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AI-powered assessment tools for E-learning: Enhancing feedback and grading systems

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Abstract

Recently, there has been increased incorporation of artificial intelligence in the education system, which has impacted the practice and use of assessment in learning. To this end, the following is a paper discussing the role of AI in grading, instant feedback, and personalized adaptive testing. The paper also covers the ability of AI to minimize bias and introduce fairness while grading, as well as the ability that comes with the mass LMS platforms. Moreover, this paper discusses the issues and guidelines regarding the ethical use of AI in education: data protection, the problem of automated prejudice in AI, and the replacement of human tutors. When these seemingly unimportant problems are solved, and institutions admit that ethical practices are critical, such opportunities for Artificial Intelligence can be harnessed to make learning more efficient and fairer. At last, integrating AI into learning benefits teachers and students: it enhances the teaching and learning processes. It creates the prospects for the future global exposition of technology with human creativity to enrich learners.

Keywords: Artificial Intelligence (AI); Education; Assessment Tools; Automated Grading; Personalized Feedback; Adaptive Learning

1. Introduction

The emergence of e-learning platforms has changed how learners learn by ensuring they have an easier and more flexible way of accessing educational needs worldwide. However, this has also led to difficulties, mainly in assessment and feedback, which will be discussed below. Most conventional grading systems involve tedious computation by the instructors, cannot be used to grade large classes, are subjective, and may yield different scores for the same work in other courses. For that reason, the application of artificial intelligence (AI) in educational assessments may be useful as it tries to automatize and improve the process [22].

AI in education is not just limited to a system of making tasks automatic but also about enhancing the quality of learning. In formative assessment, AI applications can recommend timely feedback to learners, customize the test according to learners' performance, and evaluate learners' progress in real time. It can also help automate the scoring of various problems, from factual, multiple-choice answers to open-ended ones or even programming assignments. In addition, AI minimizes factors such as biases in grading and makes sure that the same results are provided across a diverse cohort.

This article examines new technologies to deliver assessment and feedback in e-learning, particularly AI tools. This post explores the different aspects of AI being integrated into grading, feedback giving, and even proctoring methods that are adaptive. Further, the article discusses the pros of applying AI for its scalability, reduction of bias, and assistance to educators, as well as the pros and cons of implementing AI in learning. In the future, embedded AI is expected to characterize the future of e-learning assessments as it progresses.

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2. Overview of AI in education

The use of Artificial Intelligence (AI) in education changes various characteristics of the learning experience. In learning, from the intelligent tutoring system to intelligent estimation, AI is revolutionizing education and practice. AI has the greatest impact on assessments, but it is present at all levels of the education process. Is

From the context of education, artificial intelligence has very significant applications in making learning personal. In fact, with the help of big data on students' interactions, learning rates, and assessment results, AI learning systems can adapt content to the specific needs of every learner. It helps educate students where they most need help – by possibly individualizing learning with adaptive learning platforms or AI tutors. For instance, Khan Academy and Coursera are embedding AI to set the learners on the right course and enhance their learning experience.

Besides people's customization, AI makes work more effective for practitioners and organizations. These include time-tables, lateness, and even the identifying patterns in performances. So much more has been made easier by the help of an AI, thus freeing up much more of the educator's time for teaching and nurturing. The use of analytics driven by artificial intelligence enables educators to get information about students' progress and use the gathered data while changing the approach and structure of the classes [25].

Regarding assessments, AI has transformed the take, administer, and evaluate the test process. These tasks range from grading multiple-choice questions to providing feedback on essays and programming tasks to students – all of which point to the fact that AI saves teaching time while creating consistency and efficiency in assessment. AI also allows forced choice testing in which the difficulty level of questions changes with the learner's response, making the assessment experience personalized [2].

Also, according to the same source, the use of AI systems extends to content development, where the systems assist educators in developing better learning curricula by evaluating the resources within learning content and students' performances. When used to assess the usefulness of a certain instructional strategy or fill in the existing gaps in coverage of the subject, AI can enhance the learning process so that learners not only pass their tests but also understand the course material.

Though the use of AI in education has yet to be fully developed, it has been demonstrated that using artificial intelligence in the teaching/learning process positively influences learning outcomes. Through individualization of learning, enhancing the method of delivery, and reimaging the assessment, systems of artificial intelligence integration have remodeled education as a more engaging, personalized process focusing on the learner. Nevertheless, they create problems regarding ethics, data protection, and, last but not least, the tendency to shift educational processes towards AI, which are the problems that should be solved with the further growth of AI's importance for education.

3. Automating grading with AI

Artificial intelligence in grading might probably be one of the profound and most easily implemented forms of AI in education. Evaluation, particularly when it involves many learners enrolled in large-scale innovative pedagogy such as e-learning, can be tiresome for instructors. AI has enhanced this by cutting down the time and effort required to perform the evaluations by a huge margin and where the assessment evaluations' precision is more accurate. From multiple choice exams, which can be automatically graded, to written assignments, including essays and coding assignments, applications can automatically grade student work with incredible efficiency and accuracy.

Another major advantage AI enjoys when it comes to competencies or objectives testing, such as multiple choice, true/false, and matching questions, is the ability to mark the correct answers instantly. This is particularly helpful in large lecture courses or MOOCs, where thousands of learners take quizzes simultaneously. AI systems are designed to understand correct responses while grading assignments, and students receive feedback immediately. Such automation enables teachers to concentrate on more learning content and learner interaction instead of spending many hours on evaluations [9].

Integrating AI into objective assessments such as multiple choice and short answer questions is clear and revolutionary. Still, AI's impact on more assessments, such as essays, open-book responses, and projects, is subtler but just as effective. Historically, the grading of subjective work has been a time-consuming process as the human talent has to analyze not only the correctness of the facts presented in the assessment target but also its overall quality, argumentation, degree of logic, and even a writer's style. There is a lot of progress with AI tools related to this field, such as OpenAI Codex,

Grammarly, Turnitin, and so on. These systems include NLP components for assessing the structure, grammar, and coherence of written works produced by students. Some sophisticated AI also analyzes content in terms of originality and structure of the arguments, identifies plagiarism, and upholds academic standards.

Yes, the tools could be better in implementing AI in subjective assessment, but they have improved and become more efficient. For instance, Codex may be useful in grading coding assignments or projects by checking on the efficiency of coded work offered for grading and making recommendations on errors and corrections that could be implemented. Likewise, Grammarly helps enhance students' writing standards by suggesting grammatical and stylistic mistakes as the student writes. Services like Turnitin not only catch cheaters but also explain how to quote and refer to other people's work to students accidentally. These AI tools, for instance, help educators reduce the time they take in grading as they provide the students with immediate feedback.

One of the nice features of an AI-based grading system is that it is relatively easy to use in the way that it provides consistency. Unfortunately, human evaluators can be subjective and inclined to tiredness or present some sort of prejudice that will influence their grading level. As for AI tools, the criteria are similar for all the assessments so that the learning attainment of every student will be appraised to the same extent. This consistency is especially useful in big classes and online courses when several hundred or several thousand students submit their work simultaneously. Using AI, teachers can be assured that every child has been graded fairly without any outside chance of human mistakes or prejudice influencing the results.

Despite these benefits, AAI's capability to assess the students' intricate work has enhancements. Algorithms can quickly and easily grade student writing based on grammar, logic, and paper structure. Still, the problem comes with creative thinking, emotions in text, and critical thinking. For instance, AI cannot understand a student's creativity or creativity in coming up with solutions to various problems or lack of reasoning relating to a good argument in an essay. Therefore, when it comes to higher levels of analysis, grading would still require the human eye, even when AI cannot help. In such areas as literature or art, which the information amounting to a billion bytes may represent, human judgment must be included when evaluating the creativity and aesthetics of the result [9].

Still, it is impossible to doubt the advantages of using AI for grading. Automated grading also means that teachers are sparing their time and making a useful investment in students' feedback, which is vital for the learning process. Ideally, in the traditional learning environment, students wait days or weeks to receive feedback on their academic work. Feedback flow – With the help of AI, it is possible to provide instant feedback, which the students can solve quickly.

Indeed, the scalability of AI grading systems and, as an extension, AI grading systems is another advantage. With the increased popularity of online education, common testing followed by evaluation of many students is critical. AI also enables institutions to assess more student cohorts than could be achieved with traditional methods while maintaining the quality of the assessment. This scalability is especially important in large online courses, which would be heavily impracticable if supervised and graded only by humans [21].

4. Real-time and personalized feedback

The most impactful of all is that AI offers a chance for timely feedback to learners in the context of e-learning. In traditional education, formative feedback is typically lagged since teachers take time to assess assignments physically. However, feedback opportunities received days or weeks after submission are less effective at enhancing the student learning process because they delay the error correction and concept acquisition timeframe. Advanced AI solution, on the other hand, provides an immediate solution by responding instantly with feedback based on the learner. Such feedback given in real-time can also improve the effectiveness of learning and speed up the achievement of results and learning outcomes amongst students.

More advanced types of feedback systems should naturally engage the student throughout the whole process of learning. Instead of the instructor offering feedback at the end of an assignment, these tools can review student work and make recommendations while the student works through the assignment. For example, in a language learning application, AI can recognize wrong grammar or incorrect word choices the moment they are said by the student and force the student to correct them. The constant interchange between teacher and students makes it easier for students to know when they are wrong if new content is being taught, making it easier for the students to learn and retain the content being taught. Such corrections facilitate the student's attention to the information's material as they allow changing it without allowing the frustration to increase and without providing the student with the need for correction of the entire material at a later time.

Another element that defines the scope of AI-based feedback is the possibility of personalizing feedback. These tools are not general-purpose tools for providing feedback that suits any learner, but one has to customize their response to meet the needs of the individual based on the latter's performance. Much like how a supervisor identifies patterns in a student's work, for instance, frequent errors, rate of solving assignments, and strengths, an AI can give feedback about the specific students it is working with. For example, if a student makes a wrong answer to a question or set of questions repeatedly, the system can propose that they practice more, or the system could put the concept more easily. On the other hand, it would help if there was evidence that if a student has done well on specific topics, the AI could recommend more complicated content. Such targeted assessments guarantee that every learner gets specific feedback that is useful to their particular learning model, thus making improvements.

Individual coaching is the most valuable when studying subjects that include many repetitions, like coding, writing, or language learning. In coding, for instance, AI-driven platforms can highlight an error in the student's code and tell him the problem and possible remedies. Such immediate feedback enables learners to see their wrong performances and be able to correct them when doing more complex exercises. Likewise, in writing, applications such as Grammarly provide tips on tricky areas best approached in terms of punctuation, grammar, and overall comprehensibility as the particular student carries out their writing. This allows students to produce higher quality work but also gradually corrects students' writing habits.

The greatest value of real-time feedback is the ability to learn as you operate and improve one's previous performance. In traditional environments, students only get feedback after completing an assignment or test; hence, they can only benefit from the input after the next assignment or test. However, with AI implementation, there is the capacity for change as soon as required. For instance, alerts and recommendations are made immediately if a child writes a science assignment and submits a checkpoint. The student can modify and revise the project repeatedly until they learn it thoroughly and realize a higher order of proficiency. This learning process helps cultivate an explicit growth perspective where learners learn how to make something good out of something wrong.

There is another significant use of AI-based feedback applicable to learning loss detection. Cognitive computing tools can easily track lots of data about a student's performance and identify the particular areas that need help. For example, the AI might suggest that a student stays on the page to answer more questions incorrectly on a certain topic and instead refer the student to instructional videos, articles, and practice exercises to improve on the concept. Such a form of feedback is far more accurate than the techniques involving teachers making global deductions. In the case of AI, one gets feedback based on the specific difficulties facing them and other necessary resources to get through.
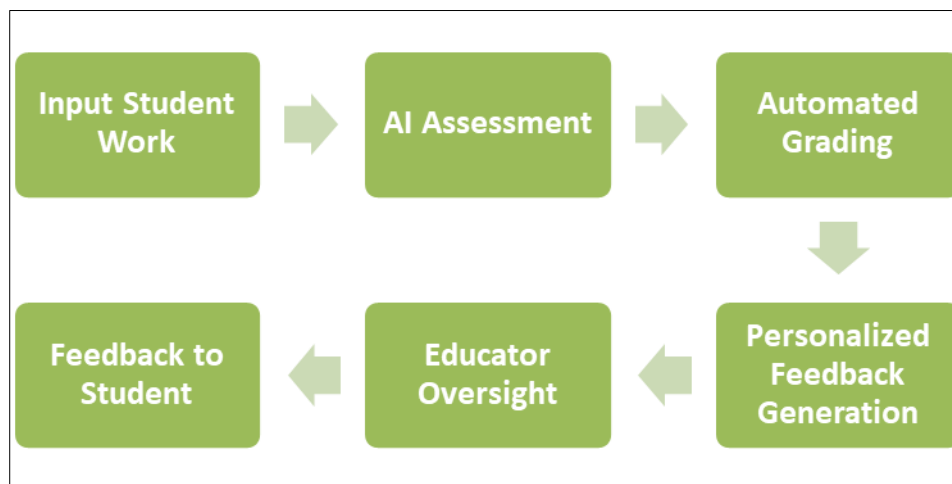
Figure 1 Flowchart: AI-Powered Grading and Feedback System

In addition, continuous feedback increases the level of stimulation among the students. Learners themselves are motivated when they have to take tests and get results immediately without protracting with many exercises with little or no rewards. AI systems can also support positive reinforcement and motivate students when they perform well, including complimenting the child or using words to encourage them. This is particularly essential when learners are always at a point where they feel alone, especially when learning online. Audience feedback is more valuable when it is immediate, as it fosters engagement, and students are likely to feel supported when obtaining feedback on their assignments.

Still, there are experiences and weaknesses of utilizing AI in creating feedback systems. For instance, at times when a human may need to interpret a code or differentiate between less and few, AI remains the best option as it is perfect in offering technical aspects such as syntax brace checks but lacks the emotional intelligence to advise on sensitive issues such as correct code documentation between less and few. Thus, despite the recent interest in using artificial intelligence in creative writing, feedback analysis is still mostly performed by people because AI still needs to understand, for example, the emotional capacity or the creative vision of a text. Also, an AI solution will recognize that a task should be taught in a certain manner based on its assessment of learning curve data and not know all the additional reasons a certain learner will have to face while learning that particular task – motivational, personal, or otherwise. This means that artificial intelligence should be used as an additional source of feedback instead of replacing human feedback [3].

5. Adaptive testing and assessments

Flexible assessment is an emergent action that was developed to address the need to approach testing by individualizing the difficulty level of the questions depending on the candidate's answers. This method differs from most conventional tests because, unlike them, this one does not offer the same questions to all learners equally. Adaptive assessment can then bring dynamism through artificial intelligence by improving the testing process of a learner's knowledge and skills.

The main integration of an adaptive test is the one that decides which question comes next depending on the student's responses. For example, if a student is correct, the system provides another difficult one in order; if wrong, the system offers another easy one. Such dynamic adjustment allows the assessment to get closer to the learner's abilities and results, which benefit them. That is why adaptive tests can be solved with fewer questions than traditional methods; the process is thus more efficient.

Another advantage of adaptive testing is that it stimulates students' interest and encourages them to study. Hole's traditional assessments are uninteresting to learners who are well-equipped to answer the questions and unchallenging to learners who come across questions that challenge their skills. Adaptive testing, on the other hand, will allow students to get challenged close to their potential and, at times, be over-challenged. It also enables the student to remain active throughout the assessment process and promotes a positive learning attitude. According to the model, learners can apply effort when they successfully work through the Demonstrated Achievable Rigor set in classrooms, thus attaining improved educational results [16].

Also, adaptive assessments can minimize test anxiety. Most learners feel pressured or anxious when sitting for an examination, especially because they may fail to prepare for questions they do not know about. Adaptive testing reduces some pressure because of increased personalization, enabling students to prove their worth without undue pressure from a mass exam. Such an approach can help design a safer testing environment within which students feel capable of performing well — and thus develop a healthier attitude toward the tasks at hand.

AI is involved in both the formal development and administration of dynamic assessments. AI algorithms can know from previous test-takers the difficulty of future questions and which type provides accurate knowledge assessment. Such data facilitate the improvement of the tests and the materials used in the tests as adjustments are made as time progresses. Moreover, AI can offer real-time monitoring and analysis to give educators insights into student and class performance. This insight helps the educators in the course to design their course to fit the gaps and skills that may have been exposed through adaptive tests [14].

The strengths of adaptive testing are apparent; however, there are also difficulties with its application. However, developing valid and reliable adaptive assessments entails some much-needed initial costs regarding technology and funding. Every university should prioritize creating a bank of questions that range from easy to complex and address a variety of fields. Moreover, the question bank must be updated strictly to preserve the credibility and significance of the questions in the question pool as the courses progress. This must continue the constant work of educators, content specialists, and technology teams to maintain and build the content base as new types of adaptive testing are developed.

The fourth difficulty is connected with the overuse of workshops and new technologies in the educational process. Though AI is beneficial in giving insights and improving the test-taking experience, it cannot eradicate the human factor in learning. Teachers will still find themselves intercepting testing outcomes and supporting children individually in the future. Adaptive assessments should also be introduced alongside classical approaches to learning rather than as their replacement; in this way, teachers will be able to use information obtained with the help of artificial intelligence in their work, remaining close friends with students at the same time.

Educational testers also question ethical issues connected with the use of adaptive tests. To that end, data privacy and algorithmic bias must first be solved to guarantee fair and equal treatment of all students. Thus, Machine-learning algorithms can reward or penalize students based on prejudice in training data development. To counter these threats, the educational institution must set extreme standards of ethical behaviors, and the algorithms have to be monitored periodically so that they are not misleading and committed to pretentious conduct.

6. Reducing bias and ensuring consistency in grading

Assessment of student learning is a fundamental component of education, but problems such as biases and inconsistency with conventional grading procedures frequently influence it. These biases can be owing to several reasons, such as evaluator bias, social bias, and even prejudice that may be in tendency with the student's background. This paper looked at various concerns associated with grading systems to determine how incorporating artificial intelligence (AI) in grading systems can help rectify these challenges and arrive at a fair and more efficient method of grading systems.

Computer-aided grading systems are another category of grading instruments that minimizes objectivity in grading. This limits more traditional grading paradigms as these primarily depend on the individual teacher's interpretations of criteria. This can result in fluctuation of scores on the same work, firstly, because different tutors can have other demands, and secondly, because they can focus on various aspects of knowledge. At the same time, AI systems are designed to process assignments using the same rules for all other students' assignments. AI can offer more objective results in grading by using algorithms as opposed to what an instructor may perceive from raw talent as opposed to talent delivered by the student after learning from the material [8].

It also has several applications: AI also enables reducing the impact of unsought bias. Bill and Melissa have supported this view by pointing out that studies have found it difficult to remove what is termed as 'differential' — the tendency of human evaluators to inadvertently permit biases to affect the scores they give, depending on the style of writing of the student, their demographic characteristics, or even how the work is presented to them. AI systems can learn data as vast as students' responses and change their perception of work given the answers felt by any of them. For instance, when grading writing assignments, AI is free to keep assessing the flow of ideas, the cohesion, or the organization of the knowledge but can never be influenced by the talents or disabilities of the writer. This is crucial since it tries to cover all the basic grounds to make giving equal standards to all candidates easier.

Besides eliminating bias, the AI grading solution improves the consistency of the tests since they do not change regularly. Conventional methods can cause consistency issues in grading within the same course or even in separate sections of the same course with different faculty members. With the increased application of AI in evaluation, it becomes easier to standardize the results and have all students in a certain course evaluated for similar work. Such consistency is most desirable in accommodating the difference in scale, for instance, in MOOCs… where thousands of student contributions may be submitted simultaneously. As an automated system, it's far easier and quicker for AI-based grading tools to assess all the submissions and maintain thorough equality across all learners.

In addition to this, AI systems can offer further solutions regarding grading patterns and progression. Hence, by comparing the collected data with previous results, educators can single out such truths as the presence of some bias or the necessity of further grading practice modifications. For example, the data may show that some groups of learners receive low scores, and the reasons can be found and action taken. The analysis of such numerical data fosters ongoing refinement of grading procedures while keeping educators responsible for their assessments.

That is why it is crucial to admit that there are some drawbacks connected with such systems as AI, which might be used to decrease the role of prejudice and become a guarantee of objectivity. In simple terms, AI is an algorithm that is only as powerful as the data it uses. If the training data is biased or consists of a small sample, the AI system will likely reinforce that bias rather than remove it. Hence, the educator and technologist must collaborate to make certain that AI systems are trained on the datasets and are diverse and inclusive. Furthermore, much still has to be said about the need for human oversight. AI assessments should be constantly observed and judged again by educators when needed, especially for those assessments that involve subjective marks that an algorithm could easily oversee.

7. Scalability and efficiency in large-scale learning platforms

There is an increasing demand for a mass learning environment in education today due to flexibility, accessibility, and personalized learning. However, as these platforms expand to hold thousands, not to mention millions of learners, issues

of scale and efficacy arise. Undoubtedly, AI is key to addressing these issues as it can keep the platforms providing learners with quality education and handle vast numbers of users.

Scalability is thus the characteristic of a system that permits increased work by using existing resources. From the perspective of system-scale learning platforms, it is about handling growing numbers of students, courses, and assessments. There are many educational paradigms where teaching cannot be scaled because of the need for more trainers and materials. With large groups of students, delivering timely feedback, individualized help, and effective and interesting teaching and learning interventions becomes challenging. In contrast, AI solutions can greatly improve scalability within institutions, as many processes can be automated, and institutions can continue to expand enrollment without compromising their service delivery [1].

One of the ways through which AI helps in scalability is through presenting automation of bureaucratic procedures. For one to grade assignments, manage enrollment, track students' progress, or assist, a lot of human resources may be needed. In this case, through AI, the various functions involved will be handled automatically, allowing the tutors to engage more in the higher teaching tasks. For example, an automated grading system that utilizes artificial intelligence can also consider multiple-choice question responses, essay feedback, and coding tasks in minutes and give the corresponding grades to those students who submitted their work to the system and relieve instructors of much of the burden of grading. Such automation helps institutions grow without a direct correlation with human resource demands.

Moreover, AI can enhance teaching and learning methods by analyzing student performance in many learners. From the collected data, multiple users can be identified, and using them, the AI system can identify areas with numerous users facing challenges. It can further adapt the material presented to them accordingly. It also means that educators can update their courses when necessary, which is important if the content is to impact a diverse audience. For example, the learning results suggest that many students fail to understand a given information segment. In that case, this can be reported to instructors so they can change the approach used to teach the segment or provide extra help.

AI also helps to scale up with the help of intelligent tutoring systems, which are used to develop the staking capital. These systems can be designed to give students help with questions and advice and do not need to have an instructor intervene. Therefore, learners can always get help when they have issues, which boosts their learning. This scalability is particularly useful when teaching online courses that can reach the globe where students might be in different time zones or have unlikely class schedules for one-to-one sessions such as office hours.

However, there are various issues that one may encounter when using AI in large-scale learning platforms. Data protection and security are well understood, so any student data issue should be handled carefully. Also, the use of AI in teaching and learning must be counter-checked by using humans so that no student is left behind. However, it is important to see that in the case of AI providing significant effectiveness, educators must still be actively involved during the process, targeting customizing timely and meaningful learning engagements with students [5].

8. The role of AI in enhancing educator support

AI is widely identified as a valuable technology that improves students' effectiveness, but at the same time, it brings great benefits to educators. As institutional expectations of teachers and trainers increase, triggered by the call for differentiation, instructions, and evaluations supported by artificial intelligence, AI has presented itself as a strategic asset that can help teachers meet those expectations. AI improves the support given to educators and, as a result, the teaching outcomes and the student's results by automating administration processes, analyzing and providing individual suggestions, and helping with the professional development of educators [11].

Another influential way AI assists educators is by handling several mundane tasks. Due to accompanying cultural changes, teachers spend a considerable portion of the day on pro forma tasks other than actual teaching and interactive learning. These responsibilities sometimes take up much time, robbing the teachers of planning lessons and time for students. Technology in its advanced artificial form can reduce these loads among professors by grading assignments, making schedules, and entering data. For instance, the AI system can easily flag the results of multiple-choice question papers and give immediate feedback to the educator. Then, the different teachers can invest more time and effort in developing interesting lesson plans for future lessons or identifying students who require extra attention and help. Such automation is not only helpful in making efficient processes but also frees up time for teachers to focus on content delivery and student engagement

. It also provides an important aspect of providing information on students' performance. Since the AI-based system can accumulate and process data on students' communication, achievements, and learning performance, educators can

receive detailed recommendations about the learners and general classroom conditions. For instance, an AI tool may identify students who require special attention to some concepts in their lessons to be accorded special attention as early as possible. Also, AI students' behavior and performance to determine which technique is likely suitable for working with them and which one needs improvements. It helps educators effectively deliver their work and leads to identifying appropriate strategies for teaching the most diverse students by making informed decisions.

Further, AI technology can support the interaction of educators and help form a collaboration. AI-based online platforms can bring teachers from different geographic regions or fields together to discuss and share valuable information and experiences. Their main advantage is that they can provide support specifically to the educators working as sole contributors to their school or who want something fresh about the existing problems daily. Besides extending the kinds of professional support currently offered to educators, AI facilitates the sharing of ideas that contribute to better practices in instructional delivery.

However, it is pertinent to appreciate that the use of AI in the approach to teaching does not exclude or compensate for an imperative component in teaching: the human factor. Despite all these expectations and possible contributions of AI, the role of educators as people who accompany and help students and build and maintain relationships with clients still needs to be more prominent. This must be done to improve the interactions between instructors and learners rather than replace them.

Table 1 Comparison of Traditional vs. AI-Powered Grading Systems

Feature	Traditional Grading	AI-Powered Grading
Time Efficiency	Slow, due to manual evaluation	Fast, automated, near-instant
Feedback Personalization	Limited by time constraints	Real-time, individualized, detailed
Consistency in Grading	Subject to human error or fatigue	High consistency, uniform criteria
Scalability	Difficult to manage large groups	Easily scalable for mass education
Bias and Fairness	Subject to unconscious biases	Can reduce bias if designed properly
Teacher Workload	High workload, repetitive tasks	Reduces routine tasks significantly

9. Ethical considerations and challenges

AI is already widely adopted across learning and teaching activities; therefore, implementing AI in education services must respect and overcome important ethical and ethical problems for education to be meaningful, just, inclusive, and truthful. AI has positive potential for augmenting learning experiences and promoting educational benefits, but it also presents many ethical issues. These aspects include data privacy questions, algorithmic fairness, explainability, and the replacement of teachers.

The most significant of the ethical challenges of using AI in education is, therefore, the challenge of data privacy. Arising from this, AI systems depend on large amounts of data to operate; this means they gather sensitive data about students and the learning environments, such as results, preferences, and demographics. This data is valuable because it lays the foundation for personalizing learning and offering feedback from experience. However, such data can be collected and used, which creates several issues under discussion, namely, the rights of students to consent and ownership and the possible misuse of the collected information. Professional educational institutions should set up principles that state how data from learners and their families will be gathered and used. Additionally, measures must be taken to ensure its security from user exploitation, which is part of students' rights.

Algorithmic bias is a much bigger ethical issue in the application of AI in education. The AI's current system works based on the available data. Sometimes, the data set contains patterns that are implicit within the current society, thereby making the performance of the AI system prejudiced in nature and quasi-unequal. For instance, the AI grading system, which is trained with data mostly with work from certain groups, will tend to grade such students better while disadvantaging other students. This bias can indeed show up in so many different guises – from effects on grading to identifying the needs of the students. To minimize these risks, the dataset used for all the AI systems being developed must be as diverse as possible. On the other hand, algorithms need to be audited continuously for bias that may come up while running various algorithms to improve the fairness of the current education provision [18].

The ethical factors of transparency are important factors that need to be considered when adopting AI technologies in the educational setting. All the stakeholders, beginning from the educators, then the students, and even the parents, should understand how the AI systems work and make their decisions. For instance, if the AI tool is applied to evaluate student performance or suggest materials for learning, the subjects need to know the principles of the evaluation. Such practices can cause agencies to be skeptical about using AI technology, while a lack of coordination makes it tough for the AI systems to earn people's trust. Educational institutions must be transparent regarding the use of AI in their FED activities while giving detailed information on how these tools work and the part they play in student learning.

However, organizing education using AI has several ethical issues; for example, AI education sometimes raises concerns about accessibility to education services. On a positive note, AI can deliver customized learning solutions, but not all users may have access to a device or even the internet. This gap can widen current disparities, most affected being the disadvantaged students, often from low-income families or in areas where there is a lack of afforestation. Education stakeholders must strive to provide technology and other support to learners so that the use of AI in education improves its results for learners across the board. They also involve offering funding for infrastructure and training of educators and students, making policies that will ensure extensive commitment to AI in education is achieved.

Lastly, ethical issues related to the dispersion of AI-influenced education should be discussed continuously. For example, education stakeholders, including educators, policymakers, researchers, and technologists, should address ethical challenges independently as a team. Best practices for using ethics in AI education are easier to develop because of guidelines that have already been determined. In incorporating AI into educational contexts, if ethicists' conclusions are to guide the decision-making process, the 4th Industrial Revolution technology can indeed be a force of good in giving an equal chance mainly to those who policies like LALs genetic algorithm may not have given such a chance.

Table 2 Key Ethical Considerations in AI-Powered Assessments

Ethical Concern	Description	Potential Solutions
Data Privacy	Student data may be misused or exposed to breaches	Robust encryption, transparent data usage policies
Algorithmic Bias	AI may reinforce societal biases due to biased training data	Diverse data sets, ongoing bias audits
Transparency in AI Decisions	Lack of clarity on how AI generates grades and feedback	Clear explanations of AI algorithms
Educator Role	Potential reduction of educator interaction	Hybrid AI systems with human oversight

10. Conclusion

Integrating artificial intelligence in teaching and learning shows that teaching, learning, assessment, and support for learners and teachers can be enhanced. In the following ways, the incorporation of AI improves learning: reducing the workload of routine activities, offering feedback to individual working, and allowing constructive and adaptive assignments. Applications based on artificial intelligence contribute to avoiding stereotypical assessment, enhance the comparability of results, and can, to the same extent, cover a bigger number of education providers and learners.

However, AI in education also has major ethical issues and challenges. Questions related to Data protection, machine learning algorithms, and the degree of openness and job substitution by robots are to be asked to ensure that AI remains a helpful supplement in the learning process rather than a replacement for teachers. However, teachers, employees, policymakers, and technologists must have a consistent discourse on the ethicality of AI and, in unison, need to move forward for responsible incorporation.

However, the number one goal is to improve accessibility and implementation of AI technology to prevent the gap between those who have and do not have access to technologies from expanding and to make people equal in education. In this way, AI is transformed into an improved tool in the learning institution, and every learner is provided with a unique learning experience grounded on the humane method of imparting knowledge to individual learners without compromising AI efficiency with strict ethical standards that should be followed in this process.

References

[1] AI Ethics in Higher Education: Insights from Africa and Beyond. (2023). In SpringerBriefs in ethics.

[2] Almusaed, A., Almssad, A., Yitmen, I., & Homod, R. Z. (2023). Enhancing Student Engagement: Harnessing "AIED"'s Power in Hybrid Education—A Review Analysis. Education Sciences, 13(7), 632.

[3] Araya, D., & Marber, P. (2023). Augmented Education in the Global Age. In Routledge eBooks.

[4] Brynjolfsson, E., & McAfee, A. (2014). "The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies." The New Digital Age.

[5] Chan, C. K. Y., & Lee, K. K. W. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers? Smart Learning Environments, 10(1).

[6] Chassignol, M., & Faber, T. (2022). "AI in Education: Implications for Teaching and Learning." EdTech Magazine. Retrieved from EdTech Magazine.

[7] Crawford, K. (2021). Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence. Yale University Press.

[8] Dautil, F., Fregin, M., Hofmann, M., Luckin, R., Majchrzak, T., Broecke, S., Lane, M., Salvi, A., Schleicher, A., & Van, R. (2021). Opportunities and drawbacks of using artificial intelligence for training. In OECD Social Employment and Migration Working Papers.

[9] Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M. A., Al-Busaidi, A. S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis, D., . . . Wright, R. (2023a). Opinion Paper: "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. International Journal of Information Management, 71, 102642.

[10] Fitzgerald, A., & Hossain, M. (2021). "The Role of AI in Educational Assessment: Enhancing Feedback and Grading Systems." Journal of Educational Technology Systems, 49(2), 203-219.

[11] George, B., & Wooden, O. (2023). Managing the Strategic Transformation of Higher Education through Artificial Intelligence. Administrative Sciences, 13(9), 196.

[12] Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. Center for Curriculum Redesign.

[13] Hwang, G. J., & Chang, H. F. (2019). "Innovations in Educational Technology: A Review of AI in Education." International Journal of Interactive Mobile Technologies, 13(6), 69-90.

[14] Kamalov, F., Calonge, D. S., & Gurrib, I. (2023). New Era of Artificial Intelligence in Education: Towards a Sustainable Multifaceted Revolution. Sustainability, 15(16), 12451.

[15] Kimmons, R., & Veletsianos, G. (2018). Educational Technology and the Future of Education: An Overview. Routledge.

[16] Kizilcec, R. F., Pérez-Sanagustín, M., & Maldonado, J. J. (2016). Self-regulated learning strategies predict learner behavior and goal attainment in Massive Open Online Courses. Computers & Education, 104, 18–33.

[17] Luckin, R. (2018). Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. Routledge.

[18] Marijan, D., & Sen, S. (2022). Industry–Academia Research Collaboration and Knowledge Co-creation: Patterns and Anti-patterns. ACM Transactions on Software Engineering and Methodology, 31(3), 1–52.

[19] OECD. (2019). "Artificial Intelligence in Education: The Role of AI in Teaching and Learning." Retrieved from OECD Website.

[20] O'Neil, C. (2016). Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy. Crown Publishing Group.

[21] Ra, S., Jagannathan, S., & Maclean, R. (2021). Powering a Learning Society During an Age of Disruption. Springer Nature.

[22] Ranjan, S., & Mishra, S. (2021). Perceiving university students' opinions from Google app reviews. Concurrency and Computation Practice and Experience, 34(10).

[23] Selwyn, N. (2019). "Education and Technology: Key Issues and Debates." London: Bloomsbury Academic.

[24] Siemens, G. (2013). "Learning Analytics: The Emergence of a New Field of Study." Journal of Learning Analytics, 1(1), 1-3.

[25] Tlili, A., Huang, R., Shehata, B., Liu, D., Zhao, J., Metwally, A. H. S., Wang, H., Denden, M., Bozkurt, A., Lee, L., Beyoglu, D., Altinay, F., Sharma, R. C., Altinay, Z., Li, Z., Liu, J., Ahmad, F., Hu, Y., Salha, S., . . . Burgos, D. (2022). Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis. Smart Learning Environments, 9(1).

[26] Vietnam integration : education, cultures and ethics : voices of teachers. (2023).

[27] World Economic Forum. (2020). "The Future of Jobs Report 2020." Retrieved from WEF Website.

[28] Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, A. (2019). "Systematic Review of Research on Artificial Intelligence in Higher Education: Current Trends and Future Directions." International Journal of Educational Technology in Higher Education, 16(1), 1-29.

[29] A. Dave, N. Banerjee and C. Patel, "CARE: Lightweight attack resilient secure boot architecture with onboard recovery for RISC-V based SOC", Proc. 22nd Int. Symp. Quality Electron. Design (ISQED), pp. 516-521, Apr. 2021.

[30] A. Dave, N. Banerjee and C. Patel, "SRACARE: Secure Remote Attestation with Code Authentication and Resilience

[31] Engine," 2020 IEEE International Conference on Embedded Software and Systems (ICESS), Shanghai, China, 2020, pp. 1-8, doi: 10.1109/ICESS49830.2020.9301516.

[32] Dave, A., Wiseman, M., & Safford, D. (2021, January 16). SEDAT:Security Enhanced Device Attestation with TPM2.0. arXiv.org. https://arxiv.org/abs/2101.06362

[33] A. Dave, M. Wiseman and D. Safford, "SEDAT: Security enhanced device attestation with TPM2.0", arXiv:2101.06362, 2021.

[34] Avani Dave. (2021). Trusted Building Blocks for Resilient Embedded Systems Design. University of Maryland.

[35] A. Dave, N. Banerjee and C. Patel, "CARE: Lightweight attack resilient secure boot architecturewith onboard recovery for RISC-V based SOC", arXiv:2101.06300, 2021.

[36] Avani Dave Nilanjan Banerjee Chintan Patel. Rares: Runtime attackresilient embedded system design using verified proof-of-execution.arXiv preprint arXiv:2305.03266, 2023.

[37] Elemam, S. M., & Saide, A. (2023). A Critical Perspective on Education Across Cultural Differences. Research in Education and Rehabilitation, 6(2), 166-174.

[38] Rahman, M.A., Butcher, C. & Chen, Z. Void evolution and coalescence in porous ductile materials in simple shear. Int J Fracture, 177, 129–139 (2012). https://doi.org/10.1007/s10704-012-9759-2

[39] Rahman, M. A. (2012). Influence of simple shear and void clustering on void coalescence. University of New Brunswick, NB, Canada. https://unbscholar.lib.unb.ca/items/659cc6b8-bee6-4c20-a801-1d854e67ec48

[40] Rahman, M.A., Uddin, M.M. and Kabir, L. 2024. Experimental Investigation of Void Coalescence in XTral-728 Plate Containing Three-Void Cluster. European Journal of Engineering and Technology Research. 9, 1 (Feb. 2024), 60–65. https://doi.org/10.24018/ejeng.2024.9.1.3116

[41] Rahman, M.A. Enhancing Reliability in Shell and Tube Heat Exchangers: Establishing Plugging Criteria for Tube Wall Loss and Estimating Remaining Useful Life. Journal of Failure Analysis and Prevention, 24, 1083–1095 (2024). https://doi.org/10.1007/s11668-024-01934-6

[42] Rahman, Mohammad Atiqur. 2024. "Optimization of Design Parameters for Improved Buoy Reliability in Wave Energy Converter Systems". Journal of Engineering Research and Reports 26 (7):334-46. https://doi.org/10.9734/jerr/2024/v26i71213