CrossMark

Impacts on Education and Teaching from the Advance of Artificial Intelligence in Secondary Schools

Konstantinos Aletras*

ABSTRACT

Artificial Intelligence has begun to rapidly invade our daily lives as well as the education system. It decisively affects the lives of all of us in every aspect. It tends to change the way everyone works, including, pupils, students, and teachers with unprecedented rapidity.

This specific work aims to study the changes that the new reality has brought to the way of teaching, to assessment, to the differentiation of teaching, and to any form of feedback that can be offered in real time, from the teacher's side.

From the student's point of view, we will look for the ways in which it affects the process of studying the courses, in the preparation of assignments, in strengthening the interest in learning, especially of students with learning gaps, and how much and how it contributes to changing the way of working and thinking of the students.

Education will be directly affected and will have to adapt to the new reality. The new reality introduces other learning requirements and techniques. New tools are being introduced, never seen before, which have not been tested before. The demands for new knowledge are great but at the same time, the insecurity that every innovative achievement creates grows. The application of artificial intelligence in secondary schools, where this has been achieved, will be studied.

The work will then list the positives and negatives that have been recorded from the implementation of artificial intelligence in education as well as expectations and fears for the future.

The specific research is bibliographic and additionally, due to the immediacy and rapidity of the changes, it also includes reports from the international press. The investigation of the bibliography is done, separately, for the teachers and for the students, with different criteria in each case.

Keywords: AI, education, school, teachers.

*Corresponding Author:
e-mail: kostas.aletras.2@gmail.com

1. INTRODUCTION

Artificial intelligence has begun to permeate daily life in a variety of forms and applications, as well as being used and impacting education and teachers. Some examples include translation systems, search engines, chatbots, navigation programs, and specialized web applications that provide learning in a variety of fields [1]. Such as the popular ChatGPT, as well as specialized applications used by teachers to prepare courses, creation of lesson plans, administrative support, and from students in studying their courses and supporting their assignments [2].

Education, on every side, has not been unaffected. Long-term curricula are already being designed for a digitized, high-quality educational process, digitally combining different sciences and technologies, for personalized and distance learning. The experience in distance teaching during the pandemic, as well as the technological means used, are a legacy for the new step of artificial intelligence and digitization of the educational [1].

Especially, the year 2023 is considered as the year of artificial intelligence literacy, for each of us [3]. Starting in 2004, the term "artificial intelligence" was searched between 2 and 40 times each day around the world. However, as of early March 2023, the global daily search for the term artificial intelligence had reached 100 searches per day. It will remain at the same levels of search until early September 2023. Searching for what happened this month, it was found that many different AI apps premiered on the internet that month, and it was announced on February 9, 2023, that the ChatGPT app passed successfully the exams of United States Medical Licensing Exam [4].

The developments in this field are such that they cannot leave anyone unaffected, each of us, not only cannot ignore the new reality, but in order to be able to follow the new developments, we should be trained in the new technological data.

In the context of this article, the implementation of artificial intelligence in secondary schools is analyzed, where this has been done, from the point of view of the teacher, the student as well as the school's administration. The work will then list the positives and negatives that have been recorded from the implementation of artificial intelligence for teachers and students as well as expectations and fears for the future. The specific research is bibliographic and additionally, due to the immediacy and rapidity of the changes, it also includes reports from the international press.

2. The Implementation of Artificial Intelligence in Secondary Schools

2.1. From the Teacher's Point of View

The use of artificial intelligence by the teacher can be distinguished into the following categories:

1) *As a teaching assistant*. Adaptive learning technologies can help students who have difficulties or deficiencies in some specific subjects of a course [5]. For example, students who struggle with math concepts such as fractions in math can be offered more examples and exercises, personalized and tailored to each student's learning needs, at the time they need it, even in a playful environment that will make learning more engaging and enjoyable [6].

2) *With natural language processing applications*. These applications offer the possibility of creating text summaries emphasizing the main points of the text. Direct translation of texts in any language, taking into account its peculiarities and the terminology that the text may contain. They improve students' written speech, with feedback, and suggestions, at a lower or higher level, such as grammatical errors, and at a higher level with suggestions for better syntax and speech structure. Semantic and emotional analysis of text, in order to classify its paragraphs according to the positive, negative, or neutral nuances they have. They classify texts into categories, which are suitable for reading by specific groups of students so that they have better learning outcomes. Answer in natural language, with great accuracy, and create written text taking into account emotions and terminology [7]. Teachers can facilitate their work by using all of the above, saving time and making more targeted interventions, where needed, and producing targeted and tailored educational materials.

3) *Intelligent AI teaching systems*. Such systems have two purposes: one is to provide specialized instruction and personalized guidance to students, like a teacher, and the second purpose is to create evaluation models of the learning process, providing suggestions and guidelines for improvement [8].

4) *Use of virtual and augmented reality systems in teaching*. Virtual reality lectures where students are at home, in different parts of the world, through virtual reality glasses they have the feeling of being in the same auditorium or classroom. Subjects of medicine, biology can be presented to students through this kind of technology. Also, chemistry experiments, which have a degree of danger or geology lessons, such as the eruption of a volcano or diving into oceans or the center of the earth can be done through virtual reality technology. Difficult concepts can be explained in an illustrative and attractive way. When virtual reality systems, such as Google Translate, Apple Translate, Timekettle M2, and others, can instantly translate any lecture or debate, language barriers are broken down. As a result, students can attend lectures and classes in any language they choose. They generally increase students' interest in the course and their engagement with the learning subject [9].

5) *Provides data analysis for cognitive students' needs to aid teachers in their work*. Artificial intelligence applications, such as EdApp, Courseau, Heights, and others similar, aid in the development of individualized curriculum by analyzing students' performance and learning difficulties. Voice assistance for hearing impaired students, such as translating a text into sign language. Pedagogical patterns are suggested and created for students in need. Evaluation of whether a subject of study is more or less beneficial in daily life. Assistance in determining which students and where need aid. Monitoring the participation of teachers and students in the design and effectiveness of the evaluation and the interventions that have been made [10].

6) *Personalized suggestions to teachers for each student via AI apps, allowing teachers to give personalized training based on the student's individual needs*. Through artificial intelligence, the profile of each student is analyzed, the pace of learning, the areas in which they fall behind, their performance, and their strengths. Through such an analysis, personalized ways of helping the student are provided. Intelligent systems offer personalized instruction to students in need, personal recommendations, videos, and educational materials. Data analysis of all students can help teachers in targeted interventions [11].

7) *Creation of educational material through artificial intelligence applications*. Create tests, prepare students for tests, and help with language learning [2]. In

addition, adapting lesson plans for different lesson durations, creating better lesson plans, highlighting through detection of students' special talents, strengthening through these abilities the relationship with teachers, and adapting teaching to students' interests [12].

8) *Class management*. Online monitoring of one or more classes, guiding students during the progress of the course. The teacher can share his screen with the students and guide the educational process, without the students being disoriented from the lesson. Creating reports for parents, about their general presence in the lesson. Creating quizzes, reports for teachers, timetables, and general applications that make the work of teachers easier [13].

9) *They strengthen the cooperation between students and teachers*. They facilitate student-teacher communication online, and enable group work, which boosts students' self-confidence and interest. They help teachers to improve aspects of their teaching, analyzing the weaknesses of a teaching, and a lesson plan, in relation to the students of each class [14]. Grouping students according to work style and pace, Artificial intelligence systems detect the degree of cooperation of each student, enabling teachers to strengthen students who lag behind in cooperative learning. They supervise the work groups and inform the teachers when the work groups go off topic. They recognize the learning gaps of each student and create learning bridges, for each one individually [15].

10) *Eliminate human error*. AI applications will eliminate human error and incorrect or distorted transfer of concepts, from the teaching side [16].

2.2. From the Student's Side

Artificial intelligence systems offer many capabilities that can enhance learning, on the part of the student, in the following ways and means:

1) *Personalized learning systems*. Focusing on the features of AI-powered personalized learning apps in 2023, we find that they offer the following: personalized learning assistance through AI systems and question sets to support each student according to their learning needs. Additional preparation of the student according to learning gaps. Grading and evaluation of student effort. Language support for difficult concepts, offers explanations and development of these concepts, in a simpler way. Communication with other students–users of the applications enhancing interaction and learning assistance. They enable students to ask questions and get answers. They give students the flexibility to choose the teaching format that suits them, lecture, text, game, problem solving, and whatever else each AI platform offers. They offer plenty of memorization exercises [17].

2) *Language learning systems*. Using chatbots, equipped with speech understanding algorithms,

they assess the level of learning of each student and supply them with educational material corresponding to their specialized needs. They help in learning the correct pronunciation of each language. They answer questions and give clarifications in real time. They are available on various operating systems and a multitude of electronic devices, computers, laptops, tablets, and mobile phones. They allow the voice communication of students who speak different languages. Also, offer, voice and text recognition, of objects in real time via camera, for immediate. They create lessons for real situations and needs, such as directions for a trip, communicating with the doctor at the hospital, and meeting a foreign-speaking classmate [18].

3) *Rating and feedback*. The students themselves are empowered to progress through the artificial intelligence systems in evaluating their knowledge. They can set goals and be helped to achieve them or evaluate the extent to which their goals have been met. Study suggestions from appropriate sources, so that students can more easily achieve their goals. Students can create a digital repository of their work and can share their achievements, if they want, with other students. Manage study time with alerts and warnings about time wastage, on irrelevant sources such as social networks. Chatbots that conduct student performance assessments tend to be more descriptive and interactive with students than humans, making communication better and student engagement stronger. Artificial intelligence systems will provide students with more verbal assessment to make inferences about their progress rather than just grade-number assessments [19].

4) *Virtual libraries*. Through artificial intelligence programs, students will be able to advance to libraries and scientific articles targeted, gaining knowledge, saving time, and expanding the possibilities of a school library. Thus, students will have the opportunity to deal with more complex issues and focus on the broader study and understanding of their teaching subjects [20].

5) *Simulations*. Virtual environments that combine artificial intelligence to cover every requirement or every aspect of students' thinking and imagination. Even with the students being a part of the virtual world, the simulation environments are immersive and engage the participants. Tangible and total participation in the experiments, in contrast to traditional classrooms, where there were many restrictions to do so. They offer an easy way to gain hands-on experience without being in a similar environment, properly preparing for the rigors of the real world. They bridge theory with the real world. They prepare students for a collaborative environment by providing opportunities for collaborative work and problem solving. Engaging with such innovative environments paves the way for the future business world for students [21]. Examples of these programs

include ChatGPT, which offers limitless, free replies to questions on any subject. The QuillBot is a helpful tool for composing and paraphrasing documents as well as for proficiently learning a foreign language. The Google Bard offers solutions to a wide range of problems. By merely providing the topic, Slidego may build one-click presentations, saving students time and providing ideas. Duolingo offers numerous sorts of tasks for learning foreign languages, starting at any knowledge level, according to the requirements and learning rate of each student. There are also many paid AI apps available for students. One such illustration is Gradescope, an artificial intelligence program that offers assignment grading and peer-to-peer feedback. Grammrly is an AI application, that allows kids to educate themselves on any subject they choose, and is specifically developed to help students with their grammar and spelling [22].

6) *Time management and creating a study plan.* Artificial intelligence applications allow students to create a study plan, that is, suggest what to do and when, prioritize key study items, aiming for faster study with better learning outcomes. This reduces students' stress and boosts confidence in their abilities [23].

7) *Virtual classrooms and collaborative environments.* Classrooms are becoming global through virtual environments. A student has access to, may connect with, and encounter classmates from all over the world, as well as groups with comparable learning styles and interests. Enables real-time use of virtual whiteboards, virtual teaching aids, and simulations, in collaborative environments with students and teachers from around the world. Such environments can eliminate the limitations of a real classroom and give new possibilities and perspectives to students [24].

8) *Improving the capabilities of students in special education.* Students with various learning difficulties, such as comprehension of written or spoken language, difficulty in spelling, hyperactivity, distraction, various learning gaps, socialization difficulties, and students with mobility impaired, can be directly helped with the appropriate applications of artificial intelligence and join world classes, with students who need to be treated accordingly and special instructors who have the appropriate qualifications for the specific case [25].

9) *Anonymity.* AI applications offer anonymity, in the expression of queries, in the diagnosis of learning difficulties, and in any issue that can be solved by artificial intelligence without human intervention and thus they will express themselves more freely, without hesitating to ask and report any problem that concerns them [26].

3. RISKS OF THE USE OF ARTIFICIAL INTELLIGENCE IN EDUCATION: FROM THE SIDE OF THE STUDENT AND THE TEACHER

3.1. The Risks of Using Artificial Intelligence in Secondary Education

The use of artificial intelligence in education is a promising, rapidly emerging technology with unpredictable results. The positive elements it provides are obviously too many. They have already been described above from the teacher's side and from the student's side. But, especially the negative consequences of its application, it is difficult to predict and above all to certify them, due to the lack of broad and long-term experience of this innovative and revolutionary technology.

3.2. The Risks of Using Artificial Intelligence in Secondary Education for Teachers

For educators, artificial intelligence and its applications, is an innovative tool, a valuable helper, but are there concerns and fears, and negative effects, which are summarized below:

1) *Job loss.* Virtual teachers are already being used in the classroom. With very good performance and prospects indeed. Teachers may experience a far higher chance of job loss than other professions, particularly less trained ones, but this is now assumed due to a lack of available statistical surveys [27]. It is a technological revolution, which is going to make dramatic changes, worldwide, in every aspect of our lives, especially in the labor market. The role of the teacher in the school is expected to change gradually. Teachers will need to take on different roles from those of traditional teaching. Data analysis, analysis, and management of emotions will occupy a dominant position in their new tasks. Initially, they may need to support the robots' machine learning, but as technology advances and robots better understand how humans manage the school, the classroom, and the students, perhaps that role will begin to disappear [28]. According to other views, teachers are hard to replace because they offer a personal touch, and inspire creativity, emotional support, and passion for learning in the classroom [29]. Additionally, in some countries, secondary education workers in occupations other than teaching, such as cooks, bus drivers, and librarians are at a similar risk of losing their jobs due to AI [30].

2) *Need for retraining to meet the demands of new technology.* Already the internet is flooded with ads aimed at educators, with the aim of rapidly training them in artificial intelligence. The new reality is already here. Educators should be prepared to use and exploit the advantages offered by artificial intelligence to help improve their work [31]. Artificial intelligence systems collect data, to offer personalized teaching, depending on the needs of each student. To the extent that teachers interact with AI applications, there is a need to train them to extract and interpret such information so that they can make use of it. Artificial intelligence applications

also draw data from the latest trends in education, the latest developments in each subject or pedagogical method, tracking a huge number of scientific articles and analyses. Teachers should be ready, able to handle for the benefit of the school and the students, this information provided to them [32].

3) *Increased workload*. Initially, the use and learning of new technologies, combined with teaching tasks, may lead to an increased workload for teachers in the early stages of their implementation.

4) *Lack of direct personal interaction*. Fears are expressed that teachers will get to know their students through written reports of AI applications rather than through face-to-face contact. They clearly feel the fear that they will fail in the task of instilling social skills in students, since the latter will have been used to asking questions and getting answers from machines for most of their school life. Social skills are considered essential for success in life [33].

5) *Taking responsibility for managing artificial intelligence*. An emerging topic of discussion is the skills and technological knowledge that educators need to develop to manage the applications of artificial intelligence being introduced into schools and the real impact they have on learning. process and in the student community. New administrative and managerial tasks which they will soon have to be trained and develop the new skills necessary for the proper management of the new technology.

6) *Ethical dilemmas for the use of artificial intelligence*. A basic ethical dilemma, which also concerns students, is the issue of personal data protection. Teachers are concerned about protecting the personal data of themselves and their students, for whom they are responsible. A leak of personal data, in any form, through artificial intelligence applications that manage a lot of sensitive personal information, will be the responsibility of the educators who manage them or the developers of these applications and to what extent. Teachers' decision-making autonomy is compromised due to automated responses coming through artificial intelligence. There is a sense that the appetite for new ideas and suggestions will be limited as they are dictated by the wise machine, leading to a reluctance to take initiative, less creativity, limited human control, and an AI-led school. An essential moral dilemma is about who will be responsible. In general, for the whole operation of artificial intelligence in education, the creators of the applications, the companies that manage them, the school administration and to what extent is the responsibility of the classroom teacher [34].

7) *Difficulty in using and accepting new technology*. Teachers themselves must invest time in training in the efficient use of the new technology before they may use them. Most teachers and school managers do not have experience with these technologies, they themselves need to fully learn the new applications in order to achieve the maximum results from their application in the educational process. It takes time, effort, and support for insecurities in front of the new and complex, difficulty of changing the usual routine of the educational process. Possible lack of access to such applications, for the purpose of self-education or additional engagement, for the purpose of learning [35].

8) *Depreciation of the teacher's position*. To the extent that the educational process passes to the applications of artificial intelligence, the role and position of the teacher are degraded, especially in relation to the traditional role they hold, vis-à-vis the students. Also, in administrative matters, the role of the manager will be downgraded, in the management and execution of decisions that he has not made and will have been made by applications. He will simply be asked to manage decisions and execute them. Teachers will not have the dominant position they held in the traditional school [35].

9) *Redefining the role of the teacher and his goals in the educational process*. The role of the teacher in artificial intelligence schools, it is difficult to predict exactly who and at what rates will change in each country and at each grade level. What is certain is that he will not be the same with the traditional role, as we were used to it. These cool views, give weight to the human-centered character of education and consider that man is an irreplaceable part of it. Artificial intelligence can be a valuable assistant to the teacher for repetitive tasks, such as planning, testing, lesson plans, and adapting curricula to particular needs, not a replacement [36]. It is felt that the overall interaction and social support provided by the human teacher is irreplaceable and a key element of a healthy school environment. So it is hard to believe that human teachers will be replaced in the future but will work alongside artificial intelligence, which will work in support, upgrading the quality of education and filling the gaps on the teacher's side as well [37].

3.3. The Risks of Using Artificial Intelligence in Secondary Education for Students

Trying to focus on detecting and predicting risks for students, from the use of artificial intelligence in the educational process, we focus on the following aspects:

1) *Data security and privacy breach*. Artificial intelligence systems manage vast amounts of students' personal data to help them learn, make predictions, and make recommendations. Given this huge amount of information, the question of the security of this personal data arises. To train the algorithms, the various applications use names, addresses, performance, pace and learning capabilities, medical and financial data, which are sensitive information for each student. This raises the issue of disseminating and making available or selling this data to sub-applications and partner branches of the AI application. Also, a significant risk is the possibility

of the application being intercepted or hacked. On the one hand, the training of the artificial intelligence program must be ensured, but at the same time, special attention must be paid to the security of this data [38].

2) *Bias and discrimination by the algorithms of artificial intelligence applications*. We may be driven to do so by the learning algorithms of artificial intelligence applications or by the deliberate design of applications by their own developers [39].

3) *Lack of human interaction and emotional support*. There are fears that the exclusive use of AI systems in education may lead to the emotional alienation of students and a sense of machine abandonment as human teachers are removed [40]. The sense of need for success and recognition that human teachers inspire will likely be lacking, leading to reduced interest or indifference on the part of students [41].

4) *Laziness on the part of the students*. There is a clear concern that the facilitation offered by technology can lead to student disengagement, reduced effort, inactivity, leaving creativity and active learning to the reassurance of the ready work of application [16].

5) *Too much emphasis on standardized tests rather than learning itself*. It is a disadvantage and advantage of artificial intelligence systems, America's largest universities use standardized tests to test students' knowledge. Students started learning using the questions from previous tests, without primarily emphasizing the knowledge itself. With the COVID-19 pandemic, the logic of standardized tests began to change. The question is whether AI applications should apply standardized tests, as they have probably been trained, or apply different types of assessment of student learning and knowledge, in a variety of ways [42].

6) *Reduction of students' authentic thinking with simultaneous dependence on applications*. There is a widespread fear of reducing students' thinking and effort in learning and problem solving without the support of artificial intelligence applications and computers [16].

7) *Decreased ability to make decisions*. Students due to familiarity and habit, the ease with which intelligent systems provide them, may be led to be reluctant or avoid decision-making, as they have been "trained" in decision-making or used to the advice of AI applications [43].

8) *Acceptance without criticism of the teaching of intelligent applications*. The impact of enhancing traditional teaching or replacing it with teaching through intelligent applications is studied. If this will lead to the authentication of the applications, in the eyes of the students, and the acceptance of any answer, without critical thinking. It is a matter that needs investigation and further study, as well as how traditional teaching could be combined with the existing, emerging reality.

9) *Creating stress and excessive pressure on students from learning expectations, through artificial intelligence applications*. It is an emerging topic of discussion on the internet that needs further study and investigation.

4. CONCLUSIONS

It is clear, from the above research, that the era of artificial intelligence has already begun, that we are living at the beginning of a mental and technological revolution, the consequences of which are difficult to predict. No area of human activity and no aspect of our lives will be unaffected. So is education. Teachers, whether in secondary education or at other levels, will receive support through new tools aimed at enhancing their work. These tools will address weaknesses, bridge gaps, minimize human error, offer innovative learning resources, and provide tailored materials to meet individual student needs. They will also streamline day-to-day tasks, offer suggestions for lesson plans, adjust curricula, and offer administrative improvements. Students will experience tailored learning with a personal online assistant, customized teaching, and assessments that match their requirements. They'll engage in global virtual classrooms, interact with peers worldwide, and have individual study plans, flexible tests, and additional language-learning opportunities. They can also ask questions anonymously and receive special education evaluations. But artificial intelligence, as many expectations and benefits as it brings, creates fears and fuels discussions about the negative consequences that its application can have. Teachers worry about being replaced by artificial intelligence, downgrading their role, and becoming disconnected from students. They fear failure in the social aspect of the educational work they provide. At the same time, they worry about their professional competence, the time it will take to assimilate the new technologies, and the extent to which they will be able to respond to it. They are also concerned about handling the vast amount of personal data collected by artificial intelligence applications. Additionally, they feel responsible and accountable for training and managing the AI applications used in the educational process. They fear that their imagination and creativity will be overpowered by the authority of artificial intelligence, as will their decision-making capacity. On the student side, there is widespread fear about the personal data that AI applications collect, separate and personalized for each student, and who will be responsible for its use and management now and in the future. Great concern is emerging about racist and bigoted patterns and stereotypes, which various AI applications may reproduce depending on how they are programmed and trained. Concern is expressed about whether students will put their efforts into the machine and rest themselves, whether they will focus on passing tests without immersing themselves in knowledge, whether they will become accustomed to standardized forms of assessment and fail other modes of examination, whether the new technologies create excessive and stressful demands. Also, there is a lot of talk about whether the teacher who offered emotional support, confirmation, appreciation and socialization, a role model, will exist in the classroom or whether the replacement machine will be

able to adequately replace the above characteristics. We must note here that the above research was largely based on articles, documents, news from the international press. The era of artificial intelligence has just begun, so research and practical application data are still insufficient or non-existent. There are mainly predictions and estimates from scientists and people in technology and the press.

REFERENCES

[1] European Commission. Directorate General for Education, Youth, Sport and Culture. Ethical guidelines on the use of artificial intelligence (AI) and data in teaching and learning for educators. [Internet]. 2022. LU: Publications Office. [cited 2023 Jul 22]. Available from: https://data.europa.eu/doi/10.2766/153756.

[2] University of San Diego's innovative. 43 examples of artificial intelligence in education. 2023.

[3] Talagala N. Why 2023 will be the year of AI education. 2023 Jan 10. Available from: https://www.forbes.com/sites/nishatalagala/2023/01/10/why-2023-will-be-the-year-of-ai-education/?sh=1d8f9a942c38.

[4] Kung TH, Cheatham M, Medenilla A, Sillos C, De Leon L, Elepaño C, *et al.* Performance of ChatGPT on USMLE: potential for AI-assisted medical education using large language models. Dagan A, ed. *PLoS Digit Health*. 2023 Feb 9;2(2):e0000198.

[5] Bertrand M. AI won't replace teachers—but a classroom revolution is coming. 2023 May 24. Available from: https://www.aljazeera.com/opinions/2023/5/24/ai-wont-replace-teachers-classroom-revolution-coming.

[6] Cormie A. Let's get personal: adaptive learning tech and education. 2022 Mar 16. Available from: https://blog.google/outreach-initiatives/education/adaptive-learning-technology/.

[7] Goddard W. Natural language processing in education. 2022. Available from: https://itchronicles.com/artificial-intelligence/nlp-in-education/.

[8] Sedlmeier P. Intelligent tutoring systems. In: *International Encyclopedia of the Social & Behavioral Sciences [Internet]*. Elsevier; 2001. 7674–8. [cited 2023 Jul 23]. https://linkinghub.elsevier.com/retrieve/pii/B0080430767016181.

[9] Spilka D. How VR and AR are revolutionizing eLearning for learners of all ages. 2023 May 18. Available from: https://elearning-industry.com/how-vr-and-ar-are-revolutionizing-elearning-for-learners-of-all-ages.

[10] Lucariello K. The role of AI in assisting teachers and in formative assessments of students. 2023 Jun 1. Available from: https://thejournal.com/articles/2023/06/01/the-role-of-ai-in-assisting-teachers-and-in-formative-assessments-of-students.aspx.

[11] Meehir K. How AI is personalizing education for every student. 2023 Jun 6. Available from: https://elearningindustry.com/how-ai-is-personalizing-education-for-every-student.

[12] ViewSonic. AI in education: 5 ways it can assist teachers [Internet]. 2022. Available from: https://www.viewsonic.com/library/education/ai-in-education-5-ways-it-can-assist-teachers/.

[13] Baluja H. 10 best classroom management software for teachers in 2023. 2023. Available from: https://geekflare.com/classroom-management-software/.

[14] Frąckiewicz M. The future of teacher-AI collaboration in the classroom [Internet]. 2023. Available from: https://ts2.space/en/the-future-of-teacher-ai-collaboration-in-the-classroom/.

[15] Joshi N. How AI can be a key enabler of collaborative learning [Internet]. 2019. Available from: https://www.allerin.com/blog/how-ai-can-be-a-key-enabler-of-collaborative-learning.

[16] ULLAH R. Advantages and disadvantages of artificial intelligence in education. 2023. Available from: https://techbaji.com/education/advantages-disadvantages-artificial-intelligence-education/#Laziness_in_the_students.

[17] McFarland A. 10 best AI tools for education [Internet]. 2023. Available from: https://www.unite.ai/10-best-ai-tools-for-education/.

[18] v-soft consulting. 7 of the best language-learning chatbot apps [Internet]. 2023. Available from: https://blog.vsoftconsulting.com/blog/7-of-the-best-language-learning-chatbot-apps.

[19] Spencer J. 5 ways artificial intelligence might transform assessment practices [Internet]. 2023. Available from: https://spencerauthor.com/ai-assessment/.

[20] Frąckiewicz M. Transforming school libraries with AI [Internet]. 2023. Available from: https://ts2.space/en/transforming-school-libraries-with-ai/.

[21] Bouronikos V. Revolutionizing AI education with the power of simulation-based learning [Internet]. 2023. Available from: https://ied.eu/blog/education-blog/simulation-based-learning-ai-education/.

[22] Ingle P. Best AI tools for students (September 2023). 2023 Aug 31. Available from: https://www.marktechpost.com/2023/08/31/best-ai-tools-for-students-2023/.

[23] Reclaim.ai, Inc. Top 5 free apps for students time management and productivity [Internet]. 2023. Available from: https://reclaim.ai/blog/student-time-management-app.

[24] Akash S. Collaborative learning in the metaverse: the future of education [Internet]. 2023. Available from: https://www.analyticsinsight.net/collaborative-learning-in-the-metaverse-the-future-of-education/.

[25] Glenn JK, Goldman J. Task delegation to physician extenders–some comparisons. *Am J Public Health*. 1976 Jan;66(1):64–6.

[26] Seo K, Tang J, Roll I, Fels S, Yoon D. The impact of artificial intelligence on learner-instructor interaction in online learning. *Int J Educ Technol High Educ*. 2021 Dec;18(1):54.

[27] Eager B. Will artificial intelligence (AI) take your academic job in 2023? [Internet]. 2023. Bron Eager. Available from: https://broneager.com/ai-and-academic-jobs.

[28] British Council. Will I lose my job to a robot? British counsil. 2023.

[29] Santosh K. The rise of education and AI: will robots replace teachers? [Internet]. 2023. Linkedin. Available from: https://www.linkedin.com/pulse/rise-education-ai-robots-replace-teachers-santosh-k.

[30] Hansen M. How technology will change the demand for teachers [Internet]. 2016. Available from: https://www.brookings.edu/articles/how-technology-will-change-the-demand-for-teachers/.

[31] BCS. AI should be part of teacher training courses, professional body advises [Internet]. 2023. BCS. Available from: https://www.bcs.org/articles-opinion-and-research/ai-should-be-part-of-teacher-training-courses-professional-body-advises/.

[32] Frąckiewicz M. The impact of AI on teacher training and professional development [Internet]. 2023. t2.space. Available from: https://ts2.space/en/the-impact-of-ai-on-teacher-training-and-professional-development/.

[33] Kingsley A. ChatGPT use in education, for and against. [Internet]. 2023. Available from: https://www.linkedin.com/pulse/chatgpt-use-education-against-al-kingsley.

[34] TAXILA beyond education. The ethics of AI in education: why it matters and how to address it [Internet]. 2023. TAXILA beyond education. Available from: https://taxila.in/blog/the-ethics-of-ai-in-education/.

[35] Nnabuife OA, Frederick O. *Teachers' Resistance to the Use of Educational Communications Technology in State Owned Tertiary Institutions in Enugu State*, vol. 5. Nigeria; 2019.

[36] Marr B. Will artificial intelligence replace teachers? [Internet]. 2022. Available from: https://bernardmarr.com/will-artificial-intelligence-replace-teachers/.

[37] Jumpstart Team. Will AI replace teachers in the future? [Internet]. 2022. Available from: https://www.jumpstartmag.com/will-ai-replace-teachers-in-the-future/.

[38] The Economic Times. AI and privacy: the privacy concerns surrounding AI, its potential impact on personal data read more at: Econ Times [Internet]. 2023 Apr 25. Available from: https://economictimes.indiatimes.com/news/how-to/ai-and-privacy-the-privacy-concerns-surrounding-ai-its-potential-impact-on-personal-data/articleshow/99738234.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

[39] Perry AM, Lee NT. AI is coming to schools, and if we're not careful, so will its biases. 2019 Sep 26. Available from: https://www.brookings.edu/articles/ai-is-coming-to-schools-and-if-were-not-careful-so-will-its-biases/.

[40] Malekos N. The rise of artificial intelligence in education: will A.I. disrupt eLearning? [Internet]. 2023. Available from: https://www.learnworlds.com/artificial-intelligence-in-education/.

[41] Shonubi OS. AI in the classroom: pros, cons and the role of EdTech companies. 2023 Feb 21. Available from: https://www.forbes.com/sites/theyec/2023/02/21/ai-in-the-classroom-pros-cons-and-the-role-of-edtech-companies/?sh=309939f2feb4.

[42] Asay M. How AI could radically change education and standardized testing. TechRupublic [Internet]. 2021 Jun 10. Available from: https://www.techrepublic.com/article/how-ai-could-radically-change-education-and-standardized-testing/.

[43] Ahmad SF, Han H, Alam MM, Rehmat M, Irshad M, Arraño-Muñoz M, *et al.* Impact of artificial intelligence on human loss in decision making, laziness and safety in education. *Humanit Soc Sci Commun*. 2023 Jun 9;10(1):311.