Table 1:

Matleena Salminen, from hostinger.com, discussed the importance of artificial intelligence soon, including its impact on the education process (hostinger.com, 2024), as shown in Table 2.

Table 1. *The top online learning statistics in 2024, (*https://www.devlinpeck.com/content/online-learning-statistics*, 2024)*

The Top Online Learning Statistics in 2024	
1.	Worldwide, 49% of students have completed some sort of online learning
2.	70% of students say online learning is better than traditional classroom learning
3.	The number of online learning users is expected to increase to 57 million by 2027
4.	80% of businesses now offer online learning or training solutions
5.	63% of students in the US engage in online learning activities daily
6.	Online learning can increase student and employee retention to as much as 50%
7.	Online learning can reduce the time needed to learn a subject by 40% to 60%
8.	The online learning industry is projected to be worth more than $370 billion by 2026
9.	Online learning and training can improve employee performance by 15% to 25%

Table 2. *The importance of artificial intelligence in the near future, (*https://www.hostinger.com/tutorials/ai-statistics*, 2024)*

The Top Artificial Intelligence Statistics in 2024	
1.	The Global AI Market Size Is Expected to Grow 37% Every Year From 2023 to 2030
2.	Over 40% Of Business Leaders Report Increased Productivity Through AI Automation
3.	Artificial Intelligence Is Expected to Create 133 Million New Jobs by 2030
4.	AI Will Contribute Over $15 Trillion to the Global Economy by 2030
5.	Interest in AI Website Builders Has Grown 50% in Previous 12 Months
6.	25% Of Companies Have Adopted AI to Address Labor Shortages
7.	33% Of All AI Adoption Cases Focus on the Automation of IT Processes
8.	AI Startup Funding Has Increased on Average by 66% Between 2021 and 2023
9.	The Artificial Intelligence Industry Is Expected to Be Worth $190 Billion by 2030
10.	Increased AI Adoption and Digital Access Will Drive Job Growth in Over 50% Of Surveyed Businesses
11.	50% of Surveyed Companies Plan to Invest in On-The-Job and Internal Training Departments Related to AI Adoption

Further, in educational environments, AI chatbots are acknowledged for serving various functions, which can be grouped into four categories: teaching agents, collaborative agents, learnable agents, and peer agents, each exhibiting varying degrees of efficacy (Kuhail et al., 2023). Numerous studies indicate that AI chatbots motivate students and help in their dedicated engagement by providing quick assistance, especially in online environments. Besides the mentioned benefits in learning, this can also lead to unintended consequences in the educational process:

- Using AI to write seminars, essays, or projects;
- Cheating;
- Misinformation.

Detection of AI-generated content

In the absence of adopted standards and principles by universities and faculties, teachers can address this issue by suggesting (rather than banning) appropriate AI tools available to students and by using suitable tools for detecting cheating. Here is the short list of 5 best AI plagiarism checkers for teachers (www.classpoint.io, 2024), Table 3.

Based on the table, it can be concluded that the proposed tools have satisfactory accuracy, allowing teachers to rely on them to detect the undesired consequences of AI applications in the educational process. The AI tool Detector Pro currently provides slightly poorer results, but it is in a phase of intensive development and improvement (www.scribbr.com,2024). Winston AI scores were obtained by running a dataset of 10,000 texts provided above through a proprietary AI detection model (gowinston.ai, 2024).

Table 3. *The best Ai plagiarism checkers for teachers in 2024, (*https://www.classpoint.io/blog/best-free-ai-detectors-for-teachers*, 2024)*

The best Ai plagiarism checkers for teachers in 2024		
No.	**AI tool**	**Accuracy**
1.	**Copyleaks**	99.12 %
2.	**GPTKit**	98%
3.	**GPTZero**	99%
4.	**AI Detector Pro**	60 - 84%
5.	**Winston AI**	99.98%

The impact of ChatGPT on modern education (Singh Gill et al., 2024) and the development of ethical standards for chatbots in educational settings (Cotton et al., 2024; Tayan et al., 2023) are currently being actively discussed. Each new technological breakthrough compels us to rethink the limits of educational possibilities. ChatGPT marks the latest achievement in this ongoing evolution, but it is far from the final one. The potential implications, possibilities, and concerns about the use of ChatGPT in education are discussed in numerous scientific papers (Ipek et al., 2023; Karakose et al., 2023; Athanassopoulos et al., 2023).

In the context of this discussion and for the purpose of the overall project, the following research question was posed: to what extent can existing AI detectors such as Winston AI successfully detect AI-generated content for essays and projects?

Computer science students who are proficient in AI tools participated in our experiment. Essay assignments were distributed to the students, and they were instructed on how they could use AI tools in completing their tasks. Some of them used ChatGPT to a greater or lesser extent, while others had to rely on their own abilities. The following are the settings of our experiment:

- 60 students from two different faculties, participated,
- 20 students were not allowed to use artificial intelligence for creating the essay content
- 20 students were allowed to use artificial intelligence to create an Introduction section
- 20 students are allowed to use artificial intelligence to create the entire content of the essay.

All students submitted their assignments on time and indicated the extent to which they used ChatGPT for creating the essay content:

- 0%,
- less than 50%,
- more than 50%.

Winston AI was chosen to check the extent of ChatGPT usage in students' essay preparation. The verification was conducted in the following manner:

1. First, students who claimed they did not use ChatGPT at all for essay preparation were checked.
2. Afterward, students who claimed to have partially used ChatGPT were checked. The verification was conducted in two ways: checking the Introduction text and checking the entire document text.

3. Finally, the essays of students who claimed to have fully used ChatGPT for essay creation were verified.

Winston AI is very easy to use and intuitive, both for checking text and for importing entire documents (Figures 3 and 4, respectively).

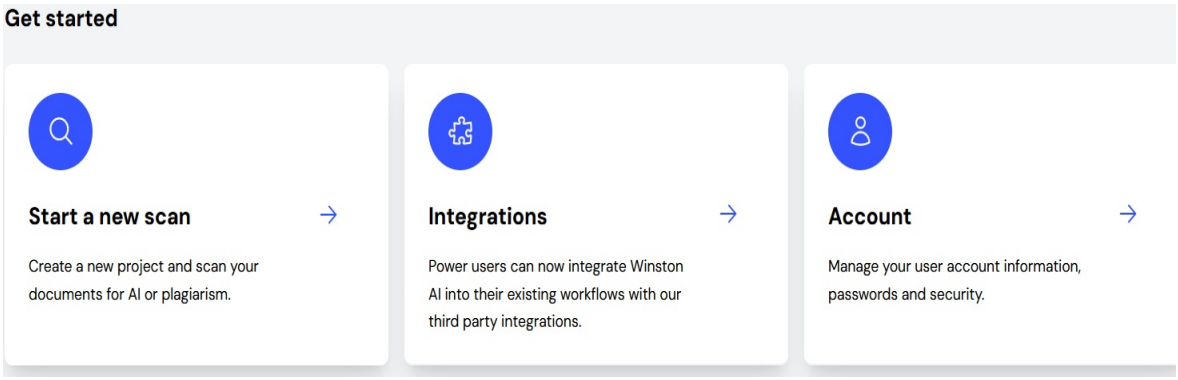

Figure 2. Winston AI, starting a new scan (source: authors)

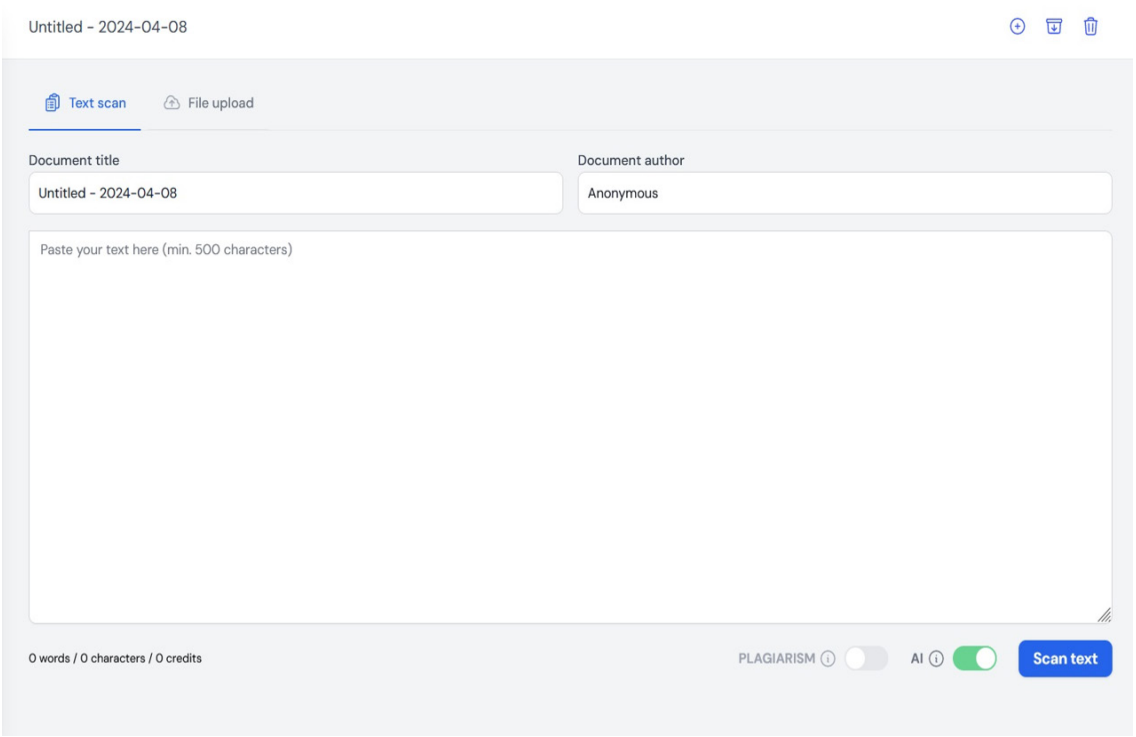

Figure 3. Winston AI, paste the text for the new scan (source: authors)

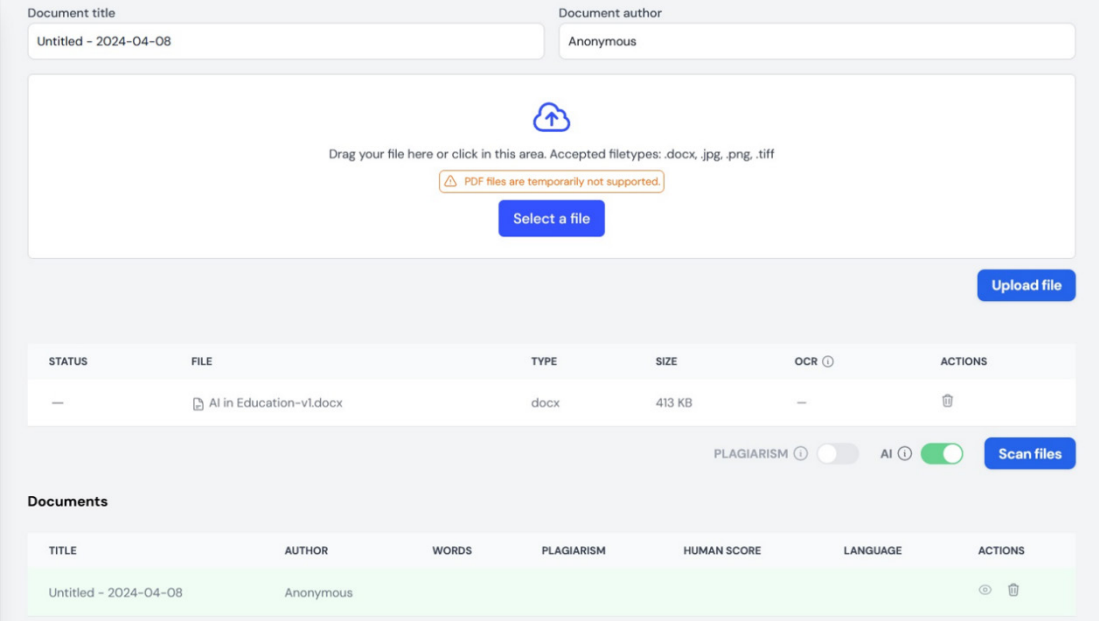

Figure 4. Winston AI, import the text document for the new scan (source: authors)

In the initial phase, essays from students who reliably did not use AI for their creation were reviewed. Winston AI effectively completed the task, confirming that tools like ChatGPT were not utilized in the essay preparation (Figure 5).

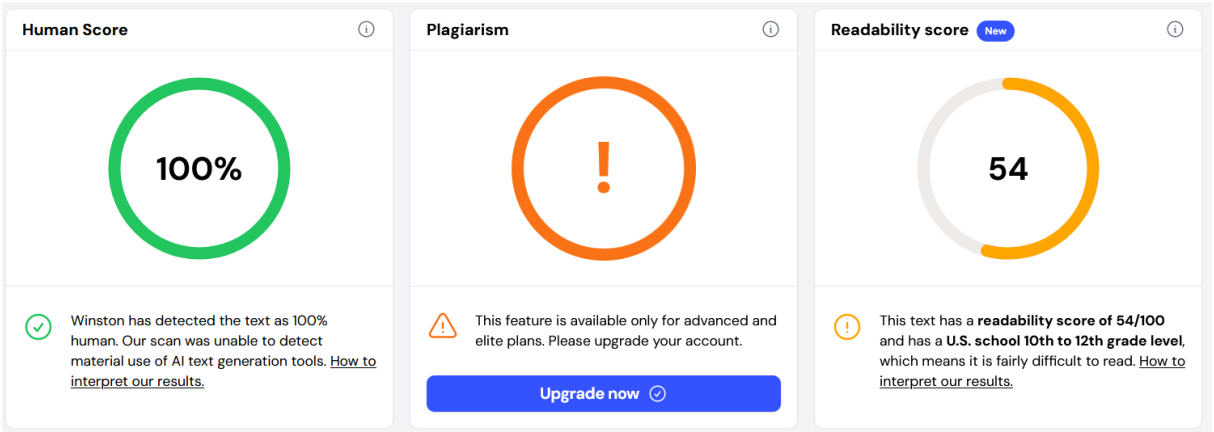

Figure 5. Winston AI, Report 1 (source: authors)

In the second step, essays from students who were limited to using ChatGPT only for the introduction were reviewed. In this case, as well, Winston AI provided the expected results. One of the relevant examples is shown in the following figure.

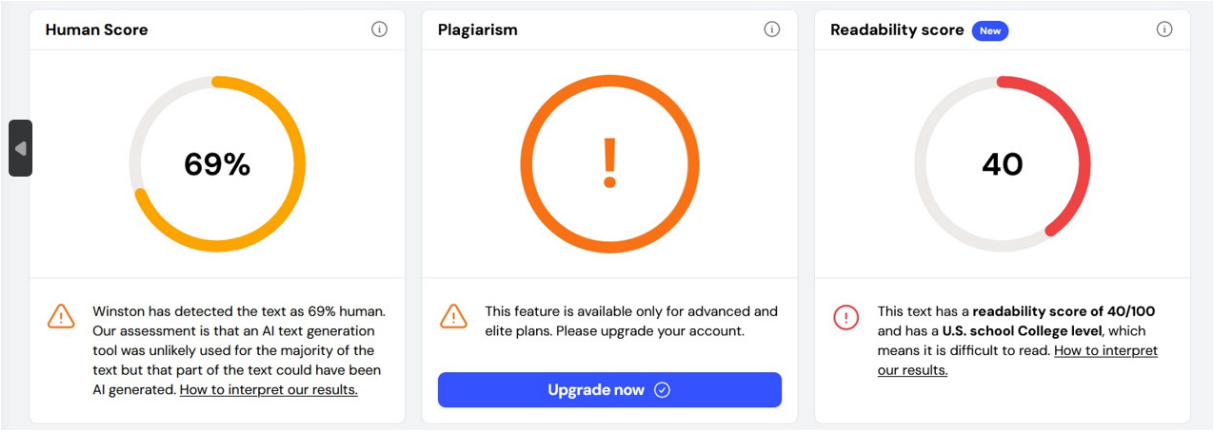

Figure 6. Winston AI, Report 2 (source: authors)

Finally, it was the turn of students whose task was to act as complete fraudsters. In the worst-case scenario (shown in the next figure), Winston AI detected that the student had 21% original work, with the rest being the work of ChatGPT or a similar AI tool. In other cases, the originality did not exceed 8%.

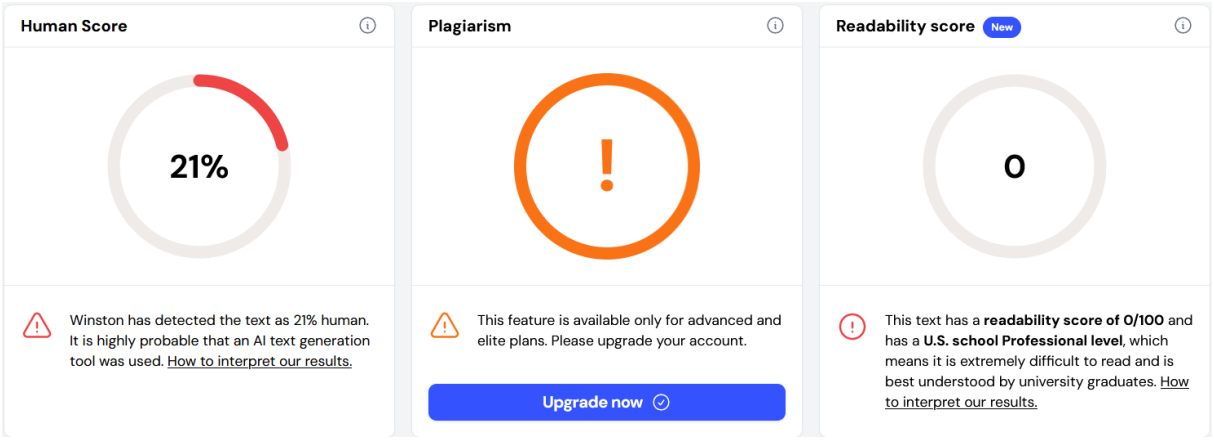

Figure 7. Winston AI, Report 3 (source: authors)

We can conclude that teachers are not powerless against this type of student fraud. It has been proven that tools like Winston AI can be of significant help to teachers in preventing unethical student behavior, simultaneously embracing technological progress with the potential to greatly enhance both educational learning and teaching methods. Additionally, Winston AI, in its full version, enables the detection of classical plagiarism as well.

Discussions

The educational process can be significantly improved by implementing AI tools and technologies. The advantages are numerous, and the following discussion is to approve the strength of the future connection between AI and the educational process.

Personalized learning and adaptive learning are some of the key advantages. Artificial intelligence can tailor learning for each individual student, depending on their capacity, memory ability, and comprehension. It will enable the preparation of learning materials for each student individually, which will meet their needs. Once the learning material is created, AI considers the concept of adaptive learning as a key to the successful educational process of the future. Artificial intelligence enables the determination of the material's difficulty based on students' achieved results. These educational platforms have the capability to adjust the material in such a way that students will neither be bored nor find it too difficult, thereby avoiding stress. This also applies to lifelong learning as a key to success in a modern business environment. AI tools can be used to create materials that provide personalized opportunities for continuous learning after

finishing school, thereby allowing for advancement at different stages of life depending on age and needs.

Concerning the learning process, chatbots and AI processing of students' data are the primary focus. Chatbots and virtual tutors can help students engage in active learning by answering questions about the covered material to see if they have mastered it. The student receives feedback, discussions are developed, or help is offered. This makes the entire learning process interactive. Data-driven policies imply the ways in which AI applications can enable the processing and analysis of a large set of data related to students' achieved results in different learning contexts. This is of great importance, as teachers can adjust the learning process and focus on areas where students have the poorest results.

The significant advantage of AI implementation in modern education is the automation of routine tasks. AI applications allow teachers to automate some of the activities related to creating tests (which can be adapted to different groups of students), reviewing tests, and analyzing achieved results. This way, teachers can focus on improving teaching and the materials students need for learning. Further, AI technologies can provide accessibility features, such as speech-to-text transcription, text-to-speech conversion, and translation services, to accommodate diverse learning styles and disabilities, ensuring that education is accessible to all students. Additionally, some routine tasks of teachers and administration can be automated by utilizing AI capabilities, leading to the optimization of educational process costs. Learning becomes more accessible and affordable.

Support for teachers can be significantly increased soon. By using AI, teachers can track how students are performing as well as recommend appropriate instructional approaches based on their preferences and needs. AI supports teaching staff by creating insights into student progress, providing suggestions for learning strategies, and offering directions for professional development based on specific needs and interests. AI support for teaching staff can further extend towards innovative teaching methods such as gamification, adaptive learning pathways, and immersive simulations, which will contribute to increasing student motivation, critical thinking, and problem-solving skills.

As previously proved, AI in education provides many benefits, yet several challenges and potential drawbacks are possible.

First, investments are not negligible. If educational settings aim to implement AI technologies it has to be prepared for considerable investment in infrastructure, software development, training, and ongoing maintenance. Educational institutions, particularly those with limited budgets, may find themselves out of the game. Once established, problems are possible. While AI systems are highly accurate, technical issues such as software bugs, system failures, or compatibility problems with existing infrastructure can arise. These issues can interrupt learning processes and erode students' confidence in AI-based educational tools.

AI applications in education mean collecting and analyzing large volumes of sensitive student data, including personal information, learning habits, and performance metrics. It could be a security risk and the potential for breaches of data protection regulations or unauthorized access. Additionally, ensuring fairness is challenging because AI algorithms can sometimes perpetuate existing biases and inequalities in education, such as those based on gender, race, or socioeconomic status. If the training data used to develop AI models is biased or unrepresentative, the resulting recommendations and decisions may unfairly disadvantage certain groups of students.

Furthermore, concern about over-relying on technology at the expense of human interaction and mentorship is real. Automation and the depersonalization of learning can reduce the quality of education and impede the development of essential social and emotional skills. The excessive application of AI tools and resources in the educational process can deepen the digital divide between students who come from different backgrounds and do not have equal access to the Internet and the necessary technology. The large-scale application of artificial intelligence can also change and restructure the work positions of teachers and administration since a large part of work tasks will be automated. Its application will certainly develop the need for the training of teachers in that area, so that they can use it successfully. One of the disadvantages of the application of artificial intelligence in education is the danger of stifling creativity, critical thinking, and skills to solve specific real-world problems that require the ability to research, analyze, and draw correct conclusions. Of course, the application of artificial intelligence in education can open up some ethical dilemmas related to the appropriate use of student data and the danger of applying decision-making algorithms, instead of applying logical reasoning on the part of humans.

AI tools may not be accepted by teachers, students, and their parents because they have been

taught to use traditional learning methods and because of concerns about losing their jobs. Resistance to change affects the possibilities for innovation in teaching.

The analysis of these disadvantages of the AI tools application can create proactive measures that will reduce or eliminate them. The measures should adhere to policies that will protect the privacy of students and teachers and allow fair and equal access for the teachers for their professional development. With the careful use of these tools, it is possible to improve the educational process, so that the students would achieve better results.

Figure 8. AI in Education - pros & cons (https://studycorgi.com/blog/can-ai-change-the-way-we-study-in-the-near-future/, 2023)

Conclusion

AI implementation, especially in the education process, brings a huge promise through learning experience transformation, significantly improving learning outcomes and forcing a lot of innovation in teaching and learning. On the other side, it brings a lot of challenges and potential risks that must be carefully handled.

The benefits can be huge. They consist of personalized learning, adaptive instruction, enhanced engagement, and data-driven insights. These kinds of benefits will lead learning processes to wider dimensions that include the different needs of modern learners and huge support for educators. Activities in educational institutions will be more efficient and effective, as well as more transparent, making high-quality education more accessible and equitable for all.

Further, various factors need to be considered due to the sensitivity of AI implementation in educational processes. These factors can be cost, technical issues, privacy concerns, bias mitigation, digital divide, job displacement, ethical dilemmas, and resistance to changes. Obtaining the full potential AI implementation into the education process, minimizing known risks, implies the application of well-established rules for all participants in the education process, including the application of ethical codes and support frameworks for both future students and teachers.

Finally, AI implementation in education aims to approach that is finely balanced and includes technological innovation combined with human based pedagogy. This approach relies on significant collaboration, among all participants of the educational process, creativity, critical thinking, and skills included in lifelong learning.

Based on the above, AI should be seen as a tool to support human expertise, and not as its replacement. The educator's role should be to encourage students to use all the modern tools and technologies, including AI, but in the way described in the discussion above. With significant planning and right implementation including constant evaluation, AI has the huge potential to revolutionize education and unlock new frontiers of learning for generations to come.

Acknowledgements

The research is the result of the individual engagement of the author with the aim of highlighting and processing the mentioned topics of the paper, using the resources provided by the University of Kragujevac, The Faculty of Mechanical and Civil Engineering in Kraljevo of the University of Kragujevac and The Faculty of Computer Science, Goce Delcev University, Stip.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, V.M and M.J.P; methodology, V.M. and L.K.L.; software overview, L.K.L. and M.J.P; formal analysis, V.M, M.J.P. and L.K.L.; writing—original draft preparation, V.M, M.J.P. and L.K.L; writing—review and editing, V.M, M.J.P. and L.K.L. All authors have read and agreed to the published version of the manuscript.

References

Aldriye, H., Alkhalaf, A., & Alkhalaf, M. (2019). Automated grading systems for programming assignments: A literature review. *International Journal of Advanced Computer Science and Applications, 10*(3). http://dx.doi.org/10.14569/IJACSA.2019.0100328

Asi, L., Mojjada, H., Prasanna, M., & Deepika, Y. (2023). A Study on Artificial Intelligence in Marketing. *Retrieved from A Study on Artificial Intelligence in Marketing* https://doi.org/10.36948/ijfmr.2023.v05i03.3789

Athanassopoulos, S., Manoli, P., Gouvi, M., Lavidas, K., & Komis, V. (2023). The use of ChatGPT as a learning tool to improve foreign language writing in a multilingual and multicultural classroom. *Advances in Mobile Learning Educational Research*, *3*(2), 818-824. https://doi.org/10.25082/AMLER.2023.02.009

Bahoo, S., Cucculelli, M., Goga, X., & Mondolo, J. (2024). Artificial intelligence in Finance: a comprehensive review through bibliometric and content analysis. *SN Business & Economics*, *4*(2), 23, https://doi.org/10.1007/s43546-023-00618-x

Bharadiya, J. (2023). Artificial intelligence in transportation systems a critical review. *American Journal of Computing and Engineering, 6*(1), 34-45. https://doi.org/10.47672/ajce.1487

Cui, Y., Chen, F., Shiri, A., & Fan, Y. (2019). Predictive analytic models of student success in higher education: A review of methodology. *Information and Learning Sciences*, *120*(3/4), 208-227. https://doi.org/10.1108/ILS-10-2018-0104

Cotton, D. R., Cotton, P. A., & Shipway, J. R. (2024). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in education and teaching international*, *61*(2), 228-239. https://doi.org/10.1080/14703297.2023.2190148

Das, R., & Sandhane, R. (2021, July). Artificial intelligence in cyber security. In *Journal of Physics: Conference Series* (Vol. 1964, No. 4, p. 042072). IOP Publishing. https://doi.org/10.1088/1742-6596/1964/4/042072

De Andrade, I. M., & Tumelero, C. (2022). Increasing customer service efficiency through artificial intelligence chatbot. *Revista de Gestão*, *29*(3), 238-251. https://doi.org/10.1108/REGE-07-2021-0120

Dogan, M. E., Goru Dogan, T., & Bozkurt, A. (2023). The use of artificial intelligence (AI) in online learning and distance education processes: A systematic review of empirical studies. *Applied Sciences*, *13*(5), 3056. https://doi.org/10.3390/app13053056

Gandomi, A. H., Chen, F., & Abualigah, L. (2023). Big Data Analytics Using Artificial Intelligence. *Electronics, 12*(4), 957. https://doi.org/10.3390/electronics12040957

Ghosh, M., & Thirugnanam, A. (2021). Introduction to artificial intelligence. *Artificial Intelligence for Information Management: A Healthcare Perspective*, 23-44. https://doi.org/10.1007/978-981-16-0415-7_2

Gligorea, I., Cioca, M., Oancea, R., Gorski, A. T., Gorski, H., & Tudorache, P. (2023). Adaptive learning using artificial intelligence in e-learning: a literature review. *Education Sciences, 13*(12), 1216. https://doi.org/10.3390/educsci13121216

Gocen, A., & Aydemir, F. (2020). Artificial intelligence in education and schools. *Research on Education and Media*, *12*(1), 13-21, https://doi.org/10.2478/rem-2020-0003.

Harkut, D. G., & Kasat, K. (2019). Introductory chapter: artificial intelligence-challenges and applications. *Artificial Intelligence-Scope and Limitations*. https://doi.org/10.5772/intechopen.84624

Ipek, Z. H., Gözüm, A. I. C., Papadakis, S., & Kallogiannakis, M. (2023). Educational Applications of the ChatGPT AI System: A Systematic Review Research. *Educational Process: International Journal*, *12*(3), 26-55. https://dx.doi.org/10.22521/edupij.2023.123.2

Jayakrishnan, S. (2022). *Artificial intelligence (AI) in retailing-a systematic review and research agenda*. SSRN, http://dx.doi.org/10.2139/ssrn.4134959

Jordovic Pavlovic, M., Knežević, D., & Petrović, S. (2017). Data visualization and exploration of students database. In: *Proceedings of 10th International Conference Science and Higher Education in Function of Sustainable Development, October 6-7*, 2017., Mećavnik, Mokra Gora, Srbija, 2-16, ISBN978-86-83573-90-5

Karakose, T., Demirkol, M., Aslan, N., Köse, H., & Yirci, R. (2023). A conversation with ChatGPT about the impact of the COVID-19 pandemic on education: Comparative review based on human–AI collaboration. *Educational Process: International Journal*, *12*(3), 7-25. https://files.eric.ed.gov/fulltext/EJ1395258.pdf

Kuhail, M. A., Alturki, N., Alramlawi, S., & Alhejori, K. (2023). Interacting with educational chatbots: A systematic review. *Education and Information Technologies*, *28*(1), 973-1018. https://doi.org/10.1007/s10639-022-11177-3

Lin, C. C., Huang, A. Y., & Lu, O. H. (2023). Artificial intelligence in intelligent tutoring systems toward sustainable education: a systematic review. *Smart Learning Environments*, *10*(1), 41. https://doi.org/10.1186/s40561-023-00260-y

Mah, P. M. (2022). Analysis of artificial intelligence and natural language processing significance as expert systems support for e-health using pre-train deep learning models. *Acadlore Transactions on AI and Machine Learning*, *1*(2), 68-80. https://doi.org/10.56578/ataiml010201

Murtaza, M., Ahmed, Y., Shamsi, J. A., Sherwani, F., & Usman, M. (2022). AI-based personalized e-learning systems: Issues, challenges, and solutions. IEEE access, 10, 81323-81342. https://doi.org/10.1109/ACCESS.2022.3193938

Plathottam, S. J., Rzonca, A., Lakhnori, R., & Iloeje, C. O. (2023). A review of artificial intelligence applications in manufacturing operations. *Journal of Advanced Manufacturing and Processing*, *5*(3), e10159. https://doi.org/10.1002/amp2.10159

Singh Gill, S., Xu, M., Patros, P., Wu, H., Kaur, R., Kaur, K., ... & Buyya, R. (2023). Transformative Effects of ChatGPT on Modern Education: Emerging Era of AI Chatbots. *arXiv e-prints*, arXiv-2306. https://doi.org/10.1016/j.iotcps.2023.06.002.

Sodhar, I. N., Jalbani, A. H., Buller, A. H., Mirani, A. A., & Sodhar, A. N. (2020). Chapter-1 Natural Language Processing: Applications, Techniques and Challenges. *ADVANCES IN*, *1*. https://www.researchgate.net/profile/Petro-Trokhimchuck-2/publication/343981699_S_Beer_Centurial_Problem_in_Cybernetics_and_Methods_of_its_Resolution_p87-117/links/5f4be8d8458515a88b8f31c9/S-Beer-Centurial-Problem-in-Cybernetics-and-Methods-of-its-Resolution-p87-117.pdf#page=5

Spalević, Ž., Kaljević, J., Vučetić, S., & Milić, P. (2023). Enhancing Legally-Based E-Government Services in Education Through Artificial Intelligence. International Journal of Cognitive Research in Science, Engineering and Education, 11(3), 511-518. https://doi.org/10.23947/2334-8496-2023-11-3-511-518.

Steenbergen-Hu, S., & Cooper, H. (2014). A meta-analysis of the effectiveness of intelligent tutoring systems on college students' academic learning. *Journal of educational psychology*, *106*(2), 331–347. https://doi.org/10.1037/a0034752

Tajidini, F., & Kheiri, M. J. (2023). Recent advancement in Disease Diagnostic using machine learning: Systematic survey of decades, comparisons, and challenges. *arXiv preprint arXiv:2308.01319*.

Tayan, O., Hassan, A., Khankan, K., & Askool, S. (2023). Considerations for adapting higher education technology courses for AI large language models: A critical review of the impact of ChatGPT. Machine Learning with Applications, 100513. https://doi.org/10.1016/j.mlwa.2023.100513.

Tehseen Z. (2023) Transforming Education: AI-Powered Personalized Learning Revolution, https://www.techopedia.com/transforming-education-ai-powered-personalized-learning-revolution

https://blog.duolingo.com/large-language-model-duolingo-lessons/

https://www.washingtonpost.com/technology/2024/01/10/duolingo-ai-layoffs/

https://articles.noodlefactory.ai/what-is-an-ai-intelligent-tutoring-system-and-why-you-should-use-it

https://crowdmark.com/intelligent-tutoring-systems-connecting-ai-and-education/

https://www.memphis.edu/iis/projects/autotutor.php

https://www.devlinpeck.com/content/online-learning-statistics

https://livestorm.co/blog/online-teaching-tools-platforms

https://whatfix.com/blog/adaptive-learning-platforms/

https://www.hostinger.com/tutorials/ai-statistics?ppc_campaign=google_search_generic_hosting_all&bidkw=defaultkeyword&lo=2688&gad_source=1&gclid=Cj0KCQjw2a6wBhCVARIsABPeH1v8ZW6qnqvzoKKkEh8dIcYw73Uy2UrYINREESKUJEWEQi99SZJ0x_waAmgEEALw_wcB

https://www.classpoint.io/blog/students-using-ai-to-write-essays

https://www.scribbr.com/frequently-asked-questions/how-accurate-are-ai-detectors/

https://gowinston.ai/setting-new-standards-in-ai-content-detection/