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From Chalkboard to Algorithm: Redesigning India's Teacher Education for Ai-Enhanced Classrooms

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Abstract

The National Education Policy (NEP) 2020 aims to transform India's schools by bringing Artificial Intelligence (AI) and digital technologies into the classroom. However, a major challenge exists: while the policy requires AI-enhanced classrooms, it does not provide a clear plan to train teachers to use these tools effectively. This paper introduces the concept of AI-Pedagogical Content Knowledge for teachers as the essential solution to bridge the gap between having AI tools and using them meaningfully in lessons. By analyzing the goals of NEP 2020, current B.Ed. course designs, and recent research on AI in education, this paper argues that the 4-year integrated B.Ed. programme must be completely redesigned. This change is necessary to train future educators who do not just operate technology and software, but who can use AI tools with clear purpose, deep critical thinking, and strict ethical standards. The paper outlines the current gaps in teacher training, presents a six-step strategy to build AI-Based Content Pedagogy Knowledge, and connects this framework to the global Sustainable Development Goal for education (SDG 4) that guides NEP 2020. Ultimately, the paper concludes that moving from traditional chalkboards to AI-enhanced classrooms requires more than just new technology; it requires a new kind of teacher who can act as a thoughtful, caring, and well-trained guide for students using these tools.

Keywords: Artificial Intelligence in Education (AIED), AI-Pedagogical Content Knowledge (AI-PCK), Teacher Education, National Education Policy 2020, B.Ed. Curriculum Reform, Digital Pedagogy, SDG 4

INTRODUCTION

Globally, the connection between education and technology has evolved from a basic tool to a core requirement. India possesses the largest youth population in the world and aims to become a global knowledge economy by 2040. To achieve this, the National Education Policy (NEP) 2020 puts technology, specifically Artificial Intelligence (AI) at the absolute center of its reform agenda. The policy outlines an ambitious vision of AI-enhanced classrooms, adaptive learning platforms, and data-driven assessments designed to move students away from rote learning toward critical thinking.

However, a major tension exists within this vision. While NEP 2020 relies heavily on advanced technology, it also acknowledges that teachers remain the foundation of any successful classroom. The policy mandates a 4-year integrated B.Ed. programme as the minimum qualification for teachers by 2030, yet current teacher training remains rooted in outdated methods developed before AI became a major

educational tool. Merely adding basic computer modules to existing courses is not enough to prepare teachers for this shift.

This paper argues that bridging this gap requires developing a new professional capability: AI-Pedagogical Content Knowledge (AI-PCK). This concept blends basic AI awareness with subject-specific teaching skills, ethical reasoning, and professional judgment. This study maps the current state of teacher education in India against the technological goals of NEP 2020, and outlines a framework to integrate AI-PCK into the 4-year B.Ed. programme, and explores the practical conditions needed to implement it. Ultimately, this paper addresses a critical question: how can teacher education programmes prepare educators for advanced, AI-driven classrooms that do not yet fully exist?

NEP 2020'S VISION FOR AI IN EDUCATION: PROMISE AND GAPS

NEP 2020 makes its technological ambitions explicit from the introduction onwards. The policy observes that the rise of big data, machine learning, and artificial intelligence is reshaping the global employment landscape, and that education must respond by developing students capable of working alongside, and not merely beneath, intelligent machines. It calls for the integration of AI, Design Thinking, and Computational Thinking into school curricula from the middle stage onward (Chapter 4.24), and specifically identifies mathematics and computational thinking as subjects of heightened national priority given India's aspirations in AI and data science (Chapter 4.25).

The policy's technology chapter (Chapter 23) establishes the National Educational Technology Forum (NETF) as an autonomous body to guide technology adoption across school and higher education. It calls for the development of AI-based educational software in all Indian languages, the expansion of the DIKSHA platform as a repository of digital learning content, and the establishment of Virtual Labs to democratise access to experiential science education. Chapter 24 extends this vision to online and digital education, calling for blended learning models, digital infrastructure investment, and the training of teachers as online content creators.

Crucially, the policy is also remarkably candid about the risks of this technological transition. It acknowledges the digital divide and the reality that millions of students lack access to devices and connectivity and warns against screen-based education that neglects the social, affective and psychomotor dimensions of learning. It notes that a good teacher in a traditional classroom will not automatically be a good teacher in an online classroom (Chapter 24.3), implicitly recognising that pedagogical competence does not transfer automatically across media.

Yet when the policy turns to teacher education reform in Chapter 5, the specific requirements for AI-related competency are notably underspecified. The policy calls for continuous professional development (CPD) of at least 50 hours per year, a redesigned National Curriculum Framework for Teacher Education (NCFTE) and a move toward multidisciplinary 4-year integrated B.Ed. programmes by 2030. It calls for teachers to be trained in the use of educational technology and the latest pedagogical techniques. However, it does not articulate what AI-specific competencies teachers need, how those competencies should be structured developmentally, how they should be assessed, or how they interact with subject-specific pedagogy.

This constitutes a significant structural gap. A policy that mandates AI-enhanced classrooms while leaving the AI-preparedness of teachers undefined, like building a digital infrastructure without training the people who must operate it. The gap is not one of intent, NEP 2020's intentions are clearly progressive but of its specification. It is a gap that AI-PCK is designed to fill.

CONCEPTUALISING AI-PEDAGOGICAL CONTENT KNOWLEDGE (AI-PCK)

In this paper, AI-PCK is defined as a teacher's professional ability to choose, evaluate, and use AI tools effectively. This competence requires matching the right AI tool to a specific subject, learning goal, and group of students, all while ensuring that teaching priorities and ethics come first.

AI-PCK is different from digital literacy, which is just the ability to use technology. It is also different from AI literacy, which is simply understanding how AI works. AI-PCK is not just a combination of these two skills. Instead, it is the careful integration of AI skills with a teacher's subject knowledge and professional judgment. Ultimately, it allows teachers to ask not just “Can I use this AI tool?” but “Is it right to use this specific tool for students effectively?"

The following steps concern conceptual understanding of how AI-based educational tools function, not at the level of programming or data science, but at the level of pedagogical consequence.

Step 1: Foundational AI Awareness

This point involves teacher educators learning the basic functions of AI systems and how they impact the learning environment.

- Understanding Capabilities: Knowledge is gained regarding how different AI models function, such as generative models producing text or adaptive platforms altering lesson difficulty.
- Differentiating Tools: The ability to classify tools into categories (such as predictive or analytical) ensures that technology is chosen based on its actual function rather than marketing claims.
- Explaining Logic: Awareness allows for a clear explanation to student-teachers about why AI platforms generate specific, individualized paths for different learners.

Step 2: Using AI in Specific Subjects

This point focuses on applying AI tools across various school subjects. The usage is divided by discipline to highlight how specialized teaching skills differ from general technology use:

- Mathematics: Utilizing computational software and step-by-step AI tools to guide logical reasoning and proof-building, rather than simply generating final answers.
- Language & Literature: Employing AI writing assistants to analyze essay structures, provide vocabulary feedback, and help students develop a unique voice.
- Sciences: Using AI-driven simulations and data analysis tools to model complex scientific phenomena, map variables, or predict experiment outcomes.
- Social Studies: Applying generative AI to create historical roleplay scenarios or utilizing data tools to analyze geographic and demographic trends.

Step 3: Managing the Teacher-AI-Student Triad

This point addresses the shift from a traditional two-way classroom relationship to a three-way dynamic that includes the AI tool as an active classroom participant.

- Guiding AI-Student Interactions: Protocols are established to monitor how students prompt and converse with chatbots, ensuring the technology functions as a helpful partner rather than an answer generator.
- Co-Teaching with AI Agents: Lessons are designed where automated tutors handle repetitive practice or basic explanations, freeing up classroom time for collaborative, peer-to-peer projects.
- Maintaining Human Agency: Strategies are developed to ensure students remain active thinkers, preventing them from developing an over-reliance on automated suggestions during creative work.

Step 4: Data-Driven Assessment and Feedback

This point concerns how learning analytics and automated assessment tools are used to evaluate student

progress without losing human oversight.

- Interpreting Learning Analytics: Training involves learning how to read dashboard data from AI diagnostics, turning raw metrics into actionable changes for future lesson plans.
- Formative Feedback Management: Generative feedback tools are used to provide rapid, initial critiques on student drafts. This allows the focus to shift toward deep, qualitative mentoring.
- Tracking Skill Gaps: Predictive algorithms are utilized to identify hidden learning gaps before a student fails an exam, allowing for timely, targeted intervention.

Step 5: Professional Learning and AI Adaptation

Continuous growth, ensuring teacher educators can update their skills as fast as AI systems change.

- Curating and Updating Tools: Methods are learned to continuously discover, test, and apply new educational applications as older tools become obsolete.
- Collaborative Knowledge Sharing: Professional learning networks are established where educators share successful prompting strategies, lesson templates, and subject-specific AI use-cases.
- Action Research on AI: Small-scale classroom studies are conducted to measure exactly how specific algorithms affect student engagement and actual learning outcomes within the school system.

Step 6: Critical and Ethical AI Pedagogy

This point addresses the moral responsibilities, risks, and choices involved when integrating AI into educational settings.

- Identifying Algorithmic Bias: Training involves recognizing when an AI tool reproduces socioeconomic, gender, or cultural biases present in its training data.
- Protecting Data Privacy: Strict protocols must be followed regarding student data inputs, ensuring that personal details and student work are not fed into public AI models.
- Exercising AI-Minimalist Judgment: Professional discretion is maintained to intentionally exclude AI tools from lessons when human interaction, physical materials, or open-ended discussion offer superior educational value.

CURRENT STATE OF TEACHER EDUCATION IN INDIA: THE PREPAREDNESS GAP

The two-year B.Ed. programme that currently constitutes the minimum qualification for secondary school teachers in India was last substantially revised through the NCTE's 2014 curriculum framework. That framework introduced educational technology as a course component, but the content of technology-related courses has remained largely focused on basic ICT skills using computers, creating presentations, and navigating the internet. In 2014, the AI landscape was considerably less developed, and the penetration of AI tools into Indian schools was minimal.

Several further structural factors compound this gap. Teacher education institutions in India are predominantly stand-alone single-stream colleges, precisely the model that NEP 2020 seeks to phase out in favour of multidisciplinary institutions. Stand-alone TEIs typically lack the faculty expertise, infrastructure, and interdisciplinary culture needed to develop AI-PCK. They rarely have faculty members who hold expertise in both educational technology and subject-specific pedagogy simultaneously the dual competency that AI-PCK demands. They often lack the technology infrastructure needed to give student teachers meaningful hands-on experience with AI enabled platforms.

The Justice J.S. Verma Commission (2012) observed that a majority of stand-alone TEIs were producing graduates who were not meaningfully prepared for teaching. NEP 2020 itself acknowledges this bluntly in Chapter 15.2, noting that many such institutions were essentially selling degrees for a price rather than

providing genuine professional preparation. The challenge, then, is not merely to add AI content to an existing curriculum but to rebuild teacher education on a new institutional and conceptual foundation one in which AI-PCK is not an optional module but a structural principle of professional preparation.

A FRAMEWORK FOR AI-PCK INTEGRATION IN THE 4-YEAR B.ED.

A comprehensive framework must be designed to smoothly blend AI-PCK throughout the entire four-year integrated B.Ed. curriculum. This structure ensures that future educators progress from basic AI awareness to advanced, subject-specific classroom application before graduation. AI is not taught as a separate technology class. Instead, it is built directly into regular teaching methods courses (like math, science, or language methods). Hands-on classroom experience and ethical choices form the core of the program:

- Real-World Practice: Skills are built in actual classrooms by observing AI use, delivering supervised lessons with AI tools, and receiving guidance from trained mentor teachers.
- Constant Ethical Reflection: Every tool used is analyzed for practical risks, such as student data privacy, hidden biases in the software, and the danger of students becoming too dependent on technology.

CONCLUSION

While NEP 2020 presents a visionary future for AI-driven education in India, achieving this transformation requires more than digital infrastructure; it demands a fundamental shift in teacher preparation through AI-Pedagogical Content Knowledge (AI-PCK). Developing this capacity requires restructuring the 4-year integrated B.Ed. program into a progressive, subject-specific, hands-on, and ethically grounded curriculum within multidisciplinary institutions. Currently, India lacks the fully trained teacher educators, equipped practicum schools, and updated assessment systems needed for this AI driven platforms, yet NEP 2020 provides the framework to build them. Ensuring that all teachers possess AI enabled knowledge is essential to prevent marginalized students from being left behind, making this integration the ultimate test of both technological advancement and educational equity in the twenty-first century.

REFERENCES

1. Antonio, R., Etim, J., Inyang, E., Oguzie, K., & Ekong, U. (2026). Fostering preservice science teachers' AI-TPACK competence and reflections through an AI-focused pedagogical learning course. Journal of Technology and Science Education, 16(1), 112–128.
2. Cameron, S., & Williams, M. (2025). Assessing the pedagogical content knowledge of a generative artificial intelligence tool. Mathematics Education Research Journal, 37(2), 201–219.
3. Celik, I. (2023). Towards Intelligent-TPACK: An empirical study on teachers' development of AI-technological pedagogical content knowledge. Interactive Learning Environments, 31(8), 4985–5001.
4. Dutta, P., & Prajapati, R. (2025). Reimagining teacher education in India: AI-enabled pedagogy, assessment, and human–AI collaboration for 21st century classrooms. Indian Journal of Teacher Education, 3(3), 45–62.
5. Eguchi, A., Tammets, K., & Ley, T. (2025). Integrating AI competencies into teacher education programs: Shifting from basic digital literacy to ethical AI-PCK. Journal of Technology and Teacher Education, 33(1), 75–98.

6. George-Reyes, C. E., & Lizana Carrió, A. (2026). Integration of artificial intelligence into the TPACK model: Transforming teaching in the digital age. Foro de Educación, 24(1), 143–165.
7. Ibragimov, G. I., Ning, X., Yue, J., & Ng, D. (2024). An analysis of science teachers' use of artificial intelligence in education from a Technological Pedagogical Content Knowledge perspective. Online Journal of Communication and Media Technologies, 14(4), e202431.
8. Ismaniati, C., Mokhtar, F., & Osman, S. (2025). Harnessing self-efficacy: Mediating the connection between TPACK and AI intentions among teachers. Computers & Education: Artificial Intelligence, 6, 100214.
9. Lakhe Shrestha, B. L., Onesi-Ozigagun, O., & Ghimire, S. (2025). Generative AI on professional development: A narrative inquiry using TPACK framework. Frontiers in Education, 10, 1550773.
10. Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054. (Note: This is the original foundational framework that all AI-PCK / AI-TPACK models build upon).
11. Ministry of Education. (2020). National Education Policy 2020. Government of India.
12. Ministry of Human Resource Development. (1986). National Policy on Education 1986. Government of India.
13. Ministry of Education. (1968). National Policy on Education 1968. Government of India.
14. National Council of Educational Research and Training. (2023). National Curriculum Framework for School Education. NCERT.
15. Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2021). Enhancing pre-service teachers' technological pedagogical knowledge (TPACK): A systematic review. Educational Research Review, 33, 100376.
16. UNESCO. (2024). Education for sustainable development: A roadmap for achieving the Sustainable Development Goals. UNESCO Publishing.