ISSN: 2393-8048
International Advance Journal of Engineering, Science and Management (IAJESM)
Multidisciplinary, Multilingual, Indexed, Double Blind, Open Access, Peer-Reviewed, Refereed-International Journal.
SJIF Impact Factor = 8.35, January-June 2026, Published on 28th February 2026

Reimagining Teacher Professional Development through Artificial Intelligence: Pedagogical and Ethical Perspectives

Ms. Suman Rani, Assistant Professor, Department of Hindi, Shah Satnam Ji Girls' College, Sirsa, Haryana
Email Id: insansuman7777@gmail.com

Abstract

Artificial Intelligence (AI) is increasingly influencing educational practices worldwide, leading institutions to reconsider how teachers are prepared and supported in their professional roles. Traditional professional development models, often limited to periodic workshops and general digital training, do not adequately address the demands of AI-enabled classrooms. This paper examines how AI can enhance teacher professional development by enabling personalized learning pathways, strengthening instructional design, and supporting data-informed decision-making. It also analyses key ethical concerns associated with AI integration, including data privacy, algorithmic bias, teacher autonomy, and equitable access to technology. Drawing on international perspectives, particularly UNESCO's ethical AI framework and India's National Education Policy 2020, the study proposes a human-centered approach to integrating AI in teacher education. The paper argues that AI can support meaningful professional growth when implemented responsibly, with strong ethical safeguards and sustained institutional commitment.

Keywords: Artificial Intelligence, Teacher Professional Development, AI Ethics, Human-Centered Education, NEP 2020

I. Introduction

The world is experiencing an AI-driven revolution in the education system, which is forcing academic institutions to reconsider their teacher preparation and support processes. In contrast to the previous technological changes, AI not only changes the teaching aids, but also the whole process of learning, which poses the question of the changing role of the teacher. Practically, teachers waste their time in non-teaching activities. Indicatively, in one study, it is observed that teachers spend up to 50 percent of their time on administration, lesson planning and grading [25]. AI technologies have already demonstrated potential to recover part of that time; the recent studies have shown that AI can save educators about five hours a week of their time on mundane assignments [29], [30]. Such a change would allow teachers to concentrate on the human aspects of teaching - mentorship, critical facilitation, and dealing with the well-being of students. Although these are the benefits that can be achieved with the implementation of AI in education, it is not that simple. It requires novel types of teacher education. Recent UNESCO framework highlights how teachers should now have "*AI Literacy*" - the integration of technical, pedagogical and ethical literacy - as opposed to simple ICT literacy [2], [35]. At the same time, there are legitimate worries: run out of control, AI can infringe the privacy, increase the biases, or even the professionalization of teachers [1], [26]. We are examining both sides of this coin in this paper. We map out the ways of using AI to support teacher training and practice, as well as explore ethical frameworks and policies to make sure the teachers do not get disempowered. Combining insights into the world guidelines on AI and national policies (UNESCO and NEP 2020 in India), we suggest a moderate strategy of the *human-oriented* implementation of AI in the teaching profession [1], [3], [35].

II. The New Paradigm of Professional Development of Teachers

Traditionally, the teacher professional development has been based on non-regular workshops and non-specific computer training. These generalist solutions tend to be off target, since they lack access to the reality of the classroom on a day-to-day basis. On the contrary, AI facilitates sustained individualized PD. The contemporary educators have also been able to study at their pace: say, adaptive learning systems may reveal areas of pedagogical knowledge that a teacher lacks and propose specific modules or tutorials. This change is directly requested by the AI Competency Framework of Teachers by UNESCO: the five pillars of AI literacy - such as a

human-centered mindset, AI foundations, AI pedagogy, and AI as an agent of professional learning - target shifting one-off training to digital upskilling [2], [35].

- **In addition to ICT competencies** - AI Literacy: In the past, technologies of digital education assumed that teachers would only use word processors or projectors. Now they require a more profound knowledge. As an example, UNESCO singles out the ability of a teacher of the 21st century to understand the fundamentals of generative AI (such as the way big language models are designed) and even become a *prompt engineer* [2]. Practically, it will require TPD to now address the aspects such as the interpretation of data, how to assess the results of AI, and how to incorporate AI responsibly into the lessons.
- **Blurring Boundaries of PD:** When AI-based TPD is used, formal and informal learning is blurred. Educators have the opportunity to learn more about themselves on platforms (e.g. learning how to use an AI lesson planning assistant by example). This is contrary to the old model where professional development was mainly done through in-service days which were not frequent. UNESCO outlines precisely this - teachers studying with AI through action, not only by hearing at seminars.
- **Teacher as Co-Designer:** The role of teachers is changing towards being a passive consumer into co-creators. Teachers can have agency over the effects of technology on teaching by using AI tools (e.g., contributing to open AI teaching resources or training data). This is in opposition to the dread of top-down technologies. Actually, in the recent panel discussion events arranged by UNESCO, it is emphasized that teaching should become the subject of AI. One panelist emphasized: "*the role of the teacher is the core and cannot be replaced at all by any technological gadgets, on the contrary, that pedagogical core is to be strengthened and not undermined by any gadgets*" [35]. This highlights the fact that TPD should empower the teachers and not to act as operators of an assembly line.

Overall, a new paradigm is the active, AI-enhanced professional learning on an ongoing basis, with the teacher taking a decisive lead in it. This emphasizes critical questions, however, on preparedness and ethics which we discuss in subsequent sections.

III. Artificial Intelligence Technologies as Pedagogical Enablers

The industrial application of AI-based systems will revolutionize the fundamental teaching practice and serve as the second brains of teachers. These innovations can be divided into three broad groups:

- **Artificial Intelligence in Content Creation:** It is possible to have large language models (e.g. ChatGPT or education-specific AIs) write lesson plans, quizzes, and explanations based on a specific curriculum. Oak National Academy in the UK has developed, as an example, *Aila*, an AI lesson assistant, which is claimed to be "*the first publicly funded generative AI tool to go publicly available in the UK*" [29]. Teachers can create a slide deck/worksheet with a single click by typing a topic. There are initial reports of teachers who save up to five hours in a week of planning when such tools are used and also, they get time to interact with the students [29], [30]. Content differentiation is also served by generative AI: teachers are able to rapidly generate several variations of a lesson that meet the needs of different learners or languages, whereas this was labor-intensive in the past.
- **Adaptive Learning and Analytics:** Machine learning algorithms can be used to process student data (grades, engagement, even facial expressions) so as to give meaningful insights. Examples of such systems in TPD include monitoring the use of AI tools or classroom innovations by a teacher and recommending future actions. On the classroom level, the "*AI-powered headbands*" (which were tested in a Chinese school) will track the concentration of the pupils and send their attention levels to the teacher. In the same way, predictive analytics can identify students who are at risk of lagging and help the teachers to intervene at a young age [11], [12], [13]. The implication to PD is a data-driven feedback cycle: teachers are taught to use analytics dashboards as one of their professional skills. This is indicative of a larger trend

in which the practice of teaching by intuition is slowly replaced by the practice of making decisions based on data - what contemporary structures pursue.

- **Simulation and Augmented Practice:** Teacher training *Virtual coaches* or *simulators* are being developed as new AI tools. Consider this example; conversational agents have the ability to simulate a problematic classroom situation (such as a student with special needs or a contentious discipline situation) and provide real-time feedback on how the teacher would respond. This experiential learning is based on the social-constructivist theory in which the teachers learn through doing in a safe setting [15]. These types of simulations remain experimental, but they demonstrate how much AI can enable teachers to exercise and continuously develop their skills.

All these technologies have quantifiable effect. Various works indicate that teachers would save hours of time that was previously wasted by the monotony, and use the time on more meaningful pedagogy with the assistance of AI. They also facilitate innovation: when the task of administration is automated, the educator will be able to experiment with projects, inquiry-based learning, or interdisciplinary units.

IV. Artificial Intelligence Theory behind AI-improved Teacher Professionalism

In order to base these technological changes on theory, scholars have started extrapolating on traditional teacher ed models:

- **TPack to AI-TPack:** The known TPACK (Technological, Pedagogical and Content Knowledge) paradigm is being transformed into the models, which explicitly incorporate AI [5]. Educators now have to learn the technical peculiarities of AI (e.g. such facts as that a language model may hallucinate them) in addition to pedagogy and subject matter. An example would be: *What is my view of AI limitations like, and how do they impact my design of a math lesson?* An AI-TPACK perspective would answer this question. This makes sure that teachers are critical users and not passive users of AI.
- **Ecological Teacher Agency AI:** Recent qualitative studies in India have integrated the concept of *Ecological Teacher Agency* to AI integration [16], [33]. This view understands the agency as the result of an interaction between a teacher and his/her setting (students, institution, tools). Tripathi et al. (2025) discover that AI in classes redefines the beliefs and the sense of authority held by teachers. They can be empowered due to the new abilities yet be nervous about control. This paper concludes that successful PD has to focus on the teacher and a sense of agency instead of foisting technology. Practically, it implies co-designing AI policies together with teachers and providing them with the freedom to implement the tools in a more creative manner.
- **Social Constructivism with AI:** Following Vygotsky, there is educators who think about AI as another More Knowledgeable Other - a facilitator who co-constructs knowledge [15]. AI could serve as a third party in professional learning communities in conjunction with teacher and peer discussion. As an illustration, the group PD sessions might include teachers collaboratively improving AI-created lesson materials, discussing, and evaluating them. This is in line with the UNESCO focus on evidence-based pedagogy which is collaborative.

All these models are united by the fact that AI must enhance the work of teachers, not replace it. They also emphasize that PD should be transformed to be less about the tool usage and more about the way to think about AI as an educator. That is, the professional learning is no longer a mere training but a critical one.

V. Ethical Demystification and the Human-Centered Thinking

When discussing AI in education, one has to preempt the issue of ethics. The most recent document by UNESCO, a 2021 recommendation on the Ethics of AI, presents the fundamental principles that are directly applicable to TPD [1]:

- **Human Rights and Dignity:** The use of AI should not violate the basic rights (freedom, equity, privacy). To teachers, this implies that AI in the classroom (such as emotion recognition

software) must never infringe on the privacy of students or provide any form of discriminatory result.

- **Non-Discrimination and Fairness:** AI models are capable of being biased (e.g. gender bias or cultural bias in language corpora) [26]. The teachers need to be trained by PD programs to identify and fix such biases in AI output. This resonates with the principle of fairness in the UNESCO, which makes AI tools useful to all students [26].
- **Transparency and Explainability:** To be able to trust an AI tool, educators must know how it functions. UNESCO focuses on the fact that AI systems must be understandable to the users. Practically, TPD needs to demystify AI black boxes, educating teachers to understand AI recommendations as well as when to reject them [26].
- **Accountability and Human Oversight:** It is important that teachers be left to the final judgment. This aspect was highlighted by the Chilean panel convened by UNESCO AI is a mediating technology and not an authority. Although an AI tool can suggest a quiz or declare a student at risk, the teacher has to evaluate and determine its validity. The recommendation of UNESCO is clear regarding the fact that AI should not substitute ultimate human responsibility and accountability [1].

In addition to these general principles, there are also particular risks that should be addressed:

- **Data Privacy:** AI systems are data-intensive (usually student data). The instruction of consent, anonymization and secure storage should be guided. The principles of UNESCO emphasize the principle of privacy in the AI lifecycle, i.e., PD should incorporate data management training.
- **Workload and Autonomy:** Ironically, another effect of AI introduction is a stressful condition in teachers. There is the concern that AI will homogenize the classroom or turn it into the function of reporting data. Ethical PD should combat these fears and reiterate that AI is not an observation device.
- **Equity and Access:** It is at risk of increasing the divide. Rich schools can have the latest AI driven tools, and poor schools fall behind. Only a small fraction of Indian government schools even has a working computer lab, as one analysis observes [34]. PD needs to therefore conform to the local realities and demand fair infrastructure to ensure AI is advantageous to all the students.

In short, the human-centered ethos demands that technology can be used to address the professional values of the educators. The panelists in UNESCO emphasized that the transformation based on AI requires educated teachers, robust moral standards, and responsible approach to the implementation that would prioritize human judgment over automated processes. This balance will be strengthened later during our recommendations.

VI. Reforming Teacher Education in India: NEP 2020 Framework

The National Education Policy (NEP) 2020 is a national vision of India that is very compatible with these global concepts [3]. The NEP places education in a fast-evolving technological world. As an illustration, the policy observes that with the improvement in big data, machine learning, and artificial intelligence, most jobs will be automated, and a skilled workforce will be in demand. In reaction, NEP proposes to use technology widely in the education spectrum - even in teacher education.

The main NEP initiatives are aligned with AI-based PD:

- **Curriculum and Teacher ICT Skills:** NEP ascertains the incorporation of AI and computational thinking in the school curriculum as far back as Grade 3. Reportedly, under NEP 2020 starting in 2026, the Times of India noted that the Grade 3 school curriculum includes AI and Computational Thinking [3], [34]. A big training initiative is behind this curricular change: Microsoft Elevate for Educators program in India is targeting to train 2 million teachers in AI by 2030: specifically, to match the teacher skills to NEP objectives.

- **Digital Platforms and Infrastructure:** DIKSHA platform (digital content) in India and the new National Educational Technology Forum (NETF) are national frameworks of resources based on AI. An example is the Microsoft program, which, according to the introduction, connects to DIKSHA and Skill India Digital Hub, which promises AI-driven lesson resources across the country. These coincide with NEP statement of focusing on national ed-tech ecosystem.
- **Teacher Well-being and Support:** NEP recognizes the problem of teacher shortage and teacher morale. The policy demands renewed training and career opportunities in terms of teachers. Practically, it combined with AI would simply imply the application of analytics to track workload and well-being, as proposed by UNESCO professionals.

But challenges are still faced in the context of India. The absence of infrastructure (as mentioned, a massive number of government schools still face infrastructural limitations) may act as an obstacle to the adoption of AI. In addition, a lot of educators do not have simple technology training. A survey shows that the majority of teachers in India are not adequately prepared in AI in the classroom [30], [33]. To fill this so-called implementation gap, a long-term commitment to both equipment and more specific PD programs will be necessary, to ensure that the vision of AI that NEP has is not merely wishful thinking but in practice in all types of schools.

VII. International Case Studies and quantifiable Results

Practicing pilots emphasize the already existing ways the AI transforms TPD:

- **Oak National Academy (UK):** Oak NA of the UK has incorporated AI into its free curriculum platform with the support of the government. Recently, a report observes that the AI-powered lesson assistant Aila by Oak has assisted educators in developing lessons and quizzes in large scale. Using the AI tools developed by Oak, teachers stated they saved as much as five hours per week on planning and having more time to interact with students. Notably, Oak chose to go along with the collaborative design: AI features were designed in collaboration with teachers, and to make sure that they fit classroom requirements [29].
- **Basingstoke College of Technology (UK):** AI chatbots and automation (e.g. using Google Bard) became used in administration in a vocational college. At the anecdotal level, teachers in that area saved approximately 5.1 hours per week in paper work. The college also established AI Ethics Group to manage its usage as the staff felt to be the owners of the process. The main results were decreased burnout and a change in the culture toward innovation since now the teachers would use the time that was saved to develop human skills among students [29].
- **Jinhua Xiaoshun Primary (China):** In this school, students were equipped with AI-powered so-called focus headbands which monitor their attentiveness [23]. Educators were provided with instant feedback regarding the activity of every learner. Consequently, the instruction could be modified on the fly (e.g. pausing or modifying activity in case many students are losing attention). The school has more inclusive classrooms: the disengaged or neurodiverse students are identified at an early stage and accommodated, which depicts the potential of AI to provide equity.
- **International Initiatives (Europe, MENA, CIS):** Regional efforts in Europe, Middle East and Central Asia focus on contextualization and co-design of teachers. In the case of the EU countries, the AI tools are being localized in local languages and standards; the Gulf countries in the case of AI aim at personalized learning in line with national STEM objectives; CIS countries in the case of AI to reduce teacher shortages through automated translations and summaries of lessons. General lessons are the need to have multi-stakeholder governance and continual teacher training.

The quantifiable advantages of these examples include, big surveys and project assessments

claim time-savings (in many cases 4-5 hours per week), improved teacher satisfaction, and initial indicators of a positive student performance (using personalized learning analytics). Success factors are also implied by them: the involvement of teachers in co-creation, the focus on ethics in the very beginning, and the re-investment of the saved time to the development of the teachers.

VIII. Challenges and Barriers

There are still significant obstacles even with this promise:

- **Technological Preparedness:** A lot of teachers are poorly prepared. According to a UK study, a majority of teachers expressed that they required additional training and materials in order to make effective use of generative AI [30]. This resembles the results of studies across the globe: in the absence of intended PD, teachers might abuse AI or evade it. This gap in readiness needs to be dealt with through both formal training and informal support (e.g. support communities, online communities, helpdesks).
- **Data Privacy and Security:** Gathering rich data to feed AI (student learning, behaviour, etc.) is dangerous. The breach of school data of high profile has destroyed trust. Schools should come up with data governance policies, and training of teachers should consist of the best practices (consent, encryption, data minimization). The ethics of UNESCO require privacy during the lifecycle of AI [1].
- **Bias in Algorithms:** In case AI is trained on small data, it will be discriminatory against minority students or opinions. As an example, a machine-based evaluation can be programmed to focus on the answers to rote exams, thus underestimating imaginative answers of other cultures. The teachers must be trained to identify these biases. To a certain extent, we should be careful of allowing AI to handle too much, as one scientist cautions, we risk cognitive atrophy - both students and teachers will be without critical thinking skills [7]. This means that there should be various training data and frequent audits.
- **Equity and Access:** As highlighted, the inequality in infrastructure implies that the AI revolution may increase the level of existing inequalities. The urban private schools tend to jump forward as rural government schools face simple connectivity challenges. TPD initiatives otherwise might be urban-based. Interim solutions will be significant to provide low-tech solutions and offline AI tools (such as pre-loaded educational apps).
- **Teacher Well-being and Autonomy:** Other teachers are afraid of being substituted by machines or lose professional judgment. Research and experts in UNESCO highlight that well-being of the teachers is a key ingredient to sustainable AI integration. The PD programs should hence consider the psychological effects, strengthen the expertise of the teachers and make AI only a supplement but not obligatory.

Concisely, the impediments are not technical only but equally cultural and systemic. The battle against them will take time with a long-term policy endorsement and focus on human-centered design.

IX. Future Directions and Suggestions

In order to use the potential of AI in the teacher development process, we propose strategic directions:

- **Integrate AI Literacy into TPD Curricula:** Teacher education (pre-service and in-service) must contain modules about AI: its functionality, ways to evaluate it critically, and ways to deploy AI in pedagogy. This is much more than how to use ChatGPT; it is the struggle with case studies of AI in classrooms, the ethics discussion and practical projects. UNESCO specifically requests AI and data literacy as one of the competencies of the teachers [2], [35].
- **Take a Phased Integration Roadmap:** One of these models proposes 5 stages:

1. *Introduction:* AI-free teachers make independent experiments.
2. *Augmented Research:* Teachers employ AI in information collection (e.g. to create lesson

ideas).

3. *Assisted Planning:* The teachers use AI support in lesson writing and editing.
4. *Collaborative AI:* Classroom students and AI can collaboratively design lessons in real time (e.g., brainstorming conversations).
5. *Creativity Partnership:* AI is a collaborator in classroom assignments, and the teacher is in complete control.

This stepwise process (e.g., described by Laurillard et al. and others) contributes to gaining confidence and evaluating the effect stepwise.

- **Teacher-Led AI Ethics Guidelines:** Policy- School and district schools and districts ought to formulate policies with the help of teachers and parents. As an example, one of the policies could mention that AI will be graded second to the teacher, or that all student information gathered by AI is anonymized right away. Rule-making with educators is highlighted by the multi-stakeholder principle of UNESCO [1].
- **Professional Learning Communities (PLCs) with AI Focus:** Provide AI Experiences in Teacher Community: Support Teacher-teacher community of practice (online and offline). The Elevate program of Microsoft in India aims at two million teacher peer learning communities. These networks will enable teachers to exchange best practices (e.g. fast template examples, student engagement techniques) and create critical AI literacy collaboratively.
- **Companies should continue Research and Evaluation:** Lastly, we suggest longitudinal researches to trace the effects of the AI-based PD in the long run. What are the things that are memorable about AI training? Do student outcomes improve? Strict supervision (qualitative and quantitative) will see what is working. An example is that component analyses can be used to find out which had the greatest pedagogical impact, time saved or peer collaboration.

X. Conclusion

Artificial Intelligence can transform the way teachers learn and teach. As demonstrated in this paper, AI can be used to customize PD, simplify the process of lesson planning and development, and offer meaningful analytics that can be used to guide the instructional process. Nevertheless, human factors determine the success of the technology: educators should be empowered, ethics should be used to design it, and no equity should be violated. The essence of teaching, which is empathy, critical thinking and contextual judgement, should be the purpose of AI, but not its replacement, as pointed out by UNESCO and other professionals. In the future, colleges such as Manohar Memorial College of Education (and others across the world) can become the initiators of this change and integrate the awareness of AI into their educational programs in accordance with the frameworks such as UNESCO (and NEP 2020) and create a culture of reflective practice. In such a way, AI will be able to become a kind of a pedagogical catalyst - accelerating the professional development - even though teachers should remain central to the future of education.

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