

Integrating Artificial Intelligence into Teacher Training: A conceptual proposal for the ITEP curriculum

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Received 011 June 2026

Accepted 10 June 2026

Published 20 June 2026

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Doi: <https://doi.org/10.64880/tvsjir.v1i2.02>

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sector.

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Abstract:

The National Education Policy (NEP) 2020 seeks to transform teacher education through competency-based training, multidisciplinary approaches, and technology integration. As the role of Generative AI in classrooms is increasing, existing frameworks such as TPACK view technology as passive tool, thereby failing to provide pre-service programs like ITEP a functional roadmap for AI-driven pedagogical integration. This study addresses this gap by critically analysing the traditional TPACK framework and conceptualising a new AI-integrated framework tailored for preservice teachers, which can be incorporated into the ITEP curriculum. The study adopts a conceptual research design based on integrative review of existing literature on TPACK, national policy documents and AI competency frameworks. This paper explores the limitations of TPACK framework and the need to reconceptualize teacher professional development by integrating AI into the traditional TPACK framework. This study also proposes a new TPACK-AI framework and design a conceptual structured roadmap for this framework for the developmental needs of preservice teachers within the four-year ITEP curriculum in the age of AI era.

Keywords- Artificial intelligence, ITEP, Teacher Training, Technological Pedagogical Content Knowledge (TPACK)

Introduction

Artificial Intelligence can be defined as machines that can perform the tasks that human carry out through their thinking (Dorfler, 2022). The rapid advancement of Artificial Intelligence (AI) is transforming educational systems across the world. Under the mandates of the National Education

Policy (NEP) 2020, the traditional teacher training models are moving towards more holistic, multidisciplinary system. Government initiatives like the National Digital Education Architecture (NDEAR) and the DIKSHA platform have successfully built a strong digital foundation of digital infrastructure, equipping classrooms across the country with internet connectivity, digital screens, and vast repositories of static learning materials. However, just as teachers and students are getting used to these digital tools, A new technological wave has arrived and Generative AI began to grow rapidly. Due to such rapid advancement in technology, a gap has emerged in teacher training frameworks. For nearly two decades, the Technological Pedagogical Content Knowledge, TPACK model. Mishra & Koehler (2006) has served as the global benchmark for training teachers to balance subject expertise, teaching methods, and digital tools. While TPACK model proved highly effective for passive, instrument based technologies such as interactive whiteboards, online search engines, multimedia presentations, it lacks the rapidly growing AI dimension, it is not designed for systems that can write a lesson plan on their own, evaluate student essays, or hold a realistic conversation with a student. As Kumari & Raj (2025) observe, while Generative AI creates new opportunities to personalise learning and generate educational materials, these benefits will be lost if teachers lacks the specific cognitive and ethical skills required to govern these intelligent systems. In short, Indian teacher education currently possesses the necessary hardware, but lacks the theoretical framework needed to handle an active AI partner in the classroom. Without the proper training and understanding, AI's benefits in education may remain out of reach (Karsenti, 2019).

So, there is an urgent need to evolve the structure of professional teacher competencies in India. The four-year Integrated Teacher Education Programme (ITEP) provides a long-term opportunity to bring this change. As ITEP is a comprehensive , multi-semester, and multidisciplinary course, this allows teacher training institutes to replace short AI workshops and directly incorporate AI literacy into the teacher training curriculum of ITEP.

This paper bridges this gap by giving the concept of Technological Pedagogical Content Knowledge -Artificial Intelligence (TPACK-AI) framework by integrating Artificial Intelligence Knowledge (AIK) as a distinct, specialized component of professional expertise rather than using it as general passive technology. This framework outlines what it means to be a “future-ready” educator. The subsequent sections will highlight how the TPACK-AI framework can be structurally mapped across the four developmental stages of the ITEP curriculum by bridging the technical capabilities of Generative AI with the human-centric, reflective pedagogy envisioned by NEP 2020.

Research Objectives

- To critically analyse and reconceptualize the traditional TPACK framework for ITEP.
- To design a structural roadmap for integrating AI-specific skill into the four-year ITEP curriculum.

Theoretical Background of the Study

The TPACK framework is rooted in the Schulman's concept of Pedagogical Content Knowledge (PCK) which emphasises how teachers adapt and present subject matter to improve student understanding. PCK embodies the integration of content and pedagogy into a comprehensive understanding of how specific content is structured, communicated, and adapted to cater to diverse

learner's interests and capabilities (Schulman, 1987). Schulman's PCK is the blending of pedagogy and subject content knowledge. Mishra & Koehler (2006) expanded this framework by introducing Technological Knowledge (TK) domain into the PCK and proposed a

new framework, Technological Pedagogical Content Knowledge (TPACK). The integrated framework TPACK helps teachers to conceptualise the knowledge they need for technology integration in classrooms, such as AI tools. Although, TPACK framework guided teachers on how to manage the interplay between technology, pedagogy and content knowledge, but the widespread adoption of Generative AI has changed the role of technology and AI literacy became the essential competency for teachers. Ng et al. (2021) stated four interrelated dimensions of AI literacy: knowing and understanding AI, using and applying AI, evaluating and creating AI, and addressing ethical issues. The widespread emergence of AI has transformed educational practices by influencing classroom interaction, assessment and evaluation strategies which increases the professional responsibility of teachers beyond technology knowledge to integrate emerging AI technologies critically and ensure effective and ethical use.

National Education Policy (NEP) 2020 highlights the vital role of technology in transforming the teaching and learning process. It acknowledges teachers as an essential element of quality education and places strong emphasis on teacher education programme. Preparing teachers for the demands of existing education, (NEP) 2020 introduces the Four- Year Integrated Teacher Education Programme (ITEP) as a major reform in teacher education which emphasises on providing integrated, holistic and rigorous education to pre-service teachers. ITEP is a key initiative introduced as a part of (NEP) 2020 and it is a comprehensive four year multidisciplinary undergraduate programme that focuses on holistic development of both primary and secondary level teachers. ITEP is designed to meet the evolving demands of education, where educators are expected to be proficient in using modern technology. According to NEP 2020, by 2030, all teachers will need to have completed ITEP programme as the minimum qualification. The ITEP curriculum conceptual framework follows TPACK and incorporates the use of technology, content and pedagogical practices into the learning of each discipline.

As the use of AI- supported technologies continue to grow, prospective teachers graduating from the ITEP programme will be expected to enhance their competencies that extend beyond traditional domains of TPACK. The above theory provides the foundation for examining TPACK and related framework and the need to include Generative AI in teacher education curriculum in the AI era.

Review of Related Literature

Hava & Babayigit (2025) examined the relationship between teachers' AI-TPACK competencies and digital proficiency. The findings of the paper revealed that teachers with stronger AI-related competencies demonstrated greater confidence and effectiveness in integrating AI-supported instructional strategies and the study revealed that AI literacy positively influences teachers' professional adaptability, innovation, and instructional effectiveness. Yadav & Kumar (2025) highlights how the TPACK framework aligns with the objectives of ITEP, it also discusses the TPACK implementation challenges. UNESCO (2024) proposed an AI competency framework for teachers for

their lifelong professional development focusing on five dimensions - human-centred mindset, ethics of AI, AI foundations and applications, AI pedagogy and AI for professional learning. The framework recommended that AI competency frameworks for teachers to be integrated into a comprehensive strategy for AI capacity building across all educational levels. Celik (2023) introduced the Intelligent-TPACK framework to explain teachers' professional competencies for the ethical integration of AI-based technologies in education. The study emphasized that teachers must possess competencies related to AI ethics, data privacy, responsible technology use, and algorithmic awareness in addition to technological pedagogical competencies. The IntelligentTPACK model demonstrated that AI integration requires a deeper understanding of ethical and pedagogical implications rather than simple technological proficiency. Mishra et al. (2023) in his study discuss that with the rise of Generative AI, there is a need for reconceptualising the traditional TPACK framework because AI tools are not merely technological instruments for teaching; rather, they are cognitive partners that influence teaching and learning. The researchers suggested that teachers require new competencies related to prompt design, AI-assisted creativity, ethical judgment, and critical engagement with AI-generated information. The National Education Policy (2020) introduced major reforms in Indian teacher education through the implementation of the Four-Year Integrated Teacher Education Programme (ITEP). The policy emphasised multidisciplinary education, competency-based learning, digital literacy, innovative pedagogy, and technology integration. It highlighted the need for future-ready teachers capable of adapting to technological and societal transformations, thereby providing a policy foundation for the new TPACK-AI framework.

The existing literature highlighted the growing importance of AI in educational field such as AI tools, virtual assistants, intelligent tutoring systems, and AI-integrated teaching competencies in education. While UNESCO (2024) highlighted the need to prepare teachers globally for responsible integration of AI in education, NEP 2020 also emphasise the need for technology enabled and future ready teachers. However, by analysing the existing frameworks like TPACK, Intelligent TPACK, and AI-TPACK, it is concluded that these frameworks does not address the emerging competencies completely, which is required for AI-integrated teacher preparation. Also, none of these frameworks reconceptualize TPACK by adapting AI related competencies for the Four-Year Integrated Teacher Education Programme (ITEP). This study bridges this gap by proposing a new TPACK-AI framework to prepare professionally competent teachers in the age of Generative AI.

Critical Analysis of TPACK Framework

Understanding Technological Pedagogical Content Knowledge (TPACK)

The TPACK is a conceptual framework which provides a perspective on how teachers can integrate technology into their teaching (Mishra & Koehler, 2006). It consists of three knowledge domains - technology, pedagogy, and content:

• Technological Knowledge (TK)

TK refers to teacher's proficiency of using technology, digital tools used in educational contexts and familiarity with computer hardware and software. Technological Knowledge covers the ability adapt

and learn new technology. It is important to note that technological knowledge exists in a state of flux, due to the rapid rate of change in technology (Mishra, Koehler & Kereluik, 2009).

• **Pedagogical Knowledge (PK)**

PK refers to teacher's understanding of teaching process and classroom management. This involves knowledge about lesson planning, classroom management, instructional strategies, assessment and evaluation. Pedagogical Knowledge is a key to effective teaching as it supports diverse learning styles, instructional methods and help teachers to maintain a positive learning environment in the classroom.

• **Content Knowledge (CK)**

CK refers to teacher's understanding of the concepts, theories and the mastery of discipline they are teaching. It is essential because without deep knowledge of the subject, teachers cannot convey the relevant information to their students. Content knowledge enhances teacher's accuracy, problem solving ability, confidence and credibility.

Integration of TPACK with ITEP

The ITEP is introduced by (NEP) 2020 with the aim of transforming traditional teacher training into evolving demands of modern educational ecosystem. Traditional teacher education programmes involves pedagogical knowledge and content knowledge. By integrating TPACK into ITEP, it adds the technological component into the traditional teacher education programs, which encourages reflective teaching and professional development of teachers so that pre-service teachers graduating from ITEP can learn to use tech-driven instruments in the classroom for effective teaching and develop future-ready teachers. TPACK framework also promotes personalised learning which is a core objective of ITEP, ultimately promoting inclusive classrooms.

Although, the TPACK framework aligns with several objectives of ITEP, such as pedagogical and content knowledge, practical training, digital literacy, inclusive education, but there are some competencies of ITEP that cannot be fulfilled by following the TPACK framework such as AI literacy and ethical use of AI in teaching and assessment which are essential for teachers as rapid advancement of AI is transforming education across the world.

Need for reconceptualising TPACK

From the above analysis it is concluded that although TPACK provides basis for technology integration in teacher education, but with the rapid evolution of educational technologies, teachers are expected to meet the changing demands beyond technological proficiency. To fulfil this, there is a need to integrate AI in current TPACK framework and introduce a new conceptual framework to teacher education programs like ITEP. The expanded TPACK framework is necessary to address the evolving AI competency requirement for teachers. Reconceptualising TPACK would strengthen to fulfil the objectives of ITEP that integrates technological pedagogical, disciplinary, ethical and AI related competencies for teachers.

The TPACK-AI Conceptual Framework

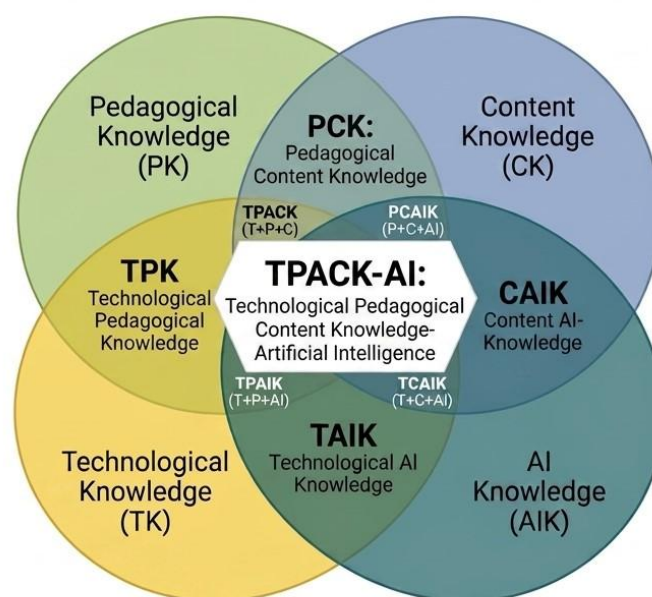
The proposed TPACK-AI Framework is an extension of the traditional TPACK framework developed to address the emerging competency requirements of AI-enabled education within the

Four-Year Integrated Teacher Education Programme (ITEP). The framework integrates Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), and Artificial Intelligence Knowledge (AIK) to prepare future teachers for effective, ethical, and innovative teaching practices in AI-supported learning environments.

Core Knowledge Domains of TPACK-AI Framework

1. Technological Knowledge (TK) : Knowledge of digital technologies, educational software, online platforms, and technology integration in teaching-learning process. It enables teachers to select and integrate appropriate technological tools into teaching, assessment and evaluation.
2. Pedagogical Knowledge (PK) : Knowledge of teaching methods, instructional strategies learner-centred pedagogy, classroom management, assessment strategies, and inclusive educational practices. It enables teachers to understand the nature of students, their learning needs and how to facilitate that learning effectively.
3. Content Knowledge (CK) : Knowledge of subject matter, curriculum content, disciplinary knowledge, and academic understanding of teachers required for effective teaching.
4. Artificial Intelligence Knowledge (AIK) : Knowledge of AI tools, AI literacy, ethical AI use, prompt giving, critical evaluation, data awareness & security and AI-supported instructional practices. It refers to teacher's understanding of educational application of artificial intelligence responsibly and effectively.

The TPACK-AI Framework emphasises the interaction among these domains to redefine teacher professional competencies for the new AI era. The framework aligns with the objectives of NEP 2020, ITEP, and UNESCO's AI competency recommendations by promoting reflective, futureready, ethically responsible, and technologically competent teachers.



TPACK-AI FRAMEWORK: An Integrated Conceptual Framework

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Longitudinal Roadmap for embedding TPACK-AI in ITEP

ITEP Stage	Focus Area	Embedded TPACK-AI Domains	Expected Competencies
Year I	Foundations of education, Educational Technology, Enhancement of Ability and Value Added Courses	Technological Knowledge (TK) Artificial Intelligence Knowledge (AIK)	• Develop digital and AI literacy • Responsible and ethical use of AI • Learn to use AI tools for teaching and learning.
Year II	Educational psychology, Educational perspectives, Contentcum-pedagogy technical skills and ICT	Pedagogical Knowledge (PK) Technological Pedagogical Knowledge (TPK) Pedagogical Content Knowledge (PCK) AI Knowledge (AIK)	• Exploring AI- supported pedagogy • Designing learnercentred lesson plans using AI tools • Learning “Prompt Pedagogy” for lesson planning • AI-assisted instructional design • Personalized and adaptive teaching strategies for diverse inclusive classroom • Integrating AI into formative assessment • Ethical integration of AI in classroom practices
Year III	Advanced pedagogical strategies, Stagespecific content-cumpedagogy, Practical field preparation	Content Knowledge (CK) Technological Content Knowledge (TCK) Content AI Knowledge (CAIK)	• Advanced subject understanding • Ability to integrate AI tools with subject content • Ability to use AI for content enrichment and concept visualisation • Critically evaluate AI-generated academic content • Effective integration of content knowledge with technology and AI

ITEP Stage	Focus Area	Embedded TPACK-AI Domains	Expected Competencies
Year IV	Advanced professional education, Intensive school internships, and action research	Integrated Technological Pedagogical Content Knowledge-Artificial Intelligence (TPACK-AI)	• Delivering live, tech-integrated lessons during school internships • Innovative instructional practices using technology and AI • Undertaking school based research projects by ethical use of AI • Professional competency & ethical decisionmaking • Readiness for integrating AI into diverse classroom practices

Conclusion

The rapid integration of Artificial Intelligence into the field of education has transformed the nature of teaching-learning process. The traditional TPACK framework provides a basis for technology integration in the field of teacher education but it lacks the emerging demands of integrating AI into educational process. The shift from traditional TPACK framework to proposed conceptual TPACK-AI framework could meet those demands for the evolving educational landscape. By integrating TPACK-AI framework into the four-year Integrated Teacher Education Programme (ITEP) supports the teacher education by introducing emerging teacher competencies such as AI literacy, reflective teaching, and responsible and ethical use of AI along with the pedagogical, disciplinary and other competencies for future-ready teachers.

The proposed TPACK-AI framework provides a comprehensive and future-oriented approach for teacher competency development within the four-year Integrated Teacher Education Programme (ITEP) in alignment with NEP 2020. By including Artificial Intelligence Knowledge (AIK) as an independent pillar, the TPACK-AI model provides a clear, practical, and multi-year roadmap for ITEP. It ensures that as our educational tools become more advanced, the teachers stay irreplaceable, empathetic, and reflective heart of the classroom. Therefore, the TPACK-AI framework may serve as a significant model for curriculum design, teacher preparation, and competency-based professional development aligned with NEP 2020 and global educational transformation.

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