Artificial Intelligence and Scientific Research

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Abstract: Artificial intelligence (AI) is a rapidly evolving field of technology that involves the development of intelligence that can perform tasks that typically require human intelligence, such as understanding natural language, recognizing patterns, and making decisions based on data. This paper explores the relation of AI and scientific research. AI facilitates the extraction of meaningful insights from large datasets, enabling researchers to uncover patterns, correlations, and trends that might otherwise remain obscured. Moreover, Artificial intelligence aids in predictive analytics, allowing scientists to forecast outcomes and identify potential areas for further investigation. Additionally, AI systems are increasingly employed in experimental design and optimization, streamlining processes and enhancing efficiency in laboratory settings. Despite its myriad benefits, the integration of AI into scientific research presents challenges related to data quality, interpretability, and ethical considerations.

Keywords: Artificial intelligence, machine learning, scientific research.

Introduction

Artificial Intelligence (AI) is a branch of computer science that focuses on creating intelligent programs (systems) capable of performing tasks traditionally requiring human intelligence. AI systems can learn from data, identify patterns and make decisions with minimal or no human intervention. By combining sophisticated algorithms with powerful computing resources, these systems can process large amounts of information quickly and accurately. This makes them invaluable tools for scientists in many fields who must analyse complex datasets or generate predictions about future events. For example, AI has been used by researchers studying climate change as it allows them to run simulations faster than ever and gain insights into the impact of environmental factors on global temperatures over periods far longer than any single scientist could study alone (Sreenu, 2023)

Artificial intelligence (AI) is a rapidly evolving field of technology that involves the development of intelligent machines that can perform tasks that typically require human intelligence, such as understanding natural language, recognizing patterns, and making decisions based on data. AI is the ability of machines to adapt to new and emerging situations, problem-solve, answer questions, create plans, and perform other intelligent functions typically associated with human beings. AI refers to the field of computer science that involves creating computer programs capable of imitating intelligent behavior and ideally enhancing human-like abilities

(Naqvi, 2020). AI, a swiftly expanding discipline, encompasses the development of intelligent robots capable of emulating human thought processes and actions, finding utility in diverse areas such as medical diagnosis, self-driving cars, and education (Wardat et al., 2023).

AI will play a pivotal role in helping to realize the promise of personalized learning — the ability to tailor the delivery, the content and the pace of learning to the specific needs of each individual student. The ability to Ingest data from multiple data sources, interrogate that data and to derive Insights — using tools such as predictive analytics and machine learning — is what makes AI such an exciting advancement in education technology and why its use will prove transformational for all stakeholders, from individual students to Ministries of Education.

Ng (2017) claims artificial intelligence to be the new electricity of this age. Artificial intelligence is a candidate to be presented as the basic building block of the Fifth Industrial Revolution by providing itself to be a powerful factor in ensuring economic development with its potential (see, Golic, 2019).

Artificial intelligence (AI), generally expressed by the general public as the ability of machines or computers to think and act as humans do, represents the efforts towards computerized systems to imitate the human mind and actions) Wartman & Combs, 2018).

Artificial intelligence system' (AI system) means software that is developed with one or more of the techniques and approaches listed in Annex I and can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments it interacts with (EC. (2021).

In this respect, the basic definition of artificial intelligence can be expressed as the skillful imitation of human behaviour or mind by tools or programs (Mohammed & Watson, 2019). According to Timms (2016) it may be an illusion of the current structure to think that artificial intelligence will come within the computer format used at home. It could get into our lives within different functions and shapes.

So, artificial Intelligence (AI) has a profound impact on our daily life. Every day we have at our disposal virtual voice assistants, chatbots, tools for filtering incoming emails, recommendation systems used in social media networks or streaming platforms, etc. The applications mentioned are just an example of what the term Artificial Intelligence covers. The magnitude of the AI term can be appreciated when we search "Artificial Intelligence" on the Internet. AI is a part of computing dedicated to the development of algorithms allowing a machine to make smart decisions, or at least behave as if it had human intelligence. This is a very generic definition that encompasses different disciplines such as Robotics, Machine Learning, Diffuse Logic, and Natural Processing Language, among others. Each one with its own variants and applications.

Chatbots are also becoming more common in daily life. The main advantage of chatbots is that their users have access to information, usually on a specific topic, without having to spend a lot of time searching and filtering data.
From virtual tutors to classroom chat bots, the application of AI in the educational world has come a long way. Since the early 1980s, AI work has been applied to try to capture the most efficient ways of teaching or training students in specific fields of knowledge such as maths and engineering. Because of the well-defined problems in maths and engineering, it was possible to completely encode the learning activity and shown to the learner what they got right or wrong along the way. One example of an older AI learning system was used to

teach individuals how to shut down a boiler system properly, effectively training users without much prior knowledge of the system. Increasingly AI is becoming more pervasive in education. Nowadays teachers and students are often using AI without being consciously aware of it. AI can be found in search engines, social media, games and other general applications. We also see AI-based language learning tools such as Duolingo used all around the world.

As AI has become a part of our lives, we might wonder if it can also positively change the traditional teaching methods. Some examples might be showing intelligent content to the students, offering them personalized learning, or improving efficiency in terms of the organization of a module or university course.

With more usage of artificial intelligence in education, major transformations can be foreseen in the education systems and its processes. Based on the study results, Sekeroglu, Dimililer and Tuncal (2019) stated that artificial intelligence could help teachers improve personalized education for their students. Artificial intelligence can provide access to appropriate and better learning opportunities for excluded people and communities, people with disabilities, refugees, people out of school, and those living in isolated communities (Pedro, Subosa, Rivas, & Valverde, 2019). Research shows how effective individually tailored approaches can be presented with the support of artificial intelligence techniques and intelligent learning environments (Mohammed & Watson, 2019). Although quality education seems to require the active participation of human teachers, artificial intelligence envisages increasing education and quality at all levels, especially by providing personalization (Grosz & Stone, 2018). Pedro et al. (2019) highlights a dual-teacher model with artificial intelligence in terms of individualized education: teachers spend a lot of time in routine and other administrative tasks, such as repeating frequently, answering questions about many topics, but in-class artificial intelligence-supported assistants (secondary teachers) will reduce the time spent on routine procedures, which will help teachers focus on student guidance and one-to-one communication.

The effective use of AI, Data & Analytics and Machine Learning can enable educators to deliver engaging, immersive educational experiences and to build personalized learning pathways for each student utilizing the augmented intelligence and insights derived from their use.

Artificial Intelligence (AI) is changing the world around us. As a term it is difficult to define even for experts because of its interdisciplinary nature and evolving capabilities. In the context of this paper, we define AI as a computer system that can achieve a particular task through certain capabilities (like speech or vision) and intelligent behaviour that was once considered unique to humans. In more lay terms we use the term AI to refer to intelligent systems that can automate tasks traditionally carried out by humans. Indeed, we read AI within the continuation of the digital age, with increased digital transformation changing the ways in which we live in the world. With such change the skills and knowhow of people must reflect the new reality and within this context, the World Economic Forum identified sixteen skills, referred to as twenty-first century skills necessary. (Makridakis, 2017)

AI will play a very important role in how we teach and learn these new skills. In one dimension, 'AIEd' has the potential to dramatically automate and help track the learner's progress in all these skills and identify where best a human teacher's assistance is needed. For teachers, AIEd can potentially be used to help identify the most effective teaching methods based on students' contexts and learning background. It can automate monotonous operational tasks, generate assessments and automate grading and feedback. AI does not

only impact what students learn through recommendations, but also how they learn, what are the learning gaps, which pedagogies are more effective and how to retain learner's attention. In these cases, teachers are the 'humanin-the-loop', where in such contexts, the role of AI is only to enable more informed decision making by teachers, by providing them predictions about students' performance or recommending relevant content to students after teachers' approval. Here, the final decision makers are teachers.

Applications of AI in Education

Personalized Learning

Tools and systems based on AI have the potential to customize learning experiences, boost the productivity of teachers, and heighten student engagement (Mena-Guacas et al., 2023). AI can help create personalized learning plans for individual students based on their learning progress, strengths, and weaknesses. AI can identify students' learning needs by analyzing data from multiple sources such as assessments, homework, and quizzes and provide targeted feedback. Besides preparing lesson contents and learning experiences, AI tools can also be used for individualized instruction (Adiguzel et al., 2023).

This can help students learn at their own pace and focus on areas, where they need more support. AI-powered adaptive learning software such as DreamBox and Knewton use data analysis to create personalized learning plans for students based on their strengths and weaknesses. For example, students can complete a pre-assessment test that generate a personalized learning plan with specific goals and recommendations.

Intelligent Tutoring Systems (ITS)

AI-powered tutoring systems can provide personalized support and feedback to students. These systems can adapt to students' learning styles and provide tailored instruction and support, helping students to improve their learning outcomes. These systems can help students stay motivated and engaged with their learning by providing immediate feedback. Carnegie Learning's AIpowered mathematics tutoring system provides immediate feedback and customized learning paths based on students' strengths and weaknesses. The system adapts to each student's learning pace and provides interactive instruction and practice problems. Educators can use ITS to provide individualized instruction, monitor student progress, and identify areas, where students need additional support. Examples include ALEKS, Carnegie Learning, and Knewton.

Automated Grading

AI can help automate the grading process, saving time for teachers and providing students with immediate feedback on their assignments. AI can provide feedback on grammar, spelling, and syntax by analyzing essays, reports, and other written assignments. By using automated grading systems, teachers can focus more on essential tasks such as lesson planning and supporting students, resulting in significant time savings (Adiguzel et al., 2023).

This can help students to improve their writing skills and reduce the workload for teachers. For example, Turnitin's AI-powered software uses

natural language processing (NLP) to analyze essays and provide grammar, spelling, and syntax feedback. The software can also detect plagiarism, helping teachers to grade assignments more efficiently and accurately.

Predictive Analytics

AI can analyze student attendance, engagement, and performance data to predict future outcomes. This information can be used to identify students who may need additional support, enabling teachers to provide targeted interventions. For instance, University of South Florida uses predictive analytics to identify at-risk students who may need additional support. The university's Student Success Center uses data analysis to monitor students' progress and provide targeted interventions.

Natural Language Processing

AI-powered NLP tools can help students learn languages and improve their writing skills by providing grammar, spelling, and punctuation feedback.

These tools can also help students to develop their critical thinking skills by analyzing and evaluating arguments and evidence. These tools also enable educators to analyze and interpret natural language data, such as student essays, discussions, and social media posts, to gain insights into student learning and engagement For example, Grammarly's NLP-powered software provides real-time feedback on writing, including suggestions for grammar, punctuation, and sentence structure. This can help students to improve their writing skills and produce higherquality written work. Other examples include Google Cloud Natural Language, IBM Watson, and Microsoft Azure Cognitive Services.

Intelligent Content

AI can help create and curate learning materials tailored to individual student's needs and learning styles. By analyzing student behavior data, AI can identify students' learning preferences and create customized learning materials that are engaging and relevant. For instance, EdTech startup Smart Sparrow uses AI to create interactive, adaptive learning materials customized to individual student's needs. For example, a biology course might use AI to generate different lab scenarios based on students' learning progress and interests.

Virtual Assistants

AI-powered virtual assistants can help students with administrative tasks such as scheduling, reminders, and task management. These tools help students stay organized and focused, enabling them to manage their time and complete their coursework more efficiently. For instance, AI-powered virtual assistants such as Brainly provide students with immediate support and answers to their academic questions. The platform uses machine learning to provide personalized support and connect students with tutors.

Automated Transcription and Translation

AI can help transcribe and translate lectures and other educational materials, making them accessible to a wider range of students. This can help students who may have difficulty understanding the language used in their coursework or may have hearing impairments. It can also help make educational content more inclusive and accessible.

For instance, Otter.ai uses AI-powered speech recognition to transcribe real-time lectures and other educational materials. The software can also translate spoken content into multiple languages, making educational content more accessible to students who may speak different languages.

Other examples include Amazon Transcribe, Dragon Naturally Speaking, and Google Voice.

Learning Management Systems (LMS)

These are platforms that allow educators to create, deliver, and manage learning materials, assignments, assessments, and evaluations for students.

Educators can use LMS platforms to administer online assessments, monitor student progress, and provide feedback on student performance.

Automated Essay Scoring (AES) Software

AES software uses NLP algorithms to evaluate and grade essays and written assignments. Educators can use AES software to provide students with immediate feedback on their writing, save time on grading, and ensure consistent and objective evaluation. Examples include e-rater, Grammarly, and Turnitin.

Learning Analytics Tools

Learning analytics tools use data mining and AI algorithms to analyze student learning data and provide insights into student performance, engagement, and learning outcomes. Educators can use learning analytics tools to monitor student progress, identify at-risk students, and make data-informed decisions to improve student learning outcomes. Examples include Learning Analytics and Knowledge (LAK) and Open Learning Analytics (OLA).

Computer-Based Testing (CBT) Platforms

CBT platforms allow educators to administer online assessments, including multiple-choice, true/false, and essay questions. Educators can use CBT platforms to assess student knowledge, save time on grading, and provide students with immediate feedback (Bassey et al., 2020). Examples include ExamSoft, JAMB CBT, UNICAL Postgraduate e-exams, ProProfs, and Questionmark.

Gamification Tools

Gamification tools use game-based elements to motivate and engage students in learning activities and assessments. Educators can use gamification tools to increase student engagement, promote student learning, and provide students with immediate feedback on their performance. Examples include Classcraft, Kahoot!, and Quizlet..

Virtual Reality (VR) and Augmented Reality (AR) Tools

VR and AR tools use immersive technologies to provide students with interactive, experiential learning experiences. Educators can use VR and AR tools to engage students in handson learning activities, provide real-world experiences, and enhance student learning outcomes. Examples include Google Expeditions, Merge Cube, and Nearpod VR.

Formative Assessment tools

Formative assessment tools enable educators to monitor students' learning in real-time, provide feedback, and adjust instruction based on their performance. Examples include Mentimeter, Nearpod, and Socrative.

Online Polling Tools

Online polling tools allow educators to gather student feedback on specific topics or questions. Examples include Google Forms, Kahoot!, and Poll Everywhere.

Interactive Whiteboards

Interactive whiteboards enable educators to present and annotate digital content, engage students in interactive activities, and collaborate with students in real-time. Examples include Google Jamboard, Promethean ActivPanel, and SMART Board.

Video Conferencing Tools

Video conferencing tools allow educators to facilitate virtual classroom sessions, provide remote instruction, and connect with students in remote locations. Examples include Google Meet, Microsoft Teams, and Zoom.

Digital Portfolios

Digital portfolios enable students to collect and showcase their work, reflect on their learning, and receive feedback from educators and peers. Examples include Google Sites, Seesaw, and WordPress.

Data Visualization Tools

Data visualization tools enable educators to analyze and present data in

visual formats, such as graphs and charts, to gain insights into student performance and learning outcomes. Examples include Google Data Studio, Infogram, and Tableau.

Social Media Platforms

Social media platforms enable educators to connect with students, share

learning resources, and promote student engagement in learning activities. Examples include Facebook, Instagram, and Twitter

Plagiarism Detection

AI-based plagiarism detection software uses NLP algorithms to analyze student work and detect instances of plagiarism. Examples include Copyscape, Grammarly, and Turnitin.

Classroom Response Systems

Classroom response systems allow educators to pose questions and receive real-time student feedback using electronic devices. Examples include iClicker, Poll Everywhere, and Top Hat.

Digital Assessment Tools

Digital assessment tools provide educators with the ability to assess student knowledge and skills using a variety of question types, including multiple-choice, short answer, and essay. Examples include Edulastic, ExamView, and Google Forms.

Artificial Intelligence and Scientific Research

Artificial Intelligence (AI) has been used to accelerate advanced scientific research since its inception in the 1950s. Initially, AI was employed for specific tasks such as natural language processing and robotics control systems. However, with advancements in technology over the years, it is now possible to use AI for more complex projects like data analysis, climate change, protein interaction simulations or even drug discovery. The ability of Artificial intelligence algorithms to process large amounts of information quickly and accurately makes them invaluable tools when conducting scientific research on any topics (Sreenu, 2023).

Recently, researchers have leveraged machine learning techniques such as deep learning networks, which can discover hidden patterns within massive datasets that would be impossible for humans alone. This helps scientists make better predictions about future events based on historical data points – something not achievable before without extensive human effort being involved first-hand in every step of a project's lifecycle. Additionally, artificial neural networks can be trained using supervised methods to identify objects from images faster than ever, making it easier for scientists across all disciplines to carry out their work efficiently.

AI has become an integral part of scientific research and is increasingly used in various ways.

AI can help scientists make decisions faster, identify patterns more accurately, analyze data more efficiently and increase productivity. For example, machine learning algorithms can recognize complex patterns from large datasets, which would be difficult for humans to detect or interpret due to the sheer volume involved. Furthermore, by using natural language processing (NLP) techniques, researchers can quickly sort through vast amounts of literature related to their field and find relevant information that may have been overlooked previously. Additionally, with advances in computer vision technology, it's now possible for computers to process images much faster than humans, allowing them to recognize objects such as cells under microscopes at speeds not achievable manually, thus helping speed up processes like drug discovery significantly reducing cost-associated with traditional methods without compromising accuracy levels. Either way, this technique is extremely attractive both economically & scientifically speaking. Artificial intelligence offers numerous benefits when applied correctly within scientific research, ranging from increased efficiency, improved decision-making capabilities & higher accuracies, all leading towards accelerating time-to-market rates, thereby bringing new products/discoveries into the market quicker while saving costs simultaneously.

However, integrating Artificial Intelligence into existing scientific research processes can be challenging. AI requires large amounts of data to make accurate data-driven predictions, and this is only sometimes available in the research field due to privacy concerns or lack of resources. Additionally, it can take time for researchers to understand how best to use AI within their workflows - algorithms must be designed and tested with known training data before being implemented effectively across different projects. There are also ethical considerations when introducing new technologies; scientists need to consider any potential risks posed by using advanced tools, such as machine learning, on sensitive datasets that may have implications beyond the laboratory environment. Finally, there is often resistance from established stakeholders who do not believe in the efficacy of these systems – convincing them takes patience and understanding so that all parties involved benefit from an effective integration process.

Ethical Considerations When Working with Artificial Intelligence Systems

Ethical considerations regarding Artificial Intelligence (AI) are essential to any research. AI systems can potentially cause positive and negative impacts on society, so scientists need to take appropriate steps when working with them. The primary ethical considerations include data privacy, safety risks associated with autonomous technologies, and fairness in decision-making processes .

Data privacy is essential as AI algorithms can learn from large amounts of personal information, which must be collected responsibly and stored securely according to national laws or international regulations such as GDPR for Europe or HIPAA for USA healthcare providers. Safety risk management requires developing secure models that are tested thoroughly before being used in real-world scenarios where unexpected outcomes could lead to disastrous results if not properly managed by experts familiarised with the technology's implications; this applies especially when dealing with self-driving cars or other machines performing complex tasks autonomously without human supervision. Finally, there should also be measures taken towards ensuring fairness in decision-making across different demographic groups, including gender, race, ethnicity, etc., since biases might exist within specific datasets due to either intentional decisions during the training process design phase or unintentional bias resulting from historical patterns found inside data sources utilised by the algorithm leading up inaccurate predictions upon deployment into production environments.

Overview of Current Tools Available for Researchers to Utilise in Their Workflows

The most common AI technologies employed for scientific research are machine learning (ML) algorithms such as supervised/unsupervised learning models; deep neural networks; natural language processing (NLP); computer vision techniques like object detection and image recognition; robotics automation systems which enable scientists to interact with physical environments through autonomous robots etc. All these methods have been successfully applied across various domains, including data science, healthcare diagnostics, drug discovery processes, crop yield optimisation solutions, etc., thereby providing researchers with more efficient ways to conduct their workflows. In addition, various cloud computing platforms offer potent resources for building sophisticated ML applications within minutes without requiring upfront investment in infrastructure setup costs

"ChatGPT will redefine the future of academic research. But most academics don't know how to use it intelligently," Mushtaq Bilal, a postdoctoral researcher at the University of Southern Denmark, recently tweeted.Academia and artificial intelligence (AI) are becoming increasingly intertwined, and as AI continues to advance, it is likely that academics will continue to either embrace its potential or voice concerns about its risks."There are two camps in academia. The first is the early adopters of artificial intelligence, and the second is the professors and academics who think AI corrupts academic integrity," Bilal told Euronews Next. (**Bello**, 2023)

Artificial intelligence (AI) is already making significant contributions to scientific research, and it is likely to have an even greater impact in the coming years. Here are a few ways in which AI is likely to impact scientific research:

1. Speeding up research: AI can analyze large amounts of data much faster than humans can. This can help researchers identify patterns and trends more quickly and efficiently than traditional research methods.

2. Identifying new research directions: AI can analyze data from multiple sources and identify potential areas of research that might have been overlooked by human researchers. This can help scientists identify new research questions and directions to pursue.

3. Enhancing accuracy: AI can help eliminate errors and biases that can occur in scientific research. By analyzing data more objectively and accurately, AI can help researchers draw more accurate conclusions.

4. Developing new treatments and technologies: AI can help researchers analyze large amounts of data to develop new treatments and technologies. For example, AI can be used to analyze genomic data to identify new drug targets or to develop more accurate diagnostic tools.

Overall, AI is likely to have a significant impact on scientific research in the coming years, helping to speed up research, identify new research directions, enhance accuracy, and develop new treatments and technologies. However, it is important to note that AI is not a replacement for human researchers, but rather a tool that can help scientists conduct research more efficiently and effectively.

Challenges of Using artificial Intelligence-Powered Tools in Educational Assessment

AI powered tools in educational assessment can be beneficial in various ways, including enhancing the assessment process's accuracy, speed, and efficiency. However, several challenges are associated with using AI in educational assessment. Some of these challenges include (Igbokwe, 2023):

1.Bias and Discrimination
One of the significant limitations of AI in educational management is the potential for bias and discrimination. As argued by Mason and Rennie (2018), AI algorithms may replicate and amplify existing biases and discrimination in educational systems, leading to further inequality and injustice. For example, AI may perpetuate gender or racial biases in student evaluations or admissions decisions. Educational managers need to be aware of these limitations and work to ensure that AI is used in a fair and equitable manner.

2. Lack of Transparency and Interpretability
Another significant limitation of AI in educational management is the lack of transparency and interpretability. As noted by Veletsianos (2019), AI algorithms can be complex and difficult to understand, making it challenging for educational managers to evaluate their effectiveness and identify potential errors or biases. This lack of transparency and interpretability can make it difficult for educational managers to make informed decisions and improve their institutions' performance.

3. Data Privacy and Security Breaches
A third significant limitation of AI in educational management is the potential for data privacy and security breaches. As argued by Akkaya-Kalayci and Yildirim (2020), the use of AI in educational management requires access to large amounts of data, including personal information about students, faculty, and staff. This data is vulnerable to cyberattacks and other security breaches, potentially exposing sensitive information and undermining the trust and confidence of stakeholders.

4. Dehumanization and Loss of Personal Touch

Finally, another significant limitation of AI in educational management is the potential for dehumanization and loss of personal touch. Peters and Besley (2020), argue that the use of AI in educational management may lead to a reduction in human interaction and personalization, leading to a less satisfying and engaging educational experience for students. Educational managers need to strike a balance between the efficiency and effectiveness of AI and the importance of human interaction and personal touch in education.

5.Lack of Ethical and Legal Guidelines

One of the primary challenges of AI in educational management is the lack of ethical and legal guidelines. AI algorithms can produce biased and discriminatory results, and it is essential to ensure that AI is used ethically and transparently. It is crucial to have guidelines that protect student privacy, ensure data security, and prevent AI from being used for surveillance purposes.

6. Lack of Technical Expertise and Resources

Another challenge is the lack of technical expertise and resources. AI requires specialized skills and knowledge, and educational institutions may lack the necessary resources to implement AI effectively. Training and professional development opportunities must be provided to ensure that educators and administrators have the skills to use AI effectively.

7. Job Displacement

AI in educational management also raises concerns about job displacement. AI can automate administrative tasks, and there is a fear that this will lead to job losses for educators and administrators. It is essential to ensure that the use of AI does not lead to job displacement but rather supports educators in their work.

8. Lack of Interoperability and Compatibility

Another challenge is the lack of interoperability and compatibility between different AI systems. Educational institutions use several different systems, such as learning management systems, student information systems, and assessment tools. It is essential to ensure that these systems can work together seamlessly to provide a cohesive and efficient educational experience.

9. Tendency for Excessive Dependence on AI

There is a concern about the over-reliance on AI in educational management. AI should not replace human educators but rather support them in their work. It is essential to ensure that AI is used as a tool to enhance teaching and learning, not replace it.

In sum, AI has the potential to transform educational management, but there are also significant limitations and challenges that need to be considered and addressing these limitations requires careful planning, ongoing evaluation, and a commitment to ethical and responsible use of AI in educational management.

Suggestions

The application of AI in educational management is still in its early stages, but it has already shown promising results. For instance, AIpowered learning systems can personalize the learning experience for students, provide real-time feedback, and detect potential problems early. Similarly, AI can help educators

identify student strengths and weaknesses, enabling them to tailor their teaching methods accordingly (Igbokwe, 2023).

There should be a certain measurement system when using artificial intelligence in education.

- Applications or systems developed regarding artificial intelligence in education should be tested with pilot applications and integrated into the system according to their results.
- Academic studies should be done on the developed systems and analysed.
- Necessary infrastructure works should be created.
- An audit mechanism should be established.
- Human psychology should not be ignored.
- Preventive and supportive software should be developed.
- The effects of artificial intelligence-related systems on the decision-making power of people in their lives should be measured.
- The AI integration process should proceed in a way that does not affect social relations negatively.
- Artificial intelligence in education is not a comprehensive solution; it should be used only in the areas of need.
- The process should be carried out in an interdisciplinary fashion with all stakeholders, not just educators and engineers.
- AI systems and tools must respect data privacy and security. Humans must be in the loop.
- Systems and tools must align to our collective vision for high-quality learning, including equity.
- AI systems and tools must be inspectable, explainable, and provide human alternatives to AI-based suggestions; educators will need support to exercise professional judgment and override AI models, when necessary.
- AI systems and tools must minimize bias, promote fairness, and avoid additional testing time and burden for students and teachers.
- AI systems and tools must account for the context of teaching and learning and must work well in educational practice, given variability in students, teachers, and settings.
- Use of AI systems and tools must be safe and effective for students.
- They must include algorithmic discrimination protections, protect data privacy, provide notice and explanation, and provide a recourse to humans when problems arise. The people most affected by the use of AI in education must be part of the development of the AI model, system, or tool, even if this slows the pace of adoption.

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