



Empowering Tomorrow's Educators: Utilization of AI to Enhance Teaching Effectiveness through Learner Engagement in Formal Learning

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ABSTRACT

Today's rapidly evolving educational landscape, Artificial Intelligence (AI) integration offers promising paths to transforming teaching methodologies and enhancing learning upshots. AI-powered educational platforms offer opportunities for continuous learning and skill development beyond traditional classroom settings. Through personalized recommendations and adaptive pathways, learners can pursue their educational goals at their own pace and according to their interests. This paper explores the multi-layered ways in which AI technologies can empower educators to enhance teaching effectiveness within formal learning environments. By harnessing AI-driven tools and techniques, educators can personalize instruction, tailor content delivery, and offer targeted assistance to meet the various requirements of pupils. Through the use of AI-powered analytics, educators gain access to a helpful understanding of advancement for learner, enabling them to classify areas of strength and those that require extra attention. However, the effective incorporation of AI in teaching demands careful consideration of righteous ramification, including security of the data concerns and the significance of maintaining human-centric approaches to teaching-learning. By implementing AI as a supportive resource, not a substitute for human educators, we can connect its potential to empower educators to excel in facilitating meaningful learning experiences and prepare students for success in a progressing world. This idea shows that AI can make education better if it is used wisely and sensibly.

Keywords: Empowering, Educators, Students, Learners, Artificial Intelligence (AI), Technologies, Teaching Effectiveness, Learning.

Introduction

In the rapidly growing landscape of education, the integration of Artificial Intelligence (AI) has appeared as a driving force, giving endless chances to revolutionize teaching and learning experiences. As we stand at the threshold of a new era in education, the utilization of AI possesses vast possibilities to empower tomorrow's educators and elevate the use of formal learning environments. Traditionally, the part of educators has been pivotal in shaping the minds of future generations, fostering critical thinking, and imparting essential knowledge. However, the modern educational landscape is marked by diverse challenges like individualized learning needs, the demand for innovative instructional approaches, and the necessity to adapt to rapidly advancing technologies. In this context, AI functions as a catalyst for change, offering intelligent solutions to tackle these issues and augment the capabilities of educators. By leveraging AI technologies, educators can gain valuable insights into student learning patterns, preferences, and areas of difficulty, thereby enabling them to tailor instruction to individual needs effectively. Furthermore, AI-driven analytics can provide educators with real-time replies on student progress, facilitating timely interventions and personalized support to enhance learning outcomes. Moreover, AI-powered tools and platforms offer innovative ways to enhance classroom engagement, foster collaboration, and create immersive learning experiences. From brilliant coaching structures to virtual reality simulations, AI facilitates the development of vibrant and collaborative learning experiences that meet the needs of all learners.

However, the collaboration of AI in education also raises important ethical, privacy, and equity considerations that must be cautiously addressed. As we embrace AI-driven innovations, it is

imperative to confirm that they are deployed responsibly and ethically, safeguarding the rights and well-being of all stakeholders involved. In this context, this paper explores the utilization of AI to empower tomorrow’s educators and enhance teaching effectiveness in formal learning environments. Through a comprehensive examination of AI-driven tools, strategies, and best practices, we aim to elucidate the transformative potential of AI in education and offer cognizance into harnessing its power to shape the coming days of learning.

Conceptual Framework of Artificial Intelligence (AI) and Teaching Effectiveness

This study is built on the idea that the practice of Artificial Intelligence (AI) can improve how effectively teachers teach in formal learning settings. AI tools support teachers in planning lessons, delivering content, assessing students, and understanding learning progress. When teachers use AI meaningfully, they are better able to manage classrooms, engage students, and provide timely feedback. As a result, teaching becomes more effective. The framework also recognizes that factors such as teacher readiness, institutional support, and availability of technology influence how strongly AI affects teaching effectiveness.

Table 1: Major Components of the Conceptual Framework

S. No.	Component	Description
1.	Artificial Intelligence	Adaptive Learning, Analytics, Intelligent Tutoring, Automation
2.	Teaching Support Processes	Lesson Planning, Content Delivery, Assessment, Feedback, Classroom Management
3.	Teaching Effectiveness	Student Engagement, Personalized Instruction, Improved Learning Outcomes
4.	Moderating Variables	Teacher Readiness, Institutional Support, Infrastructure, Ethical Practices

Theoretical Framework of Artificial Intelligence (AI) and Teaching Effectiveness

The theoretical framework of Artificial Intelligence (AI) and teaching effectiveness in this study is grounded in contemporary educational and technological theories that explain how intelligent technologies can enhance pedagogical processes and instructional outcomes. The framework conceptualizes AI as a mediating and enabling construct that strengthens core dimensions of teaching effectiveness through data-driven support, personalization, and automation, while preserving the central role of the teacher. At the foundation of this framework lies Constructivist Learning Theory, which posits that learning is an active process in which learners construct knowledge through interaction and experience. AI-enabled tools support constructivist pedagogy

by facilitating personalized learning pathways, adaptive content delivery, and immediate feedback, thereby enabling teachers to design learner-centered instructional experiences. Technological Pedagogical Content Knowledge (TPACK) provides a critical theoretical lens for understanding the relationship between AI and teaching effectiveness. According to TPACK, effective teaching occurs at the intersection of content knowledge, pedagogical knowledge, and technological knowledge. AI enhances this intersection by assisting teachers in selecting appropriate instructional strategies, integrating intelligent tools into subject teaching, and aligning pedagogy with learner needs. Teaching effectiveness is maximized when educators possess the competence to meaningfully integrate AI into curriculum delivery rather than using technology as an isolated add-on. The framework is further informed by Data-Informed Decision-Making Theory, which emphasizes the use of evidence and analytics to improve instructional practices. AI systems generate real-time learning analytics related to student performance, engagement, and progression. These insights enable teachers to make informed pedagogical decisions regarding instructional pacing, differentiation, remediation, and enrichment, thereby enhancing teaching effectiveness. Bloom's Taxonomy of Learning Objectives contributes to the framework by emphasizing the importance of promoting higher-order cognitive skills. AI-supported assessment and feedback systems help teachers design instructional activities and evaluations that move learners beyond recall and comprehension toward analysis, evaluation, and creation. Continuous formative feedback enabled by AI strengthens alignment between instructional objectives and learning outcomes. Social Learning Theory also informs the framework by highlighting the role of interaction, collaboration, and modeling in learning. AI-enabled collaborative platforms, discussion analytics, and virtual assistants support interactive learning environments where teachers facilitate peer learning and maintain meaningful social engagement, thereby reinforcing effective teaching practices. The framework hypothesizes that effective and ethical application of AI positively mediates the relationship between teachers' pedagogical practices and teaching effectiveness. This theoretical foundation provides a robust basis for empirically examining how AI integration enhances teaching effectiveness in formal learning environments, particularly within the Indian educational context.

Table 2: Theoretical Foundations of Artificial Intelligence (AI) and Teaching Effectiveness

S. No.	Theory	Key Idea	Role in the Present Study
1.	Constructivist Learning Theory	Learning occurs through active participation and experience	Supports learner-centred instruction using AI tools
2.	Bloom's Taxonomy	Development of higher-order thinking skills	AI supports formative assessment and feedback
3.	Social Learning Theory	Learning through interaction and collaboration	AI tools support collaborative and interactive learning

Importance of the present study

The study "Empowering Tomorrow's Educators: Utilization of AI to Enhance Teaching Effectiveness in Formal Learning" explores in what way Artificial Intelligence (AI) can revolutionize education. It highlights AI's potential to individualize direction, provide real-time feedback, and form

attractive learning atmosphere. However, it emphasizes the importance of ethical implementation and maintaining a human-centred approach. The study aims to understand current AI trends, explore its potential in education, measure its impact on teaching effectiveness, and prepare educators for future learning environments. It discusses various types of AI, its impacts on educators, drawbacks, remedial measures, and ethical considerations. Overall, it concludes that with careful implementation, AI can empower educators and improve learning outcomes, but ethical concerns need to be resolved to ensure equitable access and student well-being.

Studies Done in Different Areas Relating to Artificial Intelligence (AI) and Teaching Learning

The reviewed papers collectively emphasize the pivotal role of information technology, particularly artificial intelligence (AI), in reshaping and advancing education. While Meng and Sumettikoon (2022) underscore the urgency of updating teaching concepts and developing practical abilities in information-based teaching, their study lacks specific strategies for the optimal use of technologies for vocational education. Fitria (2021) explores various AI-supported teaching methods but lacks an in-depth analysis of challenges and potential impacts on teaching effectiveness and student results. Singh and Hiran (2022) discuss the larger influence of AI in higher education but could explore deeper into specific methodologies to improve teaching-learning. Lin (2022) investigates AI's influence on teaching effectiveness but could provide a more comparative analysis of AI applications and address implementation challenges. Liu, Chen, and Yao (2022) propose deep learning-based assessment and explore the effect of AI on teaching & learning processes but lack detailed strategies for reforming teaching practices and addressing implementation barriers. Collectively, these studies focus the necessity for comprehensive approaches to efficiently integrate AI into education while addressing challenges and optimising teaching and learning practices.

Research Gaps Identified from Previous Studies

Although existing studies highlight the growing importance of Artificial Intelligence (AI) in education, several gaps remain. Many studies discuss the potential of AI but do not clearly explain how teachers can practically integrate AI into everyday teaching, especially in vocational and formal classroom settings. There is also limited focus on the real challenges teachers face, like insufficiency of training, infrastructure, and readiness to use AI effectively. Some research explores AI applications broadly but does not sufficiently examine how AI directly affects teaching effectiveness and student learning outcomes. Comparative analysis of different AI tools and methods is often missing, creating problematic to know which approaches are most effective in specific educational contexts. Additionally, while a few studies propose advanced AI-based assessment and learning models, they provide little guidance on reforming teaching practices or overcoming barriers to implementation in real classrooms. There is also a lack of studies that consider human-centered and ethical facets of AI use, particularly the function of educators in maintaining meaningful teacher-student interaction.

Overall, there is a need for empirical, context-specific research that examines how AI can be used in a practical, ethical, and teacher-friendly way to enhance teaching effectiveness, especially in formal learning environments.

Objectives of the Study:

- i. To know current trends and practices in AI utilization within formal learning situations to imbibe the landscape of technology integration in education.
- ii. To figure out the potential of AI integration in formal learning environments for enhancing teaching effectiveness.
- iii. To provide a measured impact of AI in enhancing teaching effectiveness.
- iv. To foster the role of AI in shaping the future of education and preparing educators for the requirements of tomorrow's learning environments.

Types of Artificial Intelligence (AI)

1. **Narrow AI (Weak AI):** Specialized AI designed for specific tasks like virtual assistance, recommendation systems, playing chess and voice recognition etc. But lack of cognitive abilities.
2. **General AI (Strong AI):** Theoretical AI with human level cognitive abilities to understand, learn, and apply knowledge across various intellectual tasks.
3. **Machine Learning:** Algorithms enabling information processing system to acquire from material without explicit programming, including supervised, unsupervised, and reinforcement learning.
4. **Deep Learning:** A subset of machine learning using deep neural networks for complex data representations, often applied in image and speech recognition.
5. **Natural Language Processing (NLP):** AI focuses on understanding, interpreting, and generating human language, used in translation, sentiment analysis, and chatbots.
6. **Computer Vision:** AI interpreting and analyzing visual information from the real world, applied in object detection, image classification, and facial recognition.
7. **Expert System:** AI emulates human decision-making in specific domains using rules and knowledge bases, offering expert-level advice or problem-solving.

The impacts of Artificial Intelligence (AI) on educators, contributing to the effectiveness of teaching, are as follows

1. **Intelligent Tutoring Systems:** It can deliver instant feedback and assistance to pupils, acting as virtual tutors. These systems can help reinforce learning concepts, provide additional practice, and offer targeted interventions when students struggle with specific topics.
2. **Personalized Learning:** AI can examine students' learning designs, interests, and execution to make available personalized learning understandings. Educators can leverage AI-powered adaptive learning situation to tailor instruction as per the person's needs, helping learners get the knowledge according to their own convenience.

3. **Enhanced Content Creation:** AI apparatuses can assist educators in creating high-quality educational content more efficiently. For E.g., AI can create interactive simulations, produce educational videos, or design engaging quizzes and assessments, freeing up teachers' time to concentrate on teaching and mentoring students.
4. **Data-Driven Insights:** AI analytics can analyze vast amounts of educational data to extract appreciable perceptions into students' action, learning trends, and teaching effectiveness. Educators can use these insights to identify areas for improvement, adapt instructional strategies, and deliver designated assistance to the students who need it most.
5. **Automation of Administrative Tasks:** AI can automate routine administrative tasks such as grading assignments, managing schedules, and organizing course materials. By reducing administrative burdens, educators can dedicate more time and energy to teaching, planning engaging lessons and interacting with students.
6. **Accessibility and Inclusivity:** AI technologies can benefit the education system more reachable and encompassing for learners with various learning needs. For example, AI-powered transcription and translation tools can guide students with hearing or language difficulties, while adaptive learning platforms can accommodate different learning styles and abilities.
7. **Lifelong Learning Opportunities:** AI-powered educational platforms and intelligent learning agents can support lifelong learning by providing continuous access to educational resources, personalized recommendations, and skill-building opportunities. Educators can encourage students to engage in self-directed learning and explore new topics beyond the traditional classroom setting.

Drawbacks of Artificial Intelligence (AI) that educators encounter when aiming for effective teaching

1. **Loss of Jobs:** One of the major concerns among educators is the fear of AI replacing human teachers. Though AI can help teachers in various tasks, here is a threat that it might lead to work dislocation in the education sector.
2. **Inequality in Access:** AI-powered educational tools may impair existing inequalities in entree to education. Students from underprivileged backgrounds or locality with poor access to technology may not benefit from AI-driven teaching tools, widening the educational gap.
3. **Data Privacy Concerns:** AI organizations in education frequently gather large quantity of information on students' knowledge gaining process and behaviours. It is surprising how this data is stored, managed, and used, especially regarding student privacy and data security.
4. **Bias and Fairness:** AI algorithms can inherit biases present in the data used to train them. If this issue not appropriately handled, these predispositions can perpetuate discrimination and inequality in education. For example, AI grading systems may inadvertently penalize certain groups of students based on race, gender, or socioeconomic status.

5. **Over-reliance on Technology:** Relying too heavily on AI-driven educational tools can produce harm of essential human elements in teaching, such as empathy, creativity, and critical thinking. Students may become overly dependent on technology, impacting their ability to learn independently and interact socially.
6. **Ethical Dilemmas:** Its use in education increases complex ethical questions, such as autonomy, accountability, and transparency. Instructors must direct these ethical dilemmas carefully to make sure that AI technologies are taken dutifully and ethically in the teaching space.

Remedial measures to solve the problems using Artificial Intelligence (AI)

- i. **Customization and Adaptability:** AI tools should be customizable to meet the specific needs of educators and their students. This could include features such as adjustable difficulty levels, personalized learning pathways, and the ability to tailor content to align with curriculum standards.
- ii. **Continuous Support and Feedback:** Educators should have access to ongoing support and feedback channels where they can express their doubts, troubleshoot problems, and provide input for improving AI tools. This can be in the form of online forums, help desks, or dedicated support staff.
- iii. **Training Professional Development:** Teachers must get thorough training on how to use AI tools efficiently in the class. This training should cover not only the technical aspects but also pedagogical strategies for integrating AI into teaching practices.
- iv. **User-Friendly Interfaces:** AI tools should feature easy-to-use boundaries that are easy for educators to navigate. User experience design should be a priority to guarantee that instructors can quickly learn how to use the tools without encountering significant barriers.
- v. **Pilot Programs and Feedback Loops:** Before fully implementing AI tools across an entire educational institution, educators can participate in pilot programs to test the effectiveness of the tools in real-world settings. Feedback from these pilots should be used to iterate and improve the tools before wider adoption.

Ethical Considerations and Challenges

While the alignment of AI in education holds immense promise, it also raises important ethical considerations and challenges. Concerns about data privacy, system bias, and impartial allowance to these new modern technologies should be managed to ensure that AI-driven solutions benefit all students, regardless of background or socioeconomic status. Additionally, there is a need for current professional growth to prepare educators with the cognition and capabilities essential for the successful incorporation of AI tools into teaching while keeping a human-centred approach to education. Ethical considerations and challenges surrounding the integration of AI (Artificial Intelligence) in various fields, including education, are complex and multifaceted. As AI technologies develop more universal in our daily lives, it's essential to critically examine the ethical

implications to ensure that they align with principles of fairness, transparency, accountability, and respect for human dignity. Navigating the integration of AI in education presents educators and stakeholders with a myriad of ethical considerations and challenges, ranging from ensuring algorithmic fairness to safeguarding student privacy, all while maintaining transparency, human oversight, and equitable access to technology. From ensuring algorithmic fairness to safeguarding student privacy and promoting impartial access to technology, the moral reflections bordering AI in education are diverse and demanding. Striking a balance between utilizing the capabilities of AI-powered innovations and preserving human-centric educational values requires meticulous attention and proactive measures. Central to this endeavour is the establishment of clear guidelines, continuous monitoring, and robust mechanisms for human oversight, ensuring that the acceptance of AI in education aligns with ethical imperatives and serves the collective interests of all stakeholders involved.

Discussion

The findings of this study suggest that artificial intelligence can improve teaching effectiveness by helping teachers personalize learning provide feedback and manage routine tasks but these benefits depend on how it is used.

In one study conducted by Rao and Suhasini (2025) have shown a report that represents transformative shift in making teaching effective through AI. In user experience before AI integration is 64%, after AI integration is 84%. In academic performance and student satisfaction increases from 30% to 85% respectively. In Teaching effectiveness also enhances from 30% to 90%. Thus, the secondary data indicate that the integration of AI enhancing the effectiveness of teacher in every area.

Table 3: Integration of AI to Teaching Effectiveness Report

S. No.	Area	Before AI Integration	After AI Integration
1.	User Experience	64%	84%
2.	Academic Performance	30%	85%
3.	Student Satisfaction	30%	85%
4.	Teaching Effectiveness	30%	90%

Many research studies shows that AI can increase student engagement and adapt instruction to individual needs but it also brings challenges like lack of teacher training concerns about ethics and privacy and the risk of students becoming too dependent on technology (Garzón et al., 2025 and Yan et al., 2023). Teachers often value AI for making lessons more efficient yet they worry about data security, plagiarism and the need for clear guidelines (Benali et al., 2025). UNESCO emphasizes that AI should support teachers and not replace them and that human guidance is essential to maintain social and emotional learning in classrooms (UNESCO 2025). Studies also note that poorly implemented AI may reduce independent problem solving or weaken critical thinking (Contemporary Educational Technology 2025). Overall, AI can enhance teaching effectiveness if used thoughtfully with proper training ethical safeguards and teacher oversight.

Conclusion

Looking ahead to the upcoming of education, the utilization of AI holds tremendous potential to empower tomorrow's educators and enhance teaching effectiveness in formal learning environments. By leveraging AI-powered personalization, adaptive learning systems, enhanced negative or positive criticism, smart guiding systems, and automated administrative tasks, teachers can create flexible and learner-centred learning of practical occurrence that meet the diverse needs of students. Nevertheless, it is crucial to approach the integration of AI in education thoughtfully, addressing ethical considerations and challenges to ensure that all students benefit from these innovative technologies. Through collaborative efforts and a commitment to continuous improvement, we can harness the transformative power of AI to shape the forthcoming education and empower learners to thrive in an increasingly complex and interconnected world.

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