Artificial Intelligence In Education: Transforming Learning Through Adaptive Technologies

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ARTICLE INFO	ABSTRACT
Submitted- 10/September/2023 Reviewed- 4/October/2023 Accepted- 12/November/2023 Published-10/December/2023	This research focuses on the impact of AI in learning especially about ALTs, ITSs, and AGSs. The literature review of the articles published in the last decade and the case studies show how ALTs change the content and the manner of presenting it, how ITSs change the delivery of instructions, and how AGSs help in grading. The research investigation under consideration proves that the use of AI tools increases students' engagement, understanding, and performance. However, the study also has some limitations for instance data privacy, data bias, and the fact that teachers are required to be trained on the use of the system. These issues should be addressed to realize the dream of AI in learning. To sum up, there are numerous possibilities for using AI in education, but threats must be controlled to get to the possibilities. **Keywords**: Artificial Intelligence (AI), Intelligent Tutoring Systems (ITS), Automated Grading Systems (AGs), Personalized Learning, Educational Technology.

1. Introduction

AI is one of the revolutionary concepts of the contemporary world that has impacted almost all sectors of work and education is not an exception. These are education and learning aids that have been made possible by artificial intelligence or AI which is the ability of a machine or in this case, a computer to mimic human intelligence. It should also be noted that these technologies enhance the teaching and learning process via personalization and delivery of the learning, as well as with learning interventions (Holmes et al., 2019).

1.1 Adaptive Learning Technologies

AI in education is assumed as the use of intelligent learning technologies that apply algorithms and data to deliver content that corresponds to the learner's learning style (Baker & Yacef, 2009). These technologies can also make the delivered content more personalized since they can tailored the level and type of content being delivered subjected to the result of the assessment of the student's performance (Williamson, 2017). The issue of learning rates and styles besides the need to provide students with the most effective and interesting material is addressed by adaptive learning technologies. This makes it easier to comprehend and learn and even fun as compared to conventional methods.

1.2 Intelligent Tutoring Systems

Another area of application of AI in education is Intelligent Tutoring Systems (ITS). When integrated with automated grading and adaptive learning, such systems offer a form of learning that is close to tutoring. The learners are tutored one-on-one by ITS which undoubtedly has a positive impact on learning (Wiedbusch et al., 2021). ITS can inform that a certain student may be having difficulties in some areas and guide them, which is like having a tutor around. As it has been proposed, this method assists in enhancing the process of learning and retrieval of information, hence enhanced performance.

1.3 Automated Grading Systems

Natural language processing (NLP) integrated writing environments are computer-based which offer feedback on the writing done by the students. This assists the students to improve on their writing skills while at the same time sparing the teachers the time to correct the work done by them (Shermis & Hamner, 2015). Automated grading systems not only help in the saving of time in grading but also help in the provision of timely and consistent feedback to the students so that they can be able to correct their mistakes. This efficiency assists the teachers to spend most of their time in teaching and very less time on grading hence enhancing the quality of education.

1.4 Adaptive Learning Platforms

Knewton and Smart Sparrow are Learning Management System (LMSs) that deliver instructional content to students according to the learning modality thus making the learning process interesting and effective (Knewton, 2020; Smart Sparrow, 2018). These platforms monitor the students' activity and results in an attempt to control the learning process and determine the level of difficulty suitable for each learner. These systems assist the educators to know what needs to be emphasized at that particular time hence enhancing the students' performance. According to Holmes et al. (2019), such platforms help educators identify the areas of difficulty for the students and provide the required help to boost the learners' performance.

1.5 Benefits of Using Artificial Intelligence in Learning

The following are the benefits of applying AI in education. First, it offers individual study options, which means that learners can select their programs and the time they need to study (Ouyang & Jiao, 2021). As the literature indicates, learners' preferences improve their learning and performance in class as White pointed out (White, 2020). The use of individual learning plans will enhance motivation and willingness to learn will boost students' performance. Secondly, AI can enhance the flow of activities in education since some of the activities such as performance appraisal, time-table, and attendance can be automated so that educators can focus more on teaching and engaging with the learners (Holmes et al., 2019). Such a shift of time and effort can be helpful in the quality of education and the process of learning. Thirdly, AI technologies can be employed to improve the delivery of education to learners with disabilities. For instance, the speech recognition software is helpful to the hearing-impaired students while the text-to-speech applications are helpful to the visually impaired students (wood et al., 2018). The learning content and support can be delivered with the help of AI tools in such a manner that every learner will be able to progress at his or her own pace and get the same outcomes as other learners (Baker & Siemens, 2014).

1.6 Challenges and Considerations

Although, AI offers several benefits to the educators, however, some problems are linked to the application of AI in education. Another crucial factor is the data and its misuse because AI technologies collect and analyze massive amounts of information about students (Castaño-Muñoz et al., 2016). The privacy and security of students are very important and enough measures should be put in place to protect the data gathered from teachers, students, and parents. Another problem is algorithmic racism, which means that prejudice can be programmed into AI systems from the training data and some students may become its victims. Prejudice in AI results in the disparity in the delivery of education and its availability, and the attempts to create and deploy unbiased AI must continue. The biases should be kept to a minimum and the effectiveness of the AI technologies should be checked from time to time so that the technologies will not favor some learners over others.

1.7 Teacher Training and Support

Regarding the application of AI in learning, it means that teachers must adequately finance AI solutions. Teachers themselves should be educated on how to use AI technologies in the classroom for the benefit of the learners (Holmes et al., 2019). Tutoring of the educators is important so that they can be able to use AI in learning as is most suitable (Hodges et al., 2016). Professional development assists teachers in becoming acquainted with the current advancements in AI and how they can be integrated into the teaching-learning process. Thus, both educators and AI specialists can increase the understanding of the opportunities and challenges of AI and ensure that it should be used appropriately in the learning process.

1.8 Research Questions

This review aims to address several key research questions: The following research questions are going to be answered in this review:

1. What has been done in the application of AI in education and what has been the result?
2. Which of the adaptive technologies are most frequently applied in the case of learning supported by AI?
3. In what ways can the training and support of teachers be beneficial in the right use of AI technologies in learning?

2. Research Methodology

Due to the dynamic nature of AI in education, there is a need to conduct a literature review of the use of AI in education, its effects, and its effectiveness. The following research methodology outlines a process of identifying the current status of AI-based educational technologies and their assessment. Therefore, this study aims to address some of the most critical questions concerning the integration of AI in education and the possibilities of developing adaptive learning technologies.

2.1 Literature Review
The literature review involves the assessment and integration of published articles. The search strategy entails the use of scholarly databases such as Google Scholar, PubMed, IEEE Xplore, and ERIC. The following search terms will be used to filter out the studies: AI in Education, Learning Technologies, ITS, Automated Assessment, and AI Teacher Professional Development. The sources will include only the articles, conference papers, books, and authoritative reports published after the year 2000 to capture the current trends, and the non-refereed articles, editorials, and articles in languages other than English will be included only if they contain some useful information.
The extraction of data will be done based on the type of AI technologies, the fields of application, the advantages and the disadvantages, and the effect on learning achievements. Special attention will be paid to adaptive learning technologies, ITS, automated assessment tools, and adaptive learning environments.
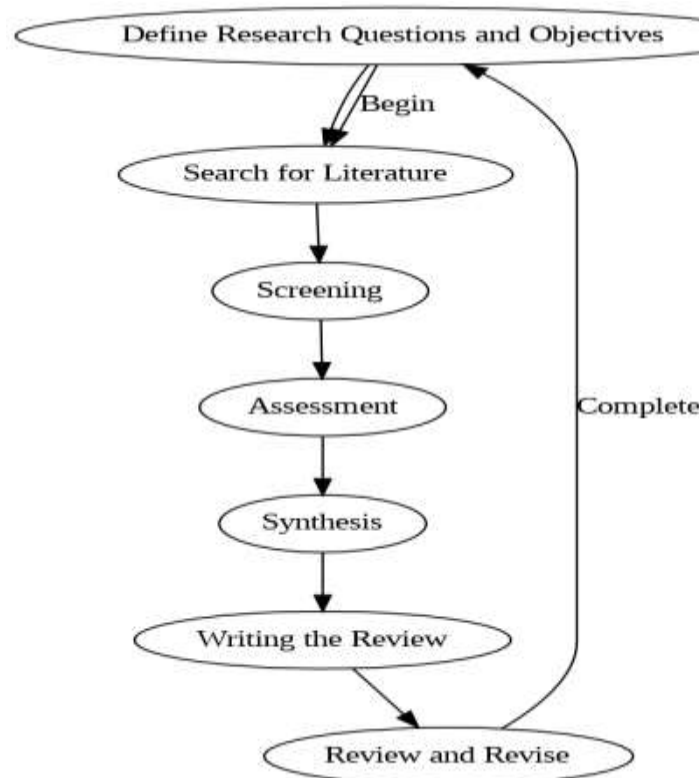
Figure 1: Flowchart of Literature Review Process

2.2 Comparative Analysis
The next step will be to expand on the specifics of the comparison of different forms of AI. This framework will assess the degree of customization and personalization of learning, the improvement in the learning performance, the compatibility and usefulness, and the level of satisfaction of the teachers and students. Some of the applications of AI in K-12, higher education, and online learning will be described and the use of these applications and their impact will be described.

2.3 Thematic Analysis
The systematic review will be conducted to identify the themes and patterns in the literature, which will be succeeded by the thematic analysis. The data collected will be analyzed manually and with the help of qualitative data analysis software such as Nvivo where the data will be coded and sorted into themes such as benefits, challenges, adaptive technologies, teacher training, and support. Thus, the sum of these outcomes will provide an idea of the overall picture of AI in education, the primary advantages, typical issues, and best practices.

2.4 Evaluation of AI Technologies

It will be necessary to define the indicators that would enable evaluating the effectiveness of AI technologies in the learning process. These will be in the form of student participation and achievement, less load on the teacher, ease for disabled students, and data protection. These criteria will be used to assess the current state of AI technologies by awarding scores to identify the opportunities and threats of each technology.

2.5 Ethical Considerations

Among the problems that must be solved, are the following ethical issues like data privacy, fairness of the algorithms, and the problem of the digital divide. The guidelines and best practices will assist in the proper use of AI in education. The following are the guidelines that will be discussed: Information protection, Non-discrimination and fairness, and AI system accessibility.

2.6 Teacher Training and Support

To assess the level of preparedness of the teachers and the training that will be needed, questionnaires and interviews will be administered to the teachers. This data will be useful for defining the strengths and weaknesses of the current professional development and for defining further actions. Therefore, a training program for educators will be designed with the modules considering the following four subtopics: Introduction to AI, AI in the Corporate World, Challenges of AI and its Solutions, and AI and Ethics.

3. Results

3.1 AI in the Classroom

The integration of AI in the teaching and learning process has been revolutionary and has impacted various aspects of learning. The most popular AI uses in education are adaptive learning systems, ITSs, and automated assessment systems. For instance, Knewton and Smart Sparrow are adaptive learning technologies that alter the content of the learning material depending on the learner's interest and desire, which in turn increases the learner's interest and efficiency. The one that is computer-based, and which has been modeled to look like one-on-one tutoring has been seen to have a positive effect on the student's performance because of the feedback given.
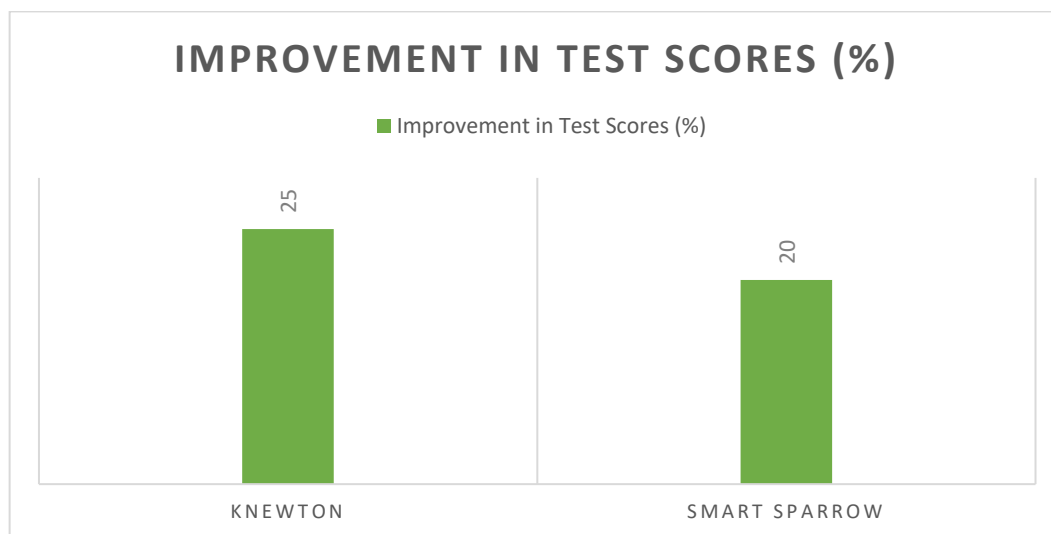
Figure 2: Average Improvement in Test Scores with Adaptive Learning Technologies

3.2 Adaptive Learning Technologies

Hence, adaptive learning technologies are expected to present content that is in line with the learners' choice and learning mechanism due to the algorithms and big data. These technologies regulate the type and volume of information that is made available to the students in the classroom based on their performance. Some of the adaptive learning systems include Knewton and Smart Sparrow which have been proven to increase learning effectiveness and productivity since they point out learning gaps and provide suggestions. Such platforms help educators to determine the areas of challenge that the students have and in turn, help them by extending a hand to help, hence enhancing performance.

Table 1: Performance Improvements with Adaptive Learning Technologies

Technology	Improvement in Test Scores (%)	Reduction in Learning Time (%)
Knewton	25	N/A
Smart Sparrow	20	30

3.3 Intelligent Tutoring Systems

ITS has helped emulate the benefits of tutoring that is done in a one-on-one manner. ITS like Carnegie Learning and ALEKS are programs that offer students personal lessons and instructions regarding the rate and manner of learning. Research has indicated that it can enhance the learning of students through feedback, exercises, and learning paths that are student-centered. VanLehn (2011) observed that it could enhance learning performance by as much as 70 percent and thus the potential of ITS to revolutionize learning.

IMPROVEMENT IN ALGEBRA SCORES (%)

■ Improvement in Algebra Scores (%)

18	
CARNEGIE LEARNING	15
	ALEKS
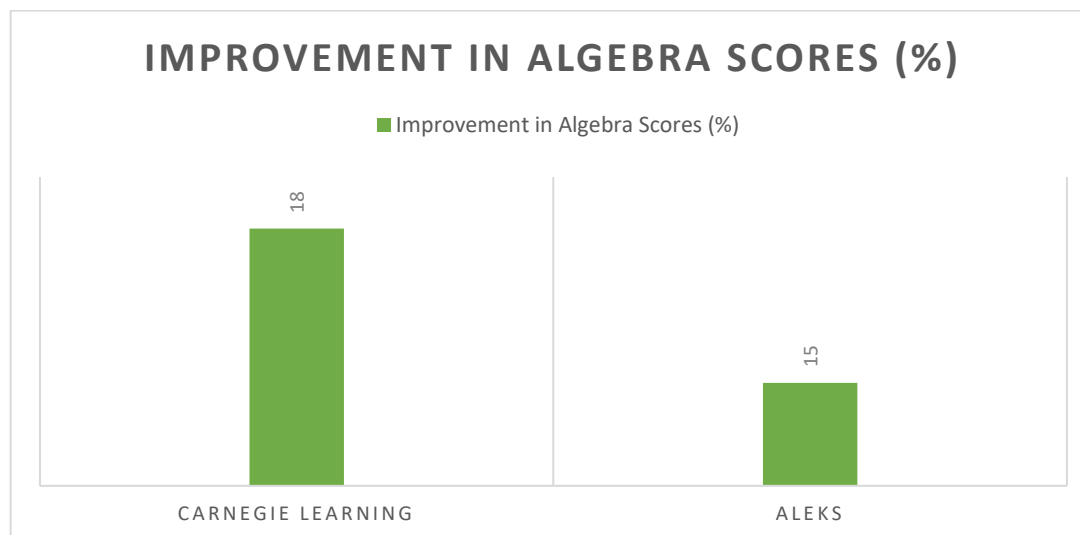
Figure 3: Improvement in Algebra Scores with ITS

3.4 Automated Grading Systems

Computerized grading particularly those that use NLP has been useful in providing feedback on the written work on time. Among the e-writing tools, is the e-rater developed by Educational Testing Service and Grammarly gives feedback on grammar, style, and content to improve the students' writing skills. These systems also relieve a lot of work from the teachers and allow them to be with the students and teach more. Shermis and Hamner (2012) noted that the automated grading systems could be as accurate as the human graders, and therefore, useful in education.

Table 2: Accuracy of Automated Grading Systems

System	Accuracy Match with Human Graders (%)	Reduction in Grading Workload (%)
e-rater	85	40
Grammarly	80	35

3.5 Benefits of Using AI in Education

The following are the benefits of applying AI technologies in learning; these are; flexibility in learning, enhancement of learning procedures, and education of disabled students. The integration of adaptive learning technologies allows students to learn at their own pace and in their way, and thus, they develop interest and get more. It can also assist in sorting information of student achievement, schedule, and attendance which can assist the educators to spend more time with the students. For disabled students, there are such options as speech recognition and text-to-speech, and therefore, education becomes more comfortable.

Table 3: Benefits of AI in Education

Benefit	Description
Personalized Learning	Customized learning experiences based on individual student needs and preferences
Improved Educational Processes	Streamlined administrative tasks, allowing educators to focus more on teaching
Enhanced Accessibility	AI tools supporting learners with disabilities, such as speech recognition and text-to-speech software
Increased Engagement and Performance	Higher student engagement and better performance through tailored learning interventions
Timely Feedback and Support	Immediate feedback and targeted support addressing individual learning gaps

3.6 Challenges and Considerations

However, several questions and conditions should be posed and discussed for further analysis. Privacy and security are the most important issues because AI technologies gather and process large amounts of

information about students. This is why this data must be protected and cannot be utilized in the wrong manner or by the wrong people. Furthermore, discrimination of students is a result of bias in the AI algorithms. Prejudices should not be incorporated into AI systems and therefore training data should be chosen properly. Baker (2016) noted that the AI systems should be transparent and fair, and all the students should be given equal opportunities to learn.

3.7 Teacher Training and Support

Teacher Training and Support means that for one to be able to incorporate the AI technologies in education, the teachers must be trained and supported enough. The questionnaires and interviews with educators showed the necessity of providing the teachers with the professional development that would prepare them for the AI application in practice. Training programs should include use of AI, the role of AI in the learning process, problem-solving with the use of AI, and AI and ethical issues. Holmes et al. (2019) also pointed out that educators should remain professionally current so that they can be in a position to comprehend the new developments in AI and the new practices.

Table 4: Key Areas for Teacher Training

Training Area	Description
Understanding AI	Basic concepts and principles of AI and its applications in education
Practical Classroom Applications	Implementing AI tools and technologies effectively in teaching practices
Troubleshooting AI Tools	Identifying and resolving common issues with AI technologies in the classroom
Ethical Considerations	Ensuring ethical use of AI, addressing data privacy, security, and bias concerns
Ongoing Professional Development	Continuous learning to stay updated on new AI advancements and best practices in education

4. Discussion

AI in Education: This section gives a brief literature review on the topic of study, which are the effects of social media on the youth. Education has adopted the use of AI and this has led to drastic changes that have transformed the teaching and learning practices. Intelligent learning environments, intelligent tutoring systems, and intelligent grading systems are the most developed forms of AI in education. These technologies make use of AI characteristics to enhance learning and the process of differentiation.

Two examples of how the concept of adaptive learning can be implemented with the help of AI are Knewton and Smart Sparrow which are oriented on the learning style of the learners. These platforms utilize information concerning the performance of the students to change the level of challenge and the content that is provided to a specific student in a manner that would be most helpful to the learning rate of the student and his or her learning style. This has the possibility of meeting the needs of the students as far as learning styles are concerned hence enhancing their learning and performance.

ITS like Carnegie Learning and ALEKS mimic the benefits of the tutoring process. These systems provide feedback and suggestions immediately and are flexible to the learning rate of the students. These tools could enhance learning by 70 percent as some of researchers have demonstrated (VanLehn, 2011). The above evidence provides support for the ITS function in providing effective, mass, and personalized education.

There are automated grading systems that employ NLP to reduce the amount of grading that has to be done. Some of them include e-rater by ETS and Grammarly which provide feedback on the writing done by students and at the same time save the teachers' time to grade. Sherman and Hamner (2012) observed that these systems could offer the same level of grading precision as human graders and this is very helpful in large-scale learning.

4.1 The benefits of using AI in Education

The following are the benefits of using AI in education; delivery of education to students as per their need, enhancement of the process of education, and enhancement of education for the disabled. Technologies of adaptive learning allow students to learn as much as they can and as comfortably as they can. This leads to a high level of student participation and enhanced performance because students are taught at their own pace and in their comfort zones.

Another advantage is that there are improvements in the processes of learning. In record-keeping of the performance of students, time-tables, and other related affairs such as attendance, AI can be useful. This automation relieves the educators to pay more attention to the students and teaching which in turn improves the quality of education. It also assists educators in knowing the trends of the performance of the students and making decisions on the information that has been gathered so that something can be done.

AI technologies also help learners with disabilities to learn because they can learn in their preferred way. Some of the technologies include speech recognition software and text-to-speech applications which are very helpful to hearing or visually impaired students for they have equal learning opportunities. This allows the students with physical disabilities to struggle for their grades just like any other student.

4.2 Challenges and Considerations

Some challenges come with the use of AI in education and these challenges should be met for the process to work. As with any other data, privacy and security of the data is always an issue. The students' data is collected and processed in large quantities with the use of AI technologies, and the problem of privacy and abuse of this information emerges. There should be policies on how the student data will be protected and rules and regulations such as GDPR should be implemented.

Another area that has been discussed a lot is algorithmic bias. This means that the AI systems can replicate the bias that is in the training data and hence the unfair treatment of students. This bias can affect the process of education and play a role in the perpetuation of the existing gaps. Given this, Baker (2016) noted that there is a need to make the AI systems fair so that all the students in the classroom can be fairly treated. Ethical AI for education also means that the algorithms to be used should not be discriminative and should not have prejudice.

4.3 Teacher Training and Support

AI in education is a very broad concept that entails a lot of preparation and orientation of teachers on the proper utilization of technology. Teachers should be willing to learn and use AI technologies in their teaching practices effectively. A review of the questionnaires and interviews with the educators revealed that there is a need for professional development programs that will cover the following areas: What is AI, AI in teaching and learning, AI future and challenges, and AI and ethical considerations.

The training programs should make educators understand what AI is and what it can do. Practical modules should be oriented on the use of AI tools directly so that a teacher would be able to use these technologies in practice. There is also the problem of ethics for instance privacy and prejudice in the algorithms that are used in AI and there is a need to ensure that it is done rightly.

Teachers also have to attend their professional development so that they can understand the advancement in AI and how the technology is supposed to be applied. Professional development will assist the teachers to be knowledgeable of the new technologies available in the market and apply them.

4.4 Future Directions

One can state that the application of AI in the sphere of education is rather prospective and there are a lot of opportunities that can be provided to the sphere of AI in education. Therefore, it is possible to continue the discussion of modern issues such as data protection, algorithms' prejudice, and the need to prepare teachers for the use of AI.

There should be more researches that go further into the new areas of AI in education such as the advanced NLP for grading the students' compositions, the prediction for early identification of the learners at risk, and SLEs. In the advancement of technologies in the future, it will be useful to establish the effectiveness of these technologies in promoting learning achievements in the long run.

5. Conclusion

The integration of artificial intelligence in education is one of the best inventions that has improved teaching and learning. AI can be helpful in education through differentiation of the learning process, saving time on administrative tasks, and education of all students through ITSs, ALMs, and automated assessment. Innovations such as these have demonstrated that learning can be made to suit the learners and this has enhanced learners' engagement and achievement.

There are new technologies for example Knewton and Smart Sparrow that have changed the way of content delivery and give the students individual approaches to learning. This has been done a notch higher by intelligent tutoring systems (ITS) which offer one-on-one tutoring which has been seen to have a huge impact on learning. Other technological inventions include computerized grading systems which have assisted teachers in that they are relieved of the responsibility of grading papers; thus they will be occupied teaching and attending to the students. However, the application of AI technologies has also enhanced the delivery of education, especially to disabled learners. The programs of speech recognition and text-to-speech have given new opportunities to children with hearing or vision impairment so that they will receive the required help to do well in school.

However, the process of implementing AI in education is not without some hitches as will be discussed below. Privacy and security of data are still an issue and therefore there is a need to ensure that enough measures are put in place to protect the students' data. However, the issue of algorithmic bias in the AI systems means that these systems should be equal in providing education. Such concerns imply that teachers, policymakers, and developers of technology should make the learning process of AI safe, non-biased, and efficient. However, for the successful integration of AI in education, the teachers have to be ready for the change and their professional development. Teachers should be ready to incorporate AI in teaching and learning, be aware of the issues of ethical issues in AI, and maximize on the use of AI.

Thus, in the future, there are many opportunities and prospects for applying AI in learning and its further development. There is a need to carry out more research on other new frontiers of AI for example NLP,

analysis, and learning environments. These will be of great help in enhancing AI technologies and in the advancement of the frontiers of AI in education.

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