Educational Administration: Theory and Practice
2025, 31(1), 537-548
ISSN: 2148-2403
https://kuey.net/

Research Article

Bridging Theory And Practice: Ai Applications In Learning And Teaching

Sobia Anwer[1*], Rebecca Paynor[2]

[1*]Ph.D. Scholar, Department of Public Administration, University of Karachi, Pakistan, Email: sobiaanwer06@gmail.com
[2]Teacher, Independent Researcher, Email: macjun3023@gmail.com

***Corresponding Author:** Sobia Anwer
*Ph.D. Scholar, Department of Public Administration, University of Karachi, Pakistan, Email: sobiaanwer06@gmail.com

Citation: Sobia Anwer, (2025). Bridging Theory And Practice: Ai Applications In Learning And Teaching, *Educational Administration: Theory and Practice*, 31(1), 537-548
Doi: 10.53555/kuey.v31i1.9649

ARTICLE INFO

ABSTRACT

This study explores the impact of artificial intelligence on virtual learning in educational settings. It examines the features and complexities of AI tools integrated with established technologies, such as virtual learning management systems. The review identifies major AI technologies used in teaching and learning processes and addresses ethical discussions and challenges associated with their implementation. Artificial intelligence is implemented in education by detailing possible benefits and challenges regarding the application of artificial intelligence in learning. It examines issues of ethical nature and the nature of the integrating process through which AI should be implemented to foster learning and teaching. Artificial intelligence is slowly and gradually entering the system of education, making it easier for students to relate theory and practice in their learning and teaching processes. The various implications of artificial intelligence in the learning environment as a customization tool, an assistant in boring tasks, and a tool that can improve teachers' and students' communication. Artificial intelligence integration also promotes such effective delivery strategies as the use of augmented and virtual realities in the teaching and learning processes, which have the potential to transform the way the students learn and comprehend difficult concepts. The findings aim to inform and enhance the effective use of AI in education, identifying both potential benefits and barriers to its development in educational settings. The study highlights the transformational impact of AI on education. It also explores the importance of ethical considerations to guide its successful adoption and recommends quality teaching and learning strategies by effectively using Artificial Intelligence.

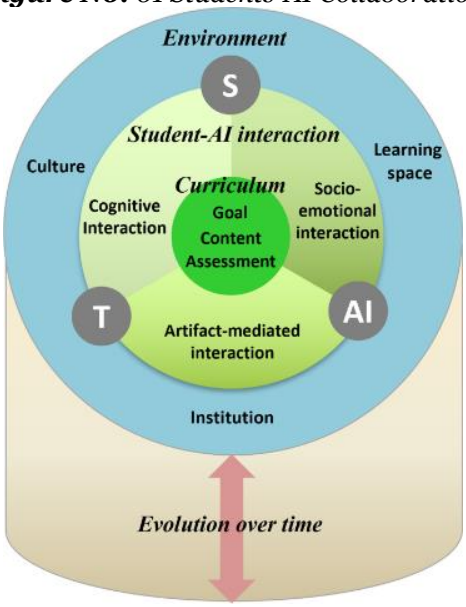
Keywords: Machine Learning, Educational Technology, Future of Education, Natural Language Processing, Artificial Intelligence, Learning and Teaching

INTRODUCTION

The integration of artificial intelligence into educational settings marks a paradigm shift in how teaching and learning are conceptualized and practised. Rapid technological advances in recent years have transformed educational transformation around the world, driven even more by the unprecedented challenges posed by the COVID-19 pandemic. This session highlighted the important role that digital tools, including AI, play in enabling distance learning and improving educational outcomes. Artificial Intelligence technologies such as TensorFlow, Azure, Watson, and Amazon's Web Services have emerged as essential components of Learning Management Systems (LMS), It is providing seamless communication between instructors and students, and facilitating administrative tasks Personalization, analysis of student-performance data, and implementation of are empowered with adaptive learning strategies tailored to individual needs (Abulibdeh, Zaidan, & Abulibdeh, 2024; Jackson, 2024).The use of AI in education extends beyond strategic planning, solving key educational

challenges by infusing traditional teaching methods with advanced analytics and machine learning algorithms. This approach enables teachers to gain deeper insights into students' learning processes, identify areas for improvement, and adjust instructional strategies accordingly. Furthermore, AI increases the accessibility and inclusiveness of education by providing personalized learning experiences that match learning styles and abilities (Alier, García-Peñalvo, & Camba, 2024; Nawaz). The widespread adoption of AI in education also raises ethical considerations about data privacy, algorithmic bias and equality. It is asserted that tool-oriented perception of AI capability and the potentiality of the AI functionality along with the anticipated educational purpose of AI, the possible dangers of AIED in the education system cannot be adequately discussed adequately (Big Innovation Centre, 2020). To all of the other technologies AI is more interactive with students as it is more independent, individual and proactive. The terms cannot be static since they depict the communication and interaction, which are being exchanged as a learning process and within its context. The roles that used to be reserved for human students and teachers alone are now filled by artificial intelligence in the form of learning peers, tutors, or helpers (Simmler & Frischknecht, 2020). The idea of DC provides two significant methodological suggestions. The system level should be included in the unit of analysis when looking at the problem instead of only the individual level. Cognitive functions might become distributed between the members of the working team, for instance; cognitive activities could involve organizing internal and external structure; or processes could be dispersed over time in a way that the results of previous actions might affect the nature of subsequent actions (Hutchins, 1995). In addition to information manipulation and computation, the study looks for a range of other interactions that may be implicated in the cognitive system, such as the relationship between an individual's memory, outside information, and object management (Hollan et al., 2000, p. 176). This provides some insight into the types of information and phenomena that a DC analysis might reveal; the paper has expanded on these results and phenomena by referencing the entirety of the DC literature, resulting in a variety of elements for SAC on learning. The four components that have been the subject of previous research were developed into the SAC model in the current study: Therefore, the four Ps of learning are as follows: (1) curriculum; (2) student-AI interaction; (3) where; (4) when; and (5) progression over time (refer to Fig. 1).

Figure No: *01 Students-AI Collaboration*

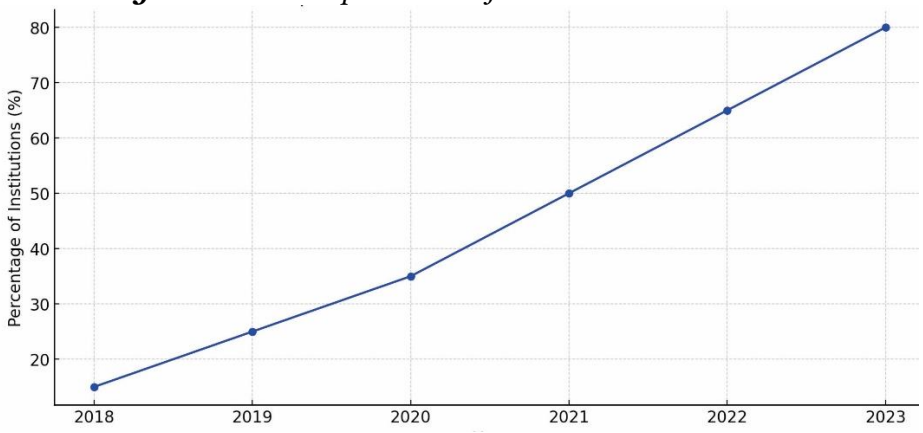


Computational Thinking and Skill Development

Parents and teachers increasingly emphasize the importance of integrating technology into children's education to better prepare them for future career opportunities. The future jobs predicted to require digital skills, nearly half of these positions will require advanced abilities in setting up and implementing digital tools and systems, thus the importance of fostering technological literacy from an early age has never been so clear (Söğüt, 2024; Walter, 2024) Furthermore, the OECD warning for 2018 highlighted the unexpected challenges that today students will face in the future, and underlined the need for flexible and growth-minded educational approaches. Historical context deeply shapes public perceptions of education, particularly in the context of integrating STEM (science, technology, engineering, and mathematics) education. There is increasing recognition that STEM education is critical for equipping students with the skills needed to meet today's technological challenges and to provide the entrepreneurial mindset necessary to succeed in a competitive environment (du Plessis, 2024; Storozhyk, 2024). These changes reflect an evolving educational system that prioritizes innovation and the practical application of knowledge. Digital skills and knowledge are no longer seen as integral but as essential components of modern education. Countries around the world are adopting

technology-education programs aimed at integrating portable technology into educational curricula. In Australia, for example, dissatisfaction with the current education system has led to widespread reform, with large segments of the population expressing and expressing concerns about student readiness for future job markets (Salsabila & Rohiem, 2024; K. H. D. Tang, 2024). Schools are adapting their approaches to include problem-solving, coding, and STEM subjects, preparing students to tackle emerging technologies and complexities effectively.

Figure No:02 *Adoption Rate of AI in Education over time*



The line graph depicting the adoption rate of AI in education over time shows a notable increase in the implementation of AI technologies in educational institutions from 2018 to 2023. The trend demonstrates a steady upward trajectory, with the adoption rate beginning at 15% in 2018 and climbing to 80% by 2023. This rise indicates a growing acceptance and integration of AI within the education sector. The sharp incline, particularly noticeable after 2020, suggests that a significant number of institutions have recognized the advantages of AI and have actively incorporated these solutions into their teaching and learning processes. This growing adoption reflects a broader movement toward leveraging technology to enhance educational outcomes and improve the efficiency of educational practices.

Cognitive Interaction between Students and Artificial Intelligence

The enhancement of instruction on AI principles for students is viewed as crucial. First, to perform an effective regulation and orchestration of the learning task operations, students have to conceptualize the definitions and types of AI and the knowledge of algorithms (Kim et al., 2021b). Second, students require the AI apprehension that reflects their sensibility about what could be potentially achieved and what might go wrong when deploying AI. Especially primary school teachers, said they feel the urgent need to teach students how to distinguish AI from other technologies since many students mix up AI technologies with other non-AI technologies and point out the peculiarities of their capability for learning and action that can help or hinder. Second, as data literacy is one of the AI supporting students' skills that is data collection, processing, and analysis, as well as data evaluation and decision-making (UNESCO, 2019). Students then get into groups to debate on how to spread Korean culture as well as the cuisine. As clearly seen from the quotes, data literacy enables the students to comprehend and appropriately address artificial Intelligence suggestion or recommendation, particularly during situations where there is ambiguity regarding the nature of the suggestion made by the AI system. As a result, meeting these objectives enables students to take an active stance in exchanging and analyzing the views and values formed in society with data that contain digital representations of real-life phenomena, objects, and processes. The majority of teachers stated that in order for students to learn informatics and computer science classes and build a foundation of knowledge in the field of artificial intelligence. It is feasible and crucial to explain to them the algorithmic, mathematical, and statistical foundations that are necessary for learning these subjects.

Authentic Problems and Tasks

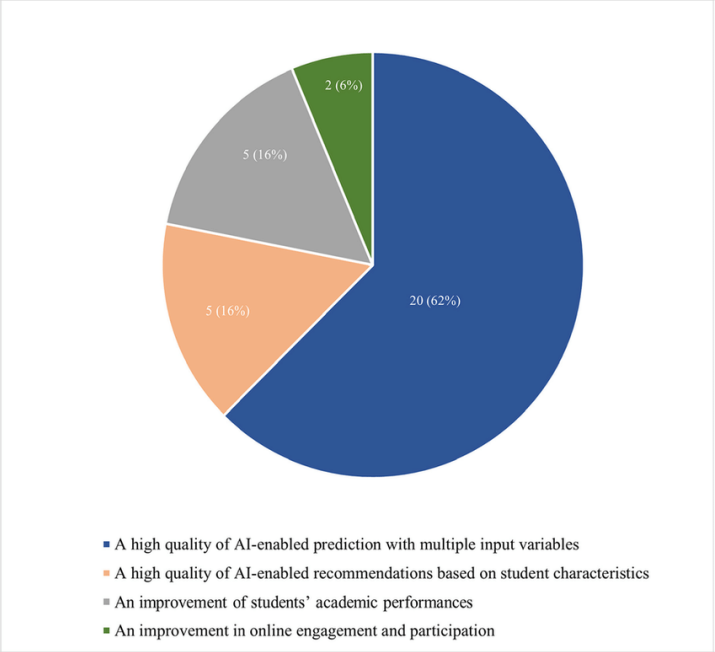
Teachers pointed out that the aspect of constructing and applying knowledge in accordance with the standards, as well as using an actual task, has to be discussed. Teachers fostered a variety of learning activities that show how content knowledge can be used to solve contextualized problems by virtue of the functional tasks their student-AI teams performed. Students wrote about class issues, including determining students who run within the classroom in outdoor shoes (home economics, P4), daily life, such as creating a weekly meal plan for the family (home economics, P4), and global issues, such as forecasting when Antarctica's glaciers will melt (social science/science, S4). Instructors support the concepts of Cho et al. (2015) about the use of realistic tasks

to increase the relevance of classroom work between what students perform in the classroom and real-world events as well as the operation of artificial intelligence technologies.

An Innovative Model towards Pedagogy

The role of technology in education is critical, providing transformational opportunities to streamline administrative tasks and maximize learning effectiveness. A study by Google for Education revealed that educators who are empowered by technology report higher levels of engagement and a greater focus on teaching rather than administrative duties. These teachers dedicate approximately three hours daily to tasks such as lesson planning and note-taking, underscoring the significant time commitment required for administrative responsibilities. In contrast, they spend an average of five hours actively teaching their students, highlighting the potential for technology to alleviate administrative burdens and maximize instructional time (Sarwar, Saima, & Gul, 2024). Globally, educators face significant stressors related to their profession, with 61% in the US and 67% in the UK citing job-related stress. Technology emerges as a promising solution to alleviate this stress, with 84% of UK teachers acknowledging that technology helps them save time, whether by simplifying administrative tasks or facilitating grading processes (Yeslyamov, 2024). Moreover, an overwhelming 88% of UK educators agree that integrating technology into the classroom enhances teaching methodologies and elevates educational standards. Recognizing teachers as catalysts for educational change, institutions are increasingly focused on strategies to empower and motivate them towards professional growth rather than administrative tasks. Technology plays a pivotal role in this paradigm shift, enabling educators to concentrate more fully on teaching strategies and student engagement (Singha, Singha, & Jasmine, 2024). By facilitating collaborative learning environments and reducing the need for traditional supplies, technology not only enhances educational outcomes but also optimizes resource allocation. In Mexico, for example, 83% of teachers highlight technology's role in simplifying tasks such as material creation and editing, while 60% emphasize its role in fostering collaborative opportunities among educators (Jiménez- Orenes- & López-Fraile, 2024). As educational institutions continue to embrace technological advancements, the potential for innovation in pedagogical practices grows, promising a future where educators can thrive in their roles as facilitators of knowledge and inspiration.

Figure No: 03 *AI Application in Online Higher Education*

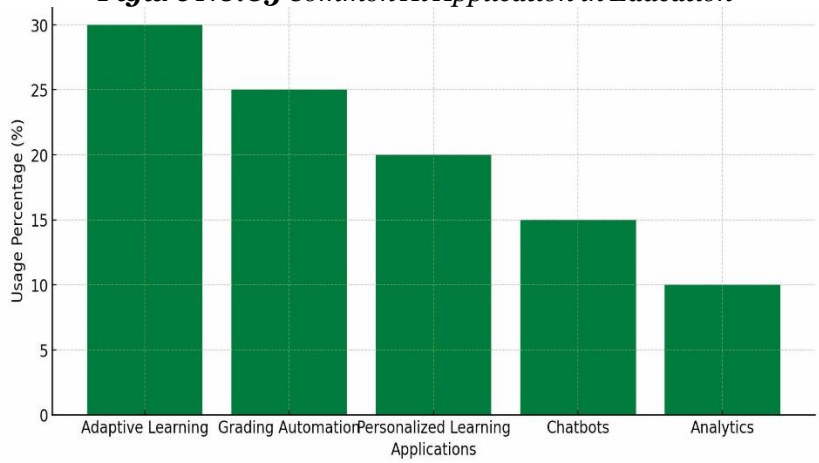


Emergence of Emerging Technologies in the Educational Scenario

The integration of cutting-edge technologies such as artificial intelligence (AI), virtual reality (VR), and augmented reality (AR) is reshaping everyday activities, particularly within educational environments. For instance, a significant percentage of children in the UK and the US are now familiar with voice assistants, underscoring the rapid adoption of AI-driven technologies among young learners. The global proliferation of mobile augmented reality is also on the rise, expected to reach over two billion users in the coming years, signaling a transformative shift in educational methodologies (A. Ahmad, 2024; N. Ahmad). Educators and researchers alike are increasingly recognizing the potential of these technologies to enhance student engagement and performance. Research examining the use of virtual reality in the classroom shows that it can increase motivation and improve learning outcomes. Importantly, in the U.S., the majority of teachers (82%)

believe that integrating technology into schools better prepares students for the work of the future, reflecting growing optimism about the educational benefits of technological innovation (Matthew et al., 2024).; Tamer, Nayir, & Bozkurt, 2024). Educational institutions around the world are actively exploring new ways to use this technology for teaching and learning. Examples include voice assistants harnessing the power of AI in classrooms to enhance student communication and learning management and initiatives by state governments to use AI technologies to improve language skills among students (Groenewald, Kumar, Avinash, & Yerasuri, 2024). Despite the potential promise of this technology, its widespread adoption in academia is still in its infancy. Educators and policymakers continue to address the challenges and opportunities associated with integrating emerging technologies into educational systems, balancing innovation with public recognition of the need to improve legal systems (Grájeda, Burgos, Córdova, & Sanjinés, 2024). As these technologies evolve, their impact on educational practices will grow, providing new ways to engage students and prepare them for the digital challenges of the future.

Figure No:05 *Common Ai Application in Education*



The bar chart illustrating common AI applications in education reveals a diverse range of technologies being utilized within educational settings. The data shows that adaptive learning systems, which tailor educational experiences to individual student needs and progress, are the most prevalent, accounting for 30% of AI applications. Grading automation tools follow closely at 25%, highlighting their role in reducing manual grading efforts for educators. Personalized learning, which involves creating custom learning paths based on student preferences and styles, comprises 20% of the applications. AI-driven chatbots, offering real-time assistance and addressing student inquiries, represent 15%, while analytics tools, used for data analysis and providing insights into student performance and institutional efficiency, make up 10%. This distribution suggests a significant emphasis on personalized education and operational efficiency, with a notable presence of chatbots and analytics indicating a broader adoption of supportive AI technologies in educational environments.

Artificial Intelligence Microsoft and Google Tools

It's becoming increasingly clear that artificial intelligence tools developed by tech giants like Microsoft and Google aren't just for experts and computer engineers. A development that has fundamentally changed the education system is the ability for organizations to quickly create and manage intelligent chatbots without the need for coding skills, as shown by the most recent version of Microsoft Virtual Agents for Power. This allows for the creation of other features, like Professor David Kellerman's Intelligent Question Bot, which responds to students' questions independently and refines its responses in response to feedback and interaction (Ivanashko, Kozak, Knysh, & Honchar, 2024). Such tools not only allow students autonomy but also support personalized learning experiences. Additionally, these AI tools are deployed on broader platforms such as Microsoft Teams (MS) and Google Tools, which integrate applications such as Meet, Calendar, Gmail, Classroom, etc. This integration provides accessibility and communication increases in educational settings and enhances collaborative learning and learning environments (Zohuri & Mossavar-Rahmani, 2024). The use of these global AI technologies in physical and virtual classrooms expands learning opportunities, especially for students with disabilities and those who use multiple languages to communicate. Through the learning strategies that AI accepts, it forces teachers to change their teaching strategies to enhance learning outcomes (authored by Yang, 2024). These technological developments are also driving business initiatives aimed at providing the necessary AI tools through platforms such as "AI as a Service" (AIaaS). These services aim to democratize access to artificial intelligence resources, allowing educational professionals to integrate AI functionalities such as logic and reasoning into their teaching without extensive development costs or technical expertise (Abdullah & Basheer, 2024).

Table No :*01 Artificial Intelligence Tools for Education*

Role description	***AI applications***
Watson from IBM	AI applications in the cloud that can be integrated into apps for data storage and management.
Amazon Web Services	Provides a wide range of products and services through the Amazon cloud.
Data Robot, Petuum, H2O	AI systems demonstrating the growth and diversity of AI applications.
Tensor Flow from Google	Open-source, comprehensive AI framework for various applications.
PowerPoint Presentation Translator	Real-time subtitle creation for presentations using AI technology.
Microsoft Azure	Cloud-hosted services for AI, enabling development of bot-based or image-recognition applications.

The table provides examples and descriptions of different types of AI tools used in education and highlights their applications. Watson from IBM provides AI services in the cloud, providing simple data storage and functional integration in educational applications. Amazon Web Services (AWS) offers a wide range of products and services through its cloud platform, enhancing the educational process. AIaaS frameworks such as Data Robot, Petuum, and H2O are examples of various AI applications and developments that provide tools for predictive analytics and functional machine learning. TensorFlow from Google is an open-source AI framework for educational applications, such as personalized learning and content development. PowerPoint Presentation Translator by Microsoft generates subtitles in real time, improving accessibility and understanding in presentations. Microsoft Azure offers cloud-enabled AI services, enabling you to develop new educational tools such as chatbots and image recognition applications. Together, these tools demonstrate the transformative potential of AI in improving educational practices and outcomes.

Applications of Artificial Intelligence in the Development of E-Learning

Artificial intelligence applications integrated into e-learning platforms can generate personalized online courses tailored to individual learning preferences. Adaptive learning utilizes machine learning algorithms to dynamically adjust course content based on student interactions, enhancing engagement and effectiveness. The increasing enrollment in online courses and programs has significantly boosted the e-learning industry in recent years. AI has the potential to revolutionize online education by offering students personalized and efficient learning experiences (Lim, 2024). Artificial intelligence enables students to receive customized education that aligns with their specific needs and interests, thereby optimizing the learning process. However, the integration of AI into e-learning also presents various challenges and considerations that require careful assessment. Here are some examples of successful real-world applications of artificial intelligence in the context of online education (Darda, Gupta, & Yadav, 2024).

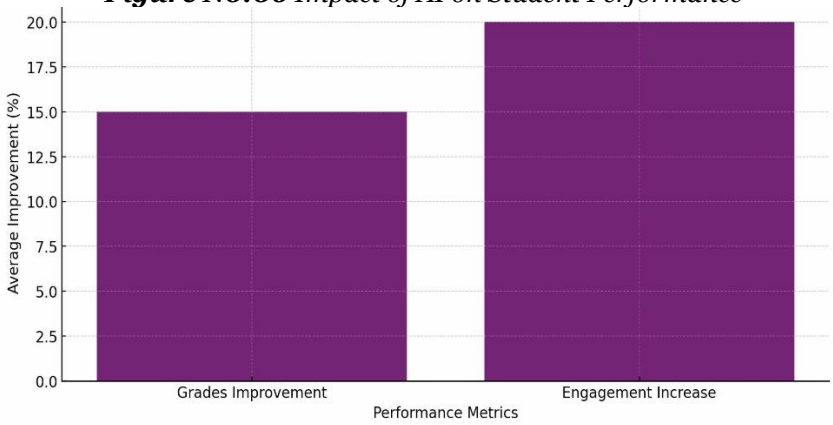
Table No 02: *Artificial Intelligence Examples for Online Learning*

Application	**Description**
Massive Open Online Courses (MOOCs)	MOOCs are accessible via the Internet and have seen significant enrollment numbers, such as 101 million learners in 2018 across platforms like Coursera, EdX, Xuetang X, Udacity, and Future Learn.
Carnegie Learning	Carnegie Learning's MATHia received the 'Best Use of Artificial Intelligence in Education' award for its adaptive learning engine tailored for grades 6 through 12, offering personalized assignments based on student abilities.
Duolingo	Duolingo, with over 300 million users, is renowned for its personalized language learning approach, gamified learning experience, and AI-powered chatbots for practicing real-world conversations.

Table 2 provides examples and descriptions of AI applications in online learning, illustrating their impact on the educational experience. Massive Open Online Courses (MOOCs) such as Coursera, EdX, Xuetang X,

Udacity, and Future Learn have revolutionized education by providing accessible online learning, with 101 million students enrolled in 2018. Carnegie Learning's MATHia, which was awarded 'Best Use of Artificial Intelligence in Education,' offers a revolutionary learning engine that tailors math instruction to students in grades 6 through 12 based on their abilities, providing them with learning-focused encouragement. With more than 300 million users, Duolingo uses AI to deliver personalized language learning through game-based experiences and AI-powered chatbots. Empowering users to deliver real-world dialogue plays a role. This project is used to enhance educational outcomes through adaptive learning, personalized instruction, and engaging sessions. AI in online learning shows a transformative role. These applications exemplify how artificial intelligence is utilized in online learning environments, enhancing educational experiences through adaptive learning, personalized instruction, and innovative learning platforms.

Figure No:06 *Impact of AI on Student Performance*



The bar chart depicting the impact of AI on student performance shows notable improvements in key metrics, highlighting the positive effects of integrating AI into education. The data indicates a 15% improvement in grades, suggesting that personalized and adaptive learning experiences facilitated by AI contribute significantly to academic success. Additionally, there is a 20% increase in student engagement, likely driven by interactive AI tools and personalized content that make learning more engaging and relevant. These improvements demonstrate that AI technologies are not only enhancing the efficiency of the learning process but also fostering greater student involvement. Overall, the figures collectively emphasize the transformative potential of AI in revolutionizing teaching and learning. The increasing adoption rate, the variety of applications, and the positive impact on student outcomes underscore the significant benefits of AI in educational settings. As AI solutions continue to evolve and become more accessible, this trend is expected to grow, further solidifying AI's role in shaping the future of education.

AI-Driven Online Learning Potential

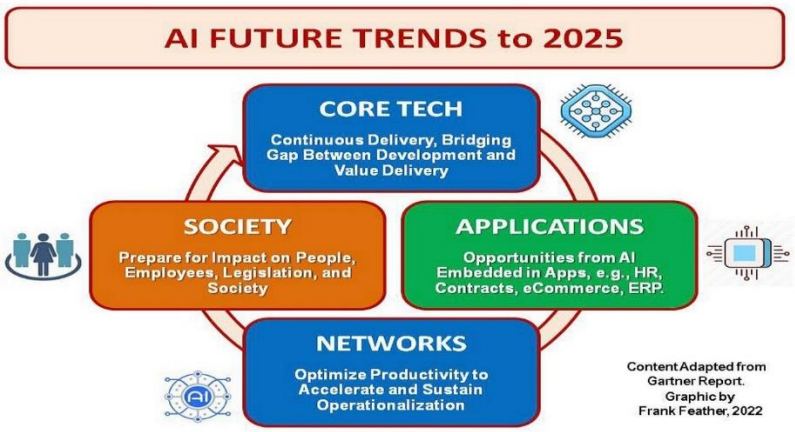
The integration of AI into LMS platforms streamlines student learning experiences by offering highly personalized content tailored to individual learning styles and paces through adaptive algorithms. AI-enhanced LMS systems act as virtual tutors, engaging users through simulated human interactions using speech, holograms, or avatars (Porayska-Pomsta, 2024). These systems accumulate real-time insights on student understanding and progress and enable flexible adjustments based on student feedback. Chatbots on these platforms act as learning aids, answering student questions, providing additional support, and customizing content to match student progress. The flexibility of learning materials ensures that struggling students have access to resources; targeted interventions are used to increase understanding, while game tools provide engagement and engagement through learning experiences. In addition, AI facilitates the creation of learning materials and self-directed learning based on student data, providing customized guidance and recommendations for material additions (Aguilera, Castro, Aguilera, & Raducanu, 2024; Ali). These developments highlight the transformative impact of AI on educational settings, from early childhood education to high school. Progress towards continuous learning requires robust digital infrastructure that can support advanced learning strategies beyond traditional standards. A.I. Furthermore, the deployment of AI in online learning environments enhances data security through automated updates and encryption protocols, ensuring safe transactions and data integrity. The burgeoning online learning market, valued at over $250 billion in 2020 and projected to grow substantially, is driven by innovations like cloud-based LMS and virtual reality technologies alongside AI (Bengsch, 2024). These technologies enable the creation of intelligent content, digital study aids, and real-time interactive assessments, catering to diverse educational needs on a global scale. Major institutions worldwide, including Ivy League universities and other prestigious colleges, are witnessing increased enrollment in online courses, indicating a shift towards accessible and technologically enhanced learning solutions (Mao, Chen, & Liu, 2024).

***Table No 03**: LMS Platforms Incorporating Artificial Intelligence*

LMS Platform	AI Features	Key Benefits
Canvas	AI-driven analytics for personalized learning paths	Enhanced student engagement and performance
	Predictive analytics for student success	Early intervention for at-risk students
	Automated grading and feedback	Reduced instructor workload
Moodle	AI-based recommendation system for resources	Personalized learning experience
	- Adaptive learning paths	Increased retention and completion rates
	Intelligent tutoring systems	Improved learning outcomes
Blackboard Learn	AI-driven content recommendations	Tailored content delivery
	Predictive analytics for student retention	Proactive support for students
	Virtual assistants for administrative tasks	Streamlined administrative processes
Knewton	Adaptive learning algorithms	Customized learning experiences
	Predictive analytics for student performance	Improved learning efficiency
	Real-time feedback and assessment	Continuous improvement in student performance
Coursera	AI-driven course recommendations	Enhanced course discovery and enrollment
	Automated grading and feedback	Scalable assessment capabilities
	Personalized learning paths	Increased learner engagement and success

The incorporation of artificial intelligence in learning management systems has significantly transformed various educational processes by improving aspects such as individual learning, prognosis, and administrative work. The following interpretation examines various LMS platforms incorporating AI features and their key benefits: AI-based analytics help Canvas design individual educational experiences, thereby improving students' participation and outcomes. In addition, there are opportunities to use predictive analytics in order to address the needs of risky students and to decrease instructors' workloads by using automated grading and feedback systems, which in turn will enhance the overall effectiveness of education. Besides the recommendation of resource materials and creating learning paths based on users' learning experiences, Moodle has the AI feature that enhances users' retention and completion rates. In addition, intelligent tutoring systems enhance outcomes since they provide specific instructions to students. In Blackboard Learn, content suggestion and predictive analysis have been integrated to enable the delivery of relevant, rich content and students' early intervention when necessary. Virtual assistants automate most of the paperwork that is likely to take much of an educator's time in their planning and execution. Newton has functional adaptive learning algorithms and predictable analysis for improving the learning environment and its effectiveness. Interactive evaluation of the students allows constant accountability of their performance and fosters an active learning process. For AI, it is incorporated in the recommendation of courses as well as automation of grading, improvements to course identification and enrollment, and scalable grading. Individual learning plans promote greater attention and outcomes among the learners.

***Figure No :07** Artificial Intelligence Future Trends in Leaning and Teaching*



Conclusion

The study emphasizes the importance of modern education systems in providing students with the knowledge and skills necessary for all aspects of life. Artificial intelligence evolves and permeates everyday life, future generations will inevitably incorporate this technology into their daily experiences. This approach implies a shift from traditional paper and blackboards to a dynamic, technology-driven educational system. AI advances are poised to place the automation of routine tasks within a broader context of digital transformation, and as such, education stands to benefit and evolve. This requires an ongoing process of rethinking and reinventing new educational strategies to optimize the potential of AI. The applications of AI in learning and teaching have shown possibilities of improving learnability and teaching methods in education. From learning models for students to facilitation models for administrative tasks in the learning process, AI has the potential of revolutionizing the system or procedure of education. Nevertheless, these advantages have to be handled alongside key concerns like data privacy, prejudice, and fairness. If these technologies are to be effectively used to help improve education with the support of artificial intelligence, then the concerned stakeholders must embrace ethical artificial intelligence development and deployment. Therefore, future discussions and partnerships between educators, technologists, policymakers, and students will be crucial to understand the ethical implications that arise from AI and to ensure that AI is being utilized to bring positive change into the education system. Additionally, the digital age has ushered in an era of unprecedented data and has inspired countries to leverage multiple data sources to provide more personalized learning opportunities tailored to students' individual needs. In addition, the present research revealed a significant lack of a general policy to coordinate the reflective process at different levels of the organization. On this front, educational policy makers are invited to answer questions related to the formation of a new developing educational system by adopting AI to the best and to warn of the potential for a malign if such an aspect exists while providing a framework for said reflections with an expectation that they will lead to actionable strategies. In contrast, policy should encourage bottom-up coordination for the purpose of intersectoral integration and sharing of resources by different stakeholders wherein schools' continuing concerns and issues will be aired and educationally relevant AI and pedagogy can be developed through academe-industry-government consortium research and development.

Ethical considerations

The application of artificial intelligence within learning and teaching environments presents several ethical implications that need to be elaborately discussed and effectively managed amidst educators as well as policymakers. One of the significant issues that can be observed is data privacy and protection, which is a crucial aspect of most of the intelligent systems due to the amount of private data they process. There is a need to abide by important laws such as GDPR and FERPA, among others. Moreover, the question of 'fairness' comes into focus when AI systems take control of educational processes: due to prejudices being inherent to the AI algorithm training dataset, such prejudices are reproduced in them, which means that education may not be fair as well. Thus, it is important to put mechanisms for transparency, accountability, and frequent checks and balances in place to avoid these problems. Besides, there is always the need to retain human input to ensure that these great inventions are complementary tools to act as aids in human decision-making processes. The digital divide is another significant issue; appropriate or inadequate access to AI-enriched learning materials may make such disparities worse. It is also important to further stress the principles of transparency, accountability, and human rights compliance to ensure the sustainability of the development of ethical pedagogical AI that is congruent with the values of the educational community to develop technology responsibly. The use of artificial intelligence in education is critical to these developments. As these trends unfold, it will be important to establish comprehensive policies that govern the ethical use of AI. Every educational system in the world must define the ethical use of student, stakeholder, and teacher data to

optimize educational outcomes, engage students in their learning, and better prepare them for the future. In parallel, the development of critical thinking and computer literacy remains key. This approach contributes to the development of innovative teaching strategies tailored to the evolving educational ecosystem. By integrating instruction and technology, educators have the tools they need to optimize classroom outcomes, foster healthy learning environments, and transform traditional classrooms into future-proof classrooms.

References

1. Abdullah, S. A., & Basheer, I. (2024). The Ethical and Social Implications of Using Artificial Intelligence in Social Studies Instruction. *Larq Journal for Philosophy, Linguistics & Social Sciences*, 1(52).
2. Abulibdeh, A., Zaidan, E., & Abulibdeh, R. (2024). Navigating the confluence of artificial Intelligence and education for sustainable development in the era of industry 4.0: Challenges, opportunities, and ethical dimensions. *Journal of Cleaner Production, 140527*.
3. Aguilera, C. A., Castro, A., Aguilera, C., & Raducanu, B. (2024). Voice-Controlled Robotics in Early Education: Implementing and Validating Child-Directed Interactions Using a Collaborative Robot and Artificial Intelligence. *Applied Sciences, 14(6), 2408*.
4. Ahmad, A. (2024). Ethical implications of artificial Intelligence in accounting: A framework for responsible AI adoption in multinational corporations in Jordan. *International Journal of Data and Network Science, 8(1), 401-414*.
5. Ahmad, N. Educating for Tomorrow: Interdisciplinary Approaches in the Age of Artificial Intelligence.
6. Akhtar, M. Revolutionizing Education: Integrating Artificial Intelligence through an Interdisciplinary Lens.
7. Albacete, P., Jordan, P., Lusetich, D., Chounta, I. A., Katz, S., & McLaren, B. M. (2018, June). Providing proactive scaffolding during tutorial dialogue using guidance from student model predictions. In *international conference on artificial intelligence in education* (pp. 20-25). Springer, Cham.
8. Ali, A. AI-Driven Education: Opportunities, Challenges, and Ethical Considerations.
9. Alier, M., García-Peñalvo, F., & Camba, J. D. (2024). Generative Artificial Intelligence in Education: From Deceptive to Disruptive.
10. Baker, T., & Smith, L. (2019). Educ-AI-tion rebooted? Exploring the future of artificial intelligence in schools and colleges. .
11. Bengsch, G. (2024). Redefining Traditional Pedagogy: The Integration of Machine Learning in the Contemporary Language Education Classroom. In *AI in Language Teaching, Learning, and Assessment* (pp. 195-221): IGI Global.
12. Dai, M. (2024). Frontiers of Intelligent Education: Artificial Intelligence Reshaping the New Landscape of Chinese Higher Education. *Journal of Advanced Research in Education, 3(2), 37-43*.
13. Darda, P., Gupta, O. J., & Yadav, S. (2024). Metamorphosing traditional pedagogy: examining the transcendent influence of Alexa in catalyzing educational paradigm shifts within rural Indian communities. *International Journal of Educational Management*.
14. Dillenbourg, P., Baker, M. J., Blaye, A., & O'Malley, C. (1995). The evolution of research on collaborative learning. In H. Spada & P. Reimann (Eds.), *Learning in humans and machine: Towards an interdisciplinary learning science* (pp. 189–211). Elsevier.
15. du Plessis, E. (2024). The Impact of Artificial Intelligence on Teacher Training in Open Distance and Electronic Learning. *Science Open Preprints*.
16. Elimadi, I., Chafiq, N., & Ghazouani, M. (2024). Artificial Intelligence in the Context of Digital Learning Environments (DLEs): Towards Adaptive Learning. In *Engineering Applications of Artificial Intelligence* (pp. 95-111): Springer.
17. Encarnação, R., Manuel, T., Palheira, H., Neves-Amado, J., & Alves, P. (2024). Artificial Intelligence in Wound Care Education: Protocol for a Scoping Review. *Nursing Reports, 14(1), 627-640*.
18. Grájeda, A., Burgos, J., Córdova, P., & Sanjinés, A. (2024). Assessing student-perceived impact of using artificial intelligence tools: Construction of a synthetic index of application in higher education. *Cogent Education, 11(1), 2287917*.
19. Groenewald, E. S., Kumar, N., Avinash, S. I., & Yerasuri, S. (2024). Virtual Laboratories Enhanced by AI for hands-on Informatics Learning. *Journal of Informatics Education and Research, 4(1)*.
20. Haider, S. (2024). Exploring opportunities and challenges of artificial Intelligence in social work education. In *The Routledge International Handbook of Social Work Teaching* (pp. 46-62).
21. Hess, B. J., Cupido, N., Ross, S., & Kvern, B. (2024). Becoming adaptive experts in an era of rapid advances in generative artificial Intelligence. *Medical Teacher, 46(3), 300-303*.
22. Hutchins, E. (1995). How a cockpit remembers its speeds. *Cognitive Science, 19*(3), 265–288.
23. Ivanashko, O., Kozak, A., Knysh, T., & Honchar, K. (2024). The Role of Artificial Intelligence in Shaping the Future of Education: Opportunities and Challenges. *Futurity Education, 4(1), 126-146*.
24. Jackson, E. A. (2024). The Evolution of Artificial Intelligence: A Theoretical Review of its Impact on Teaching and Learning in the Digital Age.
25. Jameel, T. Teaching Ethics in the Age of AI: Strategies for Educators and Technologists.

26. Jiménez-García, E., Orenes-Martínez, N., & López-Fraile, L. A. (2024). Pedagogy Wheel for Artificial Intelligence: adaptation of Carrington's Wheel. *RIED-Revista Iberoamericana de Education a Distance, 27(1)*.
27. Kucukkaragoz, H., & Meylani, R. Brave New World: Navigating New Paradigms in the Educational Landscape for the Evolving Learner in a Rapidly Changing Era.
28. Lewis, K. O., Popov, V., & Fatima, S. S. (2024). From static web to metaverse: reinventing medical education in the post-pandemic era. *Annals of Medicine, 56(1), 2305694*.
29. Lim, E. M. (2024). Metaphor analysis on pre-service early childhood teachers' conception of AI (Artificial Intelligence) education for young children. *Thinking Skills and Creativity, 51, 101455*.
30. Lin, Y. S., Chen, S. Y., Tsai, C. W., & Lai, Y. H. (2021). Exploring computational thinking skills training through augmented reality and AIoT learning. *Frontiers in Psychology*, 12.
31. Mao, J., Chen, B., & Liu, J. C. (2024). Generative Artificial Intelligence in Education and Its Implications for Assessment. *Tech Trends, 68(1), 58-66*.
32. Matthew, U. O., Kazaure, J. S., Ndukwu, C. C., Ebong, G. N., Nwanakwaugwu, A. C., & Nwamouh, U. C. (2024). Artificial Intelligence Educational Pedagogy Development: ICT Pedagogy Development for Education 5.0. In *Educational Perspectives on Digital Technologies in Modeling and Management* (pp. 65-93): IGI Global.
33. Nardi, B. A., & O'Day, V. (1999). Information ecologies: Using technology with heart. MIT Press.
34. Nawaz, B. Innovative Pedagogy: Melding Interdisciplinary and Artificial Intelligence in Education.
35. Novawan, A., Walker, S. A., & Ikeda, O. (2024). The New Face of Technology-Enhanced Language Learning (TELL) with Artificial Intelligence (AI): Teacher perspectives, practices, and challenges. *Journal of English in Academic and Professional Communication, 10(1), 1-18*.
36. Okoye, K., Nganji, J. T., & Hosseini, S. (2020). Learning analytics for educational innovation: A systematic mapping study of early indicators and success factors. *International Journal of Computer Information Systems and Industrial Management Applications, 12*, 138–154.
37. Peng, H., Ma, S., & Spector, J. M. (2019). Personalized adaptive learning: An emerging pedagogical approach enabled by a smart learning environment. *Smart Learning Environments, 6*(1), 9.
38. Porayska-Pomsta, K. (2024). From Algorithm Worship to the Art of Human Learning: Insights from 50-year journey of AI in Education. *arXiv preprint arXiv:2403.05544*.
39. Salsabila, A.-Z. A., & Rohiem, A. F. (2024). The Ethical Influence of Artificial Intelligence (AI) in Religious Education: Implications, Challenges, and Innovative Perspectives on the Merdeka Curriculum. *Proceeding International Conference on Religion, Science and Education*.
40. Sappaile, B. I., Vandika, A. Y., Deiniatur, M., Nuridayanti, N., & Arifudin, O. (2024). The Role of Artificial Intelligence in the Development of Digital Era Educational Progress. *Journal of Artificial Intelligence and Development, 3(1), 1-8*.
41. Sarwar, M. A., Saima, M., & Gul, A. (2024). The Role of Artificial Intelligence in Shaping the Future of Education at Higher Secondary Level. *Journal of Education and Social Studies, 5(1), 34-45*.
42. Singha, S., Singha, R., & Jasmine, E. (2024). Enhancing Language Teaching Materials Through Artificial Intelligence: Opportunities and Challenges. In *AI in Language Teaching, Learning, and Assessment* (pp. 22-42).
43. Söğüt, S. (2024). Generative artificial Intelligence in EFL writing: A pedagogical stance of pre-service teachers and teacher trainers. *Focus on ELT Journal, 6(1), 58-73*.
44. Stanojević, D. V. R. P. N., & Čomić, T. (2024). Challenges of integration and implementation of generative artificial Intelligence in the process of higher education.
45. Storozhyk, M. (2024). Philosophy of future: analytical overview of interaction between education, science, and Artificial Intelligence in the context of contemporary challenges. *Futurity Philosophy, 3(1), 23-47*.
46. Tamer, S., NAYİR, F., & Bozkurt, A. (2024). Reimagining education: Bridging artificial Intelligence, transhumanism, and critical pedagogy. *Journal of Educational Technology and Online Learning, 7(1), 102-115*.
47. Tan, D. Y., & Cheah, C. W. (2021). Developing a gamified AI-enabled online learning application to improve students' perception of university physics. *Computers and Education: Artificial Intelligence, 2*, 100032.
48. Tang, K. H. D. (2024). Implications of Artificial Intelligence for Teaching and Learning. *Acta Pedagogia Asiana, 3(2), 65-79*.
49. Tang, L., & Su, Y.-S. (2024). Ethical Implications and Principles of Using Artificial Intelligence Models in the Classroom: A Systematic Literature Review.
50. Walter, Y. (2024). Embracing the future of Artificial Intelligence in the classroom: the relevance of AI literacy, prompt engineering, and critical thinking in modern education. *International Journal of Educational Technology in Higher Education, 21(1), 15*.
51. Williams, R. T. (2024). The ethical implications of using generative chatbots in higher education. *Paper presented at the Frontiers in Education*.
52. Yang, A. (2024). Challenges and Opportunities for Foreign Language Teachers in the Era of Artificial Intelligence. *International Journal of Education and Humanities, 4(1), 39-50*.

53. Yeslyamov, S. (2024). Application of Software Robots Using Artificial Intelligence Technologies in the Educational Process of the University. *Journal of Robotics and Control (JRC), 5(2), 359-369*.
54. Yu, H. (2024). The application and challenges of ChatGPT in educational transformation: new demands for teachers' roles. *Heliyon*.
55. Zhu, T., Xiong, P., Li, G., Zhou, W., & Philip, S. Y. (2020). Differentially private model publishing in cyber physical systems. *Future Generation Computer Systems, 108*, 1297–1306.
56. Zohuri, B., & Mossavar-Rahmani, F. (2024). The Symbiotic Evolution: Artificial Intelligence (AI) Enhancing Human Intelligence (HI) An Innovative Technology Collaboration and Synergy. *J Mat Sci Apl Eng 3 (1), 01, 5*.