E-ISSN: 3048-6041 | Volume- 3, Issue- 3 | March 2026

Reimagining Teacher Education in India: AI-Enabled Pedagogy, Assessment, and Human–AI Collaboration for 21st Century Classrooms

Pradip Dutta
Guest Lecturer, Department of Education, Bolpur College, Birbhum,
West Bengal, India, 731204

Abstract

There is an urgent need to rethink teacher education in India due to the rapid growth of Artificial Intelligence (AI), which is changing educational institutions globally. The integration of AI into professional preparation frameworks, assessment systems, and pedagogical practices in teacher education is conceptually examined in this study. The study examines the potential of AI-enabled tools to promote competency-based assessment, reflective teaching practices, and individualized learning, drawing on current literature and policy viewpoints from the Ministry of Education and the National Council for Teacher Education. The analysis highlights emerging pedagogical innovations such as adaptive learning environments, intelligent tutoring systems, and automated assessment technologies that enable real-time feedback and data-informed instructional decisions. In order to preserve human judgment, professional autonomy, and socioemotional engagement in the learning process, the study highlights that AI should work as a collaborative partner rather than a replacement for educators. Based on a synthesis of literature and theoretical frameworks, the study proposes an AI-Integrated Teacher Education Model (AITEM) structured around four interrelated pillars: AI-enabled pedagogy, smart competency-based assessment, teacher AI literacy and professional development, and ethical human-centred governance. The study makes the case that balanced human-AI partnership, which enhances teaching efficacy while guaranteeing the ethical and responsible use of emerging technology, is the key to the future of teacher education in India.

Keywords: Artificial intelligence in teacher education, AI-enabled pedagogy, competency-based assessment, human–AI collaboration, teacher AI literacy, ethical AI governance.

Introduction

Artificial Intelligence (AI) technologies are rapidly expanding, disrupting conventional teaching-learning and assessment paradigms and changing the educational environment globally. In India, ongoing reforms guided by the Ministry of Education and regulatory developments by the National Council for Teacher Education emphasize digital integration, competency-based learning, and teacher preparedness for 21st century classrooms.

Published: 10 March 2026
DOI: https://doi.org/10.70558/SPIJSH.2026.v3.i3.45588

AI is a revolutionary force that can improve reflective practice, automate assessment, personalize instruction, and enhance inclusive education. Teacher education institutions are at a critical juncture when AI is more than just a technology add-on. However, concerns regarding professional autonomy, ethical governance, data privacy, and algorithmic bias necessitate a balanced human–AI collaborative framework.

This paper reimagines teacher education in India by proposing a structured AI-Integrated Teacher Education Model (AITEM), grounded in pedagogical, psychological, and policy frameworks.

Review of Related Literature

Artificial intelligence's potential to change teacher preparation and teaching methods is being studied more and more in recent research. Numerous aspects of AI integration, such as educational innovation, assessment systems, human–AI collaboration, and ethical governance, have been investigated by researchers. Analysing these studies comparatively helps identify emerging trends, theoretical directions, and existing research gaps in AI-supported teacher education.

Several studies emphasize the pedagogical potential of AI in enhancing teacher education programmes. For instance, Jamal (2023) argues that AI-driven systems support personalized learning pathways by identifying individual knowledge gaps and adapting instructional strategies to diverse learning styles. Similarly, Kumari et al. (2025) emphasize how adaptive feedback mechanisms in AI-enabled educational technologies enhance competency-based training, reflective practice, and lesson planning. Although both studies highlight how AI might improve professional development and instructional design, Kumari et al. place greater emphasis on assessment efficiency and structured training pathways for teacher trainees. Together, these findings suggest that AI can significantly enhance both pedagogical effectiveness and professional competency development within teacher education.

Human-AI cooperation in educational decision-making is another important issue in the literature. According to Fragiadakis (2024), there are two main models of interaction: symbiotic and AI-centric. The symbiotic approach encourages harmonious cooperation in which AI technologies enhance human knowledge rather than take its place. AI-centric methods, on the other hand, focus more on algorithmic decision-making. Further illustrating how AI systems can identify their own limitations and delegate decision-making authority to human experts in complex settings is the Learning to Defer (L2D) paradigm. This perspective reinforces the importance of maintaining human oversight in AI-supported educational environments.

The literature also demonstrates growing interest in AI-based assessment systems. Norboyev (2026) explains that automated assessment technologies using machine learning, natural language processing, speech recognition, and computer vision significantly improve evaluation speed, consistency, and large-scale data analysis. These systems facilitate more effective feedback procedures and lessen human subjectivity. However, experts also highlight possible drawbacks include algorithmic bias, data privacy issues, and the challenge of using automated algorithms to evaluate human creativity. Because of this, most people see AI-driven assessment as an additional tool rather than a substitute for human pedagogical judgment. Ethical

governance has emerged as another crucial dimension of AI integration in education. Camilleri (2024) highlights key principles including accountability, transparency, explainability, fairness, and data protection. These ideas are seen to be crucial for preserving confidence in AI-based systems and avoiding algorithmic prejudice. Ethical monitoring methods are required to enable appropriate application of AI in education, even while technological progress continues to extend its potential.

Overall, the existing literature collectively demonstrates the transformative potential of artificial intelligence in teacher education through enhanced pedagogy, assessment innovation, and collaborative human–AI interaction. Nevertheless, rather than creating an integrated framework that links AI-enabled pedagogy, assessment change, teacher competences, and ethical governance under a single conceptual model, the majority of research look at these factors independently. In order to close this gap, the current study offers a thorough framework for AI-integrated teacher education in the Indian setting, with a focus on responsible governance and balanced human–AI collaboration.

Objectives

i. To critically synthesize existing literature on AI-enabled pedagogy and assessment within teacher education contexts.
ii. To examine how AI integration is reshaping the competencies and professional identity of future teachers in 21st century classrooms.
iii. To analyse the evolving models of human–AI collaboration and their relevance for teacher education in India.
iv. To explore ethical AI governance principles necessary for responsible implementation in teacher education institutions.
v. To propose an integrated AI-Enabled Teacher Education Framework suited to the Indian educational context.

Methodology

The qualitative conceptual research design used in this study is based on methodical policy analysis and literature synthesis. A narrative-cum-thematic review approach was used since the goals center on critical integration rather than primary data collecting.

Thematic content analysis was used to examine the gathered literature. AI-enabled pedagogy, AI-driven assessment reform, teacher skills and professional identity, models of human–AI partnership, and ethical governance frameworks were the five analytical domains into which emerging themes were divided. An integrated conceptual framework specific to the Indian teacher education context was created based on this synthesis.

Theoretical Framework

The study is grounded in four complementary theoretical perspectives:

TPACK Model (Technological Pedagogical Content Knowledge)

The TPACK framework provides a foundation for understanding how technological knowledge intersects with pedagogical and content knowledge. By incorporating algorithmic awareness,

data interpretation abilities, and adaptive instructional design into teacher education, AI integration expands on TPACK.

AI-ENABLED INTEGRATION LAYER

Algorithmic Awareness | Data Interpretation Skills | Adaptive Instructional Design

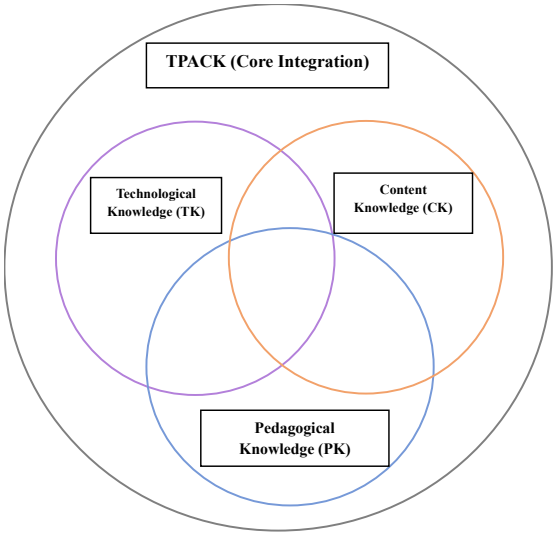

Figure 1: Extended TPACK framework

The figure presents an extended TPACK framework in which Artificial Intelligence (AI) functions as an outer integrative layer surrounding the core domains of Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). At the center lies TPACK, representing the dynamic intersection of these three foundational knowledge domains required for effective teaching.

The three overlapping inner circles illustrate the traditional TPACK structure:

- **Technological Knowledge (TK)** refers to teachers' understanding of digital tools and technologies.
- **Content Knowledge (CK)** represents subject-matter expertise.
- **Pedagogical Knowledge (PK)** involves instructional strategies, classroom management, and learning theories.

Their intersection (TPACK) signifies integrated instructional competence.

The outer circular layer labelled "AI-Enabled Integration Layer" indicates that AI does not replace the TPACK components but enhances and extends them. This layer incorporates three advanced competencies:

1. **Algorithmic Awareness** – Understanding how AI systems process data and generate outputs.

2. **Data Interpretation Skills** – The ability to analyse AI-generated learning analytics for informed instructional decisions.
3. **Adaptive Instructional Design** – Designing personalized and flexible learning pathways using AI-supported tools.

From a conceptual standpoint, the outer AI layer represents enhancement as opposed to substitution. It encompasses and impacts TK, PK, and CK concurrently, indicating that AI integration transforms teacher competencies in a comprehensive way. The approach highlights the need for pedagogical judgment and content sensitivity guided by ethical and human-centred principles in addition to technological proficiency for AI-enabled teacher education.

The extended TPACK framework primarily aligns with the objective of identifying emerging teacher competencies in AI-enabled educational environments. By viewing AI as an integrative enhancing layer rather than a replacement mechanism, it also facilitates the synthesis of AI-enabled teaching. Additionally, by establishing AI as an augmentative force within teacher professional knowledge systems, it implicitly supports the goal of human–AI collaboration.

Constructivist Learning Theory as a Pedagogical Lens for AI Integration

A crucial pedagogical basis for comprehending the use of Artificial Intelligence (AI) in teacher education is Constructivist Learning Theory. Constructivism, which stresses learner-centred, inquiry-based, and meaning-making processes, is based on the idea that students actively create knowledge via experience, reflection, and social interaction. These ideas take on new importance in today's AI-enabled learning environments.

Within the context of this study's objective to synthesize AI-enabled pedagogy and identify emerging teacher competencies, constructivism provides a theoretical lens through which AI integration can be pedagogically justified. AI-powered adaptive systems align closely with constructivist assumptions by personalizing learning pathways, offering scaffolded instructional support, and generating real-time feedback loops. When used pedagogically, AI technologies encourage reflective participation, individualized education, and chances for experiential learning rather than passive information consumption. For teacher education, this alignment is particularly significant. As the title of this study emphasizes the transformative role of AI in reshaping educational methodology, constructivism clarifies how such transformation should occur—not through technological determinism, but through enhanced facilitation of active learning. AI, therefore, functions not as a replacement for human pedagogy but as a cognitive and analytical augmentation tool that supports teachers in designing learner-centred environments.

Moreover, this constructivist framing directly supports the objective of redefining teacher professional competencies in AI-enabled contexts. Teachers are required to move beyond traditional instructional delivery toward roles as facilitators, reflective practitioners, and interpreters of AI-generated learning analytics. Therefore, only when AI integration is based on constructivist principles that emphasize autonomy, critical thinking, and contextual knowledge production does it become pedagogically useful. In this way, Constructivist Learning Theory anchors the study's broader argument: the transformative potential of AI in

teacher education lies not merely in technological advancement, but in its capacity to deepen learner-centred pedagogy through informed human–AI collaboration.

Human–AI Augmentation as a Collaborative Framework in Teacher Education

Human–AI Augmentation Theory offers a critical conceptual lens for understanding the evolving relationship between artificial intelligence and teacher professional practice. Augmentation theory reframes AI as a cooperative partner that expands human cognitive, analytical, and educational capacities, in contrast to prevalent technology narratives that frequently depict AI as a replacement mechanism aiming at automation and efficiency.

Rather than diminishing teacher agency, AI systems function as cognitive amplifiers—processing large-scale learning data, identifying patterns, and generating instructional insights that inform pedagogical decision-making. In this perspective, AI does not exercise autonomous authority over educational processes; instead, it enhances reflective judgment, adaptive instructional planning, and evidence-based assessment.

This paradigm directly supports the study's goal of creating a human–AI collaborative model inside teacher education. Teachers, both pre-service and in-service, must develop skills in incorporating adaptive recommendations, evaluating AI-generated analytics, and upholding ethical oversight. As a result, the professional identity becomes an enhanced facilitator and analytical decision-maker rather than a content broadcaster.

Aligned with the broader objective of transforming educational methodology through AI integration, augmentation theory ensures that technological innovation remains human-centred. The transformative potential of AI in teacher education, therefore, lies not in automation, but in structured collaboration between algorithmic intelligence and pedagogical expertise. To visually represent this collaborative augmentation perspective, the following conceptual framework is proposed-

Human–AI Augmentation Framework in Teacher Education

Figure 2: Human–AI Augmentation Framework

Teacher expertise, AI analytical systems, and enhanced learning outcomes are the three interrelated components of the suggested Human–AI Augmentation Framework, which is envisioned as a horizontal collaborative paradigm. Pedagogical judgment, contextual awareness, and ethical supervision are all represented by teacher expertise. AI analytical systems contribute data processing capabilities, pattern detection, and adaptive feedback mechanisms. The bidirectional interaction between teachers and AI signifies collaborative intelligence, where algorithmic outputs inform instructional decisions while human judgment contextualizes and validates AI recommendations. In the end, this synergy produces improved learning outcomes that are marked by equity, personalization, and reflective involvement.

Competency-Based Education Framework in AI-Enabled Teacher Preparation

An outcome-oriented framework for coordinating the integration of artificial intelligence with quantifiable teacher capabilities is offered by the Competency-Based Education (CBE) framework. CBE places more emphasis on mastery of precisely defined competencies, performance standards, and evidence-based progression than traditional time-bound instructional methods.

Within the context of this study's objective to redefine teacher competencies in AI-enabled educational environments, the CBE framework serves as an evaluative and structural anchor. Continuous monitoring of skill acquisition, mastery levels, and professional growth trajectories is made possible by AI-driven analytics and adaptive assessment tools. AI systems can identify competency gaps, customize professional development courses, and encourage reflective practice through real-time feedback mechanisms. In teacher education, this alignment is particularly significant. Teachers must exhibit skills beyond topic expertise, such as data literacy, ethical reasoning, adaptive instructional design, and technical fluency, as AI transforms teaching approaches. The CBE framework allows these competencies to be clearly articulated, assessed, and progressively developed.

Furthermore, AI-enhanced competency mapping strengthens accountability and transparency in teacher preparation programs. Rather than evaluating performance through isolated examinations, competency-based models supported by AI promote continuous, evidence-based assessment. This directly supports the study's broader objective of transforming educational methodology by integrating adaptive, data-informed, and learner-centred systems.

In AI-enabled teacher education, the CBE framework therefore operationalizes the theoretical underpinnings of constructivism, augmentation theory, and TPACK, converting them into quantifiable professional standards.

Analytical Findings and Conceptual Outcomes:

The thematic synthesis of contemporary literature reveals five major analytical findings aligned with the objectives of this study.

First, AI-enabled pedagogy significantly enhances personalization, adaptive scaffolding, and reflective engagement within teacher education contexts. Differentiated education is supported by intelligent tutoring systems and learning analytics platforms, but their efficacy depends more on thoughtful pedagogical integration than on technology automation.

Second, expanded teacher competencies are always emerging, according to the literature. Teachers need to acquire data literacy, algorithmic awareness, ethical reasoning, and adaptive instructional design skills in addition to traditional pedagogical and topic expertise. The professional identity of teachers is thus shifting toward a hybrid role that integrates analytical interpretation with human-centred facilitation.

Third, findings strongly favour a human–AI augmentation model over automation-based frameworks. Instead of taking the place of expert judgment, AI works best as a cognitive and

analytical companion that supports teacher decision-making. Collaborative intelligence models produce more sustainable and ethically sound educational outcomes.

Fourth, by providing real-time tracking of mastery development, individualized feedback loops, and ongoing professional progress mapping, AI integration enhances competency-based educational frameworks. This aligns with outcome-oriented teacher preparation systems and enhances accountability.

Finally, the synthesis underscores the necessity of ethical AI governance. It becomes clear that human oversight, explainability, fairness, and transparency are crucial protections to guarantee responsible and equitable implementation in teacher education settings.

All these results lend credence to the idea that structured integration, competency development, collaborative augmentation, and ethical regulation—rather than technology replacement—hold the key to AI's transformative potential in teacher education.

Proposed AI-Integrated Teacher Education Model (AITEM)

Based on the thematic synthesis and theoretical integration presented in the preceding sections, this study proposes an AI-Integrated Teacher Education Model (AITEM) tailored to the evolving educational landscape in India. The paradigm fosters balanced and human-centred AI integration by combining pedagogical, technological, professional, and ethical aspects into a single framework.

Four Core Pillars of the Model

The AI-Integrated Teacher Education Model (AITEM) is structured around four interdependent pillars that collectively support balanced, human-centred, and competency-driven AI integration in teacher preparation systems.

Pillar 1: AI-Enabled Pedagogy

This pillar focuses on transforming instructional design and classroom practice through intelligent and adaptive technologies. Differentiated learning environments where instruction is responsive to learner diversity and performance data are supported by AI-enabled pedagogy. AI tools help to maximize planning, monitoring, and reflective practice rather than taking the place of teacher agency.

Key components include:

- **Adaptive instructional strategies** that modify content delivery based on learner progress
- **Intelligent tutoring systems** that provide personalized academic support
- **Personalized learning pathways** aligned with individual competency levels
- **Data-informed instructional planning** using analytics-driven insights

This pillar operationalizes constructivist and learner-centred principles within AI-supported environments.

Pillar 2: Smart and Competency-Based Assessment

This pillar aligns AI capabilities with outcome-oriented evaluation frameworks. It integrates real-time analytics and automated systems to enhance transparency, scalability, and formative monitoring. Assessment shifts from summative tests to ongoing monitoring of mastery.

Core elements include:

- **Automated grading tools** for efficiency and consistency
- **Real-time formative feedback mechanisms**
- **Learning analytics dashboards** for performance visualization
- **Performance-based progression models** aligned with competency benchmarks

This pillar reinforces mastery-based development and accountability within teacher education programs.

Pillar 3: Teacher AI Literacy and Professional Development

Effective AI integration depends on teacher preparedness. This pillar emphasizes the development of advanced competencies necessary for responsible and informed AI adoption. It extends traditional professional training to include analytical and ethical dimensions.

Essential competencies include:

- **Algorithmic awareness** and understanding of AI decision processes
- **Data interpretation skills** for instructional decision-making
- **Ethical AI usage training** to prevent bias and misuse
- **Continuous digital pedagogy workshops** to sustain innovation

This pillar redefines teacher identity from content transmitter to augmented facilitator and analytical decision-maker.

Pillar 4: Ethical and Human-Centric Governance

Ethical governance functions as the regulatory and moral foundation of the model. It guarantees the continued transparency, equity, and accountability of AI integration. Technology integration has the potential of strengthening systemic prejudice and undermining professional autonomy in the absence of ethical controls.

Key governance principles include:

- **Data privacy protection mechanisms**
- **Bias monitoring and fairness audits**
- **Human oversight structures** in automated decision systems
- **Professional autonomy safeguards** to preserve teacher agency

This pillar ensures that AI operates within a framework of responsibility and trust.

Discussion

The findings of this study highlight the transformative potential of artificial intelligence in reimagining teacher education for the 21st century. According to the report, data-informed teaching methods, individualized learning environments, and adaptive instructional design are all supported by AI-enabled pedagogical tools. These advancements are in line with modern educational strategies that prioritize competency-based and learner-centred training methods for aspiring educators.

The integration of AI within assessment practices also demonstrates significant benefits in terms of efficiency, objectivity, and timely feedback. Automated evaluation systems and learning analytics enable instructors to monitor trainee progress more effectively while reducing administrative workload. The results, however, highlight that professional pedagogical judgment should not be replaced by AI-driven assessment; rather, it should serve as a supportive tool.

Another important insight from the study is the evolving role of teachers within AI-supported educational ecosystems. Teachers are increasingly required to serve as mediators between students' learning processes and technological systems, facilitators, and translators of learning data. This change highlights the significance of data interpretation abilities, AI literacy, and ongoing professional development in teacher education programs.

Furthermore, the analysis underscores the significance of ethical and human-centric governance in AI implementation. To guarantee appropriate and equitable use of AI in educational contexts, issues including algorithmic bias, transparency, accountability, and data protection require close regulatory supervision. Therefore, a balanced model that integrates technological innovation with human pedagogical expertise is essential for sustainable teacher education reform.

Conclusion

This study examined the transformative potential of Artificial Intelligence (AI) in teacher education and proposed the AI-Integrated Teacher Education Model (AITEM) as a comprehensive and human-centred framework for systematic integration. According to the analysis, AI may improve instructional design, facilitate competency-based assessment, support data-driven decision-making, and increase chances for ongoing professional growth when used carefully. However, the study also highlights that technological efficiency must remain aligned with ethical safeguards, transparency, and the preservation of teacher autonomy.

The AITEM framework contributes to the field by conceptualizing AI as a collaborative augmentation tool rather than a replacement for educators. The approach provides a balanced route for innovation in teacher training programs by combining AI-enabled pedagogy, intelligent assessment systems, teacher AI literacy, and ethical governance into a single structure.

The significance of this research lies in addressing the urgent need for digitally competent, analytically skilled, and ethically responsible educators in evolving learning ecosystems. Future studies should examine the model's long-term effects on teacher effectiveness, student engagement, and equity results as well as empirically validate it in various institutional contexts. Sustainable transformation ultimately depends on maintaining the centrality of human judgment within AI-supported educational environments.

References

Camilleri, M. A. (2024). Artificial intelligence governance: Ethical considerations and implications for social responsibility. *Expert systems*, *41*(7), e13406. https://doi.org/10.1111/exsy.13406

Fragiadakis, G., Diou, C., Kousiouris, G., & Nikolaidou, M. (2024). Evaluating human-ai collaboration: A review and methodological framework. arXiv preprint arXiv:2407.19098. https://doi.org/10.48550/arXiv.2407.19098

Jamal, A. (2023). The role of artificial intelligence (AI) in teacher education: Opportunities & challenges. International Journal of Research and Analytical Reviews, 10(1), 139-146. Retrieved from https://www.researchgate.net/profile/Afiya-Jamal/publication/369384184_The_Role_of_Artificial_Intelligence_AI_in_Teacher_Education_Opportunities_Challenges/links/64197dd792cfd54f8418b429/The-Role-of-Artificial-Intelligence-AI-in-Teacher-Education-Opportunities-Challenges.pdf

Kumari, D. A., Begum, D. S., Paunikar, M. S., Kaur, A. & Verma, D. S. (2025). The Role of Artificial Intelligence in Teacher Training: Enhancing Pedagogical Effectiveness. Journal of Marketing & Social Research, 2(5), 116-122. Retrieved from file:///C:/Users/USER/Downloads/Journal_of_Marketing__Social_Research_JMSR_The_Role_of_Artificial_Intelligence.pdf

Norboyev, S. (2026). Automated Assessment TECHNOLOGY Based on Artificial Intelligence. Modern American Journal of Engineering, Technology, and Innovation, 2(1), 28-33. Retrieved from https://media.neliti.com/media/publications/670720-automated-assessment-technology-based-on-8d2d9f3a.pdf