



The Impact of AI-Driven Teaching Approaches on STEM Education

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ABSTRACT

In the field of education, Artificial intelligence teaching approaches not only modify but also enhance students' learning experience. In modern times, AI-based machine learning, natural language learning tools, data analytical tools, and personalized learning tools help students experience new things and intensify their motivation. AI in education analyzes huge data to identify patterns and provide suitable recommendations to improve student engagement and performance. AI can also provide immediate and beneficial feedback to allow students to understand their strengths and weaknesses. AI supports collaborative learning environments, promoting active participation, critical thinking, and problem-solving skills to modify learning paths and deliver adaptive feedback to fulfill the aim of STEM education. AI has completely changed STEM education to provide personalized and flexible learning opportunities. Artificial intelligence helps to analyze data, provide instant feedback, and foster cooperative learning, like machine learning, natural language processing, and data analytics.

Keywords: STEM education, Artificial Intelligence, learning experience, and cooperative learning environment

Technology holds an important place in our lives, and by utilizing it in the field of education, we can enhance our intellect, thinking, learning, research, and interaction. When we use technology in studies, it is referred to as artificial intelligence (AI). The versatile field of

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Artificial Intelligence in Education utilizes AI technology to enhance educational design, processes, and evaluation. The main objective of AI-driven teaching methods in education is to develop and apply AI tools to strengthen STEM education. AI technologies enhance education and learning outcomes by utilizing learning analytics, data mining, intelligent tutoring, and automated assessment. The use and integration of AI technologies in STEM education are focused on the subject, information, medium, and environmental factors that improve AI-STEM education research and practice from an educational and technological standpoint.

The modern age is the age of science and technology, so STEM education is essential for educating students for the rapidly changing needs of the modern world. Today, we use advanced technology at an unparalleled rate, which touches all spheres of education and enhances as well as upgrades the use of artificial intelligence (AI) in STEM instruction. AI can transform the students' thinking approach and enable them to comprehend subjects and create new opportunities. The blending of STEM with AI education has enormous potential to change the experience of learning. AI includes several educational contexts, like student assessments, curriculum and teaching, and learning resources. Learning with AI technology reshapes and changes the educational experiences of students. AI can also be helpful by offering real-time feedback and modifying the information to fit students' skills. AI may also help with curriculum and education. AI can also completely change student evaluations by offering more precise and impartial assessments of knowledge and abilities.

AI may refine personalized learning environments and encourage integration and inclusiveness to provide AI literacy abilities to students. It can play a revolutionary role in STEM education by creating an engaging, effective, and fair learning environment by fully comprehending its reach. Artificial intelligence offers a plethora of potential and improves educational opportunities in STEM education that provide immersive, interactive learning experiences for students to make them better at comprehending difficult subjects.

The educational landscape has been profoundly changed by the emergence of AI, machine learning, and LLMs (Large Language Models), especially in STEM education. STEM is essential for influencing the future of society, promoting economic expansion, resolving challenging issues, and improving living standards. It develops knowledgeable citizens who can make deft judgments in a complicated environment by giving pupils the tools they need to succeed in science, technology, engineering, and math. However, the shift from theoretical knowledge to real-world problem-solving and solution design is frequently impeded by traditional STEM education frameworks. Engaging pupils in this sector requires an instructional strategy that is dynamic, interactive, and responsive. The integration of AI in STEM education is a transformative era, characterized by a recalibration of instructional paradigms and innovative learning methodologies. Advances in machine learning and LLMs have led to the creation of highly personalized learning environments, enabling immediate feedback, identification of

learning deficits, and targeted instructional support. AI supports the development of problem-solving skills by providing instant feedback, enabling iterative refinement of approaches and solutions. It also allows for experiential learning and project-based assignments, fostering deeper engagement with STEM concepts. AI-powered platforms can deliver dynamic content, simulations, and virtual labs, enhancing students' understanding of STEM concepts and promoting critical thinking and problem-solving skills. However, challenges include technical, pedagogical, ethical, and accessibility dimensions. The infusion of AI into educational environments requires sophisticated infrastructure, reliable connectivity, and state-of-the-art hardware, which can impose financial burdens and maintenance responsibilities. Addressing these concerns requires a concerted effort from educators, technologists, and policymakers to ensure that AI-driven educational practices are equitable, inclusive, and respectful.

Meaning of AI

Artificial intelligence (AI) is a computer science field that enables computing systems to perform tasks learning, reasoning, problem-solving, perception, and decision-making by utilizing intelligence and artificial learning as humans do. The term artificial intelligence (AI) describes the capacity of digital computers or robots to carry out operations like reasoning, generalization, and experience-based learning that are typically performed by intelligent creatures. To address instructional and learning demands, the nascent area of artificial intelligence (AI) in STEM education must integrate a variety of AI methodologies with intricate educational components.

AI in STEM Education

AI plays an important role in STEM education; it offers opportunities and personalized learning experiences for the development of critical AI literacy skills. Integrating AI into STEM education can enhance personalized learning, foster collaboration, and equip students with the necessary skills of the world. The future of AI in education involves supporting teachers in integrating AI, ensuring ethical development, and providing equitable access to resources.

- ❖ AI provides personalized learning in STEM subjects by creating customized problem sets and offering real-time feedback to students.
- ❖ AI literacy is essential for students to engage, contribute, and navigate an AI-driven world.
- ❖ The future of AI in education involves comprehensive strategies to integrate AI into teaching practices, ensure ethical development, and provide equitable access to resources.
- ❖ Collaboration between STEM and non-STEM disciplines is necessary to prepare students for an AI-driven world.

- ❖ AI applications in STEM education focus on student behavior detection, using data mining and analytics to track learning patterns and characteristics in instructional processes.
- ❖ Automation is one example of how AI is being used in STEM education. It employs AI technology to automatically assess student performance and provide teachers with assignments.

Benefits of AI-Driven Teaching Approaches in STEM Education

The integration of artificial intelligence (AI) in education has a positive impact on students' learning experiences. These are some advantages of AI in education:

- ❖ **Personalized Learning:** AI prepares customized learning environments according to students' needs, learning styles, and paces.
- ❖ **24/7 Access to Learning:** To make learning more flexible and accessible, AI provides such tools to students to access anytime and anywhere.
- ❖ **Efficient Administrative Tasks:** AI makes tools that allow teachers to conduct grading, scheduling, and teaching more effectively and easily.
- ❖ **Enhanced Engagement:** AI not only allows instant feedback but also supports to creation of interactive and engaging learning experiences through tools like virtual tutors and chatbots.
- ❖ **Support for Teachers:** AI gives insights to teachers to look into the performance of students. AI helps them to identify those areas where students need support and guidance.
- ❖ **Cost-Effective Learning:** AI promotes cost-effective learning by providing scalable solutions and accessibility to a larger number of students.
- ❖ **Continuous Improvement:** To improve educational content and teaching methods, reform the education system, and adapt to new challenges, AI systems can continuously analyze data.

AI Applications in STEM Education

The application of AI technologies in STEM education is an emerging field that enhances instructional and learning processes, in STEM education. AI technologies like intelligent tutoring, automated assessment, and data mining have been implemented to improve the quality of instruction and learning in STEM fields. Despite the benefits, integrating AI into STEM education faces challenges due to the complexity of educational contexts. The potential of AI technology in STEM education is promising, with studies showing improvements in student learning performance, motivation, and cognitive thinking. We use AI in teaching, providing instruction, problem-based learning, etc. The main purpose of using AI in the teaching-learning

process is to show high accuracy in learning and personalized recommendations for students and teachers. AI techniques are predominantly applied in higher education, focusing on learning prediction and intelligent tutoring systems. AI-enhanced student-centered learning promotes higher-order thinking and improves instructor-student dynamics.

Impact of AI on STEM Education

- ❖ **AI in STEM Education:** Enhances personalized learning, adaptive assessments, and immersive experiences through virtual reality.
- ❖ **Support for Teachers:** AI-based tutoring, grading assistance, and lesson planning improve teaching efficiency.
- ❖ **Challenges:** Concerns include lack of teacher training, algorithm bias, privacy issues, and ethical considerations.
- ❖ **Future Implications:** AI will reshape job markets, necessitate new skills, and emphasize the role of educators in guiding students.
- ❖ **Ethical Considerations:** Address bias, protect student data, and ensure accountability in AI usage.

Impact of AI Teaching Method in STEM Education

The application of artificial intelligence (AI) technologies in STEM education discusses the distribution of AI in various elements such as subject, information, medium, and environment. This use of AI in STEM emphasizes the positive effects of AI in STEM education and the importance of integrating diverse AI techniques into the educational system. AI-based STEM education mainly focuses on personalized learning, advanced analytics, and instructional automation. It aims to assess challenges in AI integration, examine pedagogical strategies, and evaluate short and long-term impacts. These are as follows:

- ❖ The application of AI in STEM education has shown positive effects on learning performance, affective perception, and higher-order thinking.
- ❖ AI designs new instructional strategies that are used by Instructors in conveying knowledge; this immersion improves the quality of lectures.
- ❖ By the application of AI, Learners from various educational levels benefit.
- ❖ Future research should explore the relationships between different elements in the AI-STEM system and conduct meta-analyses to deepen understanding of AI effects in STEM education.
- ❖ AI technologies have the potential to enhance teaching and learning practices in STEM fields and improve student engagement and performance.

- ❖ Practical challenges in AI integration and the efficiency of AI-enabled pedagogical strategies are key focus areas.
- ❖ AI in education enhances critical thinking, problem-solving, and adaptability skills among students. AI also offers personalized learning experiences and an improved understanding of student behaviors.
- ❖ AI in STEM education enhances student engagement, motivation, and performance.
- ❖ The integration of AI in education has the potential to transform teaching and learning processes.

CONCLUSION

The integration of AI into STEM education holds remarkable promise for revolutionizing the way students engage with learning. By nurturing critical thinking and honing problem-solving abilities, it paves the way for a more dynamic and interactive educational experience. Imagine a classroom where each student is guided by tailored learning paths that adapt to their unique strengths and challenges, igniting a passion for inquiry and exploration. However, this transformative potential comes with significant responsibilities; it is crucial to carefully navigate the associated challenges and ethical dilemmas to ensure that AI is implemented effectively and equitably in educational settings.

REFERENCES

- Almasri, F. 2024. Exploring the Impact of Artificial Intelligence in teaching and learning of Science: Systematic Review of Empirical research. In *Research in Science Education*.
- Akhmetova, A.I., Sovetkanova, D.M., Komekbayeva, L.K., Abdrakhmanov, A.E., Yessenuly, D. and Serikova, O.S. 2025. A systematic review of artificial intelligence in high school STEM education research. *Eurasia Journal of Mathematics Science and Technology Education*, **21**(4): em2623.
- Ataman, A. 2024. *Data quality in AI: Challenges, Importance & best practices in '24*.
- Copeland, B.J. (2025). *Artificial Intelligence (The Editors of Encyclopaedia Britannica, Ed.)*.
- Coursera. 2024. *What is artificial intelligence? Definition, uses, and types*.
- Enrollment Advisor. (n.d.-a). *Exploring the impact of AI on STEM education*.
- Hebebcı, M.T. 2023. Artificial Intelligence in STEM Education: New Paths to learning. In *International Conference on Academic Studies in Technology and Education (ICASTE)*.
- Home - Dataconomy. (n.d.). <https://dataconomy.com/>
- India STEM Foundation. (2024). The role of women in STEM: Achievements and challenges. In *India STEM Foundation*.
- Iyare, B. 2023. *Empowering Girls in STEM Education: The Role of AI in personalized learning paths and adaptive feedback*.
- Kaledio, P., Robert, A. and Frank, L. 2024. The impact of artificial intelligence on students' learning experience. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4716747>

- Karandish, D. 2021. *7 Benefits of AI in education*.
- Lee, Y., Kim, T., Choi, S. and Kim, W. 2021. When does AI pay off? AI-adoption intensity, complementary investments, and R&D strategy. In *The International Journal of Technological Innovation, Entrepreneurship and Technology Management*, *The International Journal of Technological Innovation, Entrepreneurship and Technology Management* [Journal-article].
- Perceptions of STEM education and artificial intelligence: a Twitter sentiment analysis. (2025). In *International Journal of STEM Education* (Vol. 12, p. Article number: 9) [Journal-article].
- OpenAI. (n.d.). *Artificial intelligence*.
- Shah, P. and EnCorps.org. 2024. AI's transformative role in STEM education: opportunities, challenges, and the future. In *EnCorps.org*. <https://pedagog.ai/2024/05/20/>
- Silverstein, M. 2019. What are Adaptive Assessments? In *Criteria*. <https://www.criteriacorp.com/blog/what-are-adaptive-assessments>
- Simplilearn. 2024. *Top 15 challenges of Artificial Intelligence in 2024*.
- Teachflow. 2022. *The Role of AI in STEM Education: Opportunities and challenges*.
- Triplett, W.J. 2023. Artificial intelligence in STEM education. *Cybersecurity and Innovative Technology Journal*, 1(1): 23–29.
- Trotta, A., Ziosi, M. and Lomonaco, V. 2023. The future of ethics in AI: challenges and opportunities. In *AI & SOCIETY* (Vol. 38, pp. 439–441).
- Vadapalli, P. 2024. Top 10 challenges in Artificial Intelligence in 2024. In *Blog*. www.google.com
- Xu, W. and Fan Ouyang. 2022. The application of AI technologies in STEM education. In *On Society* [Blog]. <https://blogs.biomedcentral.com/on-society/author/mariusjungs>
- Xu, W. and Ouyang, F. 2022. The application of AI technologies in STEM education: a systematic review from 2011 to 2021. *International Journal of STEM Education*.
- Zhai, X. and Krajcik, J. 2024. Artificial Intelligence-Based STEM Education. In *Oxford Scholarship Online* (pp. 3–14) [Book-chapter]. <https://doi.org/10.1093/oso/9780198882077.003.0001>

