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Teaching and learning with AI: a qualitative study on K-12 teachers' use and engagement with artificial intelligence

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Introduction: As artificial intelligence technologies rapidly enter educational settings, teachers find themselves navigating fundamental pedagogical shifts while maintaining professional agency. Despite growing AI adoption in schools, limited research examines how teachers actually experience and shape AI integration within their classroom contexts, especially in the contexts of developing countries. This study investigates teachers' beliefs about AI's educational role, their incorporation patterns, and associated challenges and opportunities.

Methods: Using semi-structured interviews with 20 teachers from two private schools in Delhi, India, the paper employed thematic analysis grounded in an AI Literacy and Ecological Teacher Agency Framework.

Findings/Results: Three key findings emerged: Teachers simultaneously embrace AI's potential to enhance learning and administrative efficiency while expressing deep concerns about student over-dependence and erosion of critical thinking skills. Both teachers and students demonstrate emerging technical AI competencies, but significant gaps in critical evaluation and ethical application remain, revealing a concerning literacy imbalance. Beyond surface-level tool adoption, AI integration fundamentally reshapes teachers' professional beliefs and sense of agency, prompting ongoing renegotiation of their pedagogical identities and classroom authority.

Discussion: The findings demonstrate an urgent need for teacher education that centers the teacher rather than the technology and moves beyond basic technical training to embed critical thinking and ethical reasoning into AI engagement. Parallel to this, policymakers must prioritize collaborative frameworks that position teachers as partners in AI integration design rather than passive recipients of top-down mandates. The paper concludes with a call for future research to examine AI integration across diverse educational contexts to understand how institutional and socioeconomic factors shape teachers' engagement with AI technologies.

KEYWORDS

artificial intelligence (AI), teacher education, teacher agency, digital education, education technology

1 Introduction and context

The rapid proliferation of artificial intelligence (AI) across educational systems worldwide has created significant changes in how teaching and learning occur (Espina-Romero et al., 2023). From administrative automation to personalized learning algorithms, AI technologies promise to revolutionize education by augmenting teacher capabilities, enhancing student engagement, and democratizing access to quality educational resources (Chen et al., 2020; Zhai et al., 2021). However, the integration of these powerful tools into educational practice and classrooms presents complex challenges that require careful examination (Aljemely, 2024). The recent emergence of generative AI tools has introduced capabilities that distinguish them from previous educational technologies in important ways. Unlike traditional educational software like learning management systems that are designed for specific pedagogical or administrative purposes, tools like ChatGPT and Gemini are general-purpose systems that can perform tasks previously requiring independent human cognition: writing essays, solving complex problems, creating lesson plans, and providing instant tutoring support. These capabilities offer significant opportunities for educational innovation while simultaneously presenting complex challenges regarding equity, access, and pedagogical practice. Educators worldwide report needing to adapt their instructional strategies to accommodate AI capabilities, redesigning assignments and assessment methods to promote critical thinking in an AI-enhanced environment (Tan et al., 2025). Given these recent developments, there is an increasing need to understand how teachers are making sense of AI integration in their daily practice. Teachers, as the primary mediators of educational innovation and actions, possess invaluable insights into how AI tools function in practice. While research has examined AI's technical capabilities and potential applications in education (Luckin and Holmes, 2016), there remains a gap in understanding how teachers actually perceive, navigate, and integrate AI tools within their specific contextual realities (Tan et al., 2022) Existing research has generally focused on AI's functionality and potential rather than examining teachers' beliefs about AI's role in education, their practical strategies for incorporation, and their identification of implementation challenges and opportunities (Aljemely, 2024). This gap is particularly pronounced in non-Western educational contexts, where cultural, linguistic, and infrastructural factors may significantly influence AI adoption patterns.

This research need is particularly pronounced in India, where ~248 million students and 9.8 million teachers are navigating the integration of these AI tools into educational practices (National Education Policy, 2020). Within this vast educational landscape, private schools serve ~40% of students and have historically been early adopters of educational technologies, often serving as testing grounds for innovations that later scale to public education systems (Muralidharan and Sundararaman, 2015; Sarin, 2015). It is important to note that private schools in India cater to a wide array of economic classes, ranging from elite international schools serving affluent families to more affordable private institutions accessible to middle-class and lower-middle-class families. This diversity makes private school contexts particularly valuable for understanding AI integration across different socioeconomic strata, as findings can inform broader educational policy and practice. These institutions are operating within a policy environment that is actively encouraging AI adoption. India's National Education Policy (NEP) 2020 explicitly emphasizes the integration of AI curriculum at all educational levels and aims to equip students with skills like digital literacy, coding, and computational thinking. Supporting this policy, government initiatives such as the "AI for All" campaign under Digital India and platforms like DIKSHA, NISHTHA Online, and SWAYAM that provide AI-powered educational solutions have been launched (UNICEF, 2023). The emergence of these initiatives makes it even more critical to understand AI integration from teachers' perspectives, where implementation may unfold in ways that differ from global patterns.

It is in this research and policy context that the present study examines teachers' experiences with AI in private schools in the National Capital Region (NCR) of Delhi. Drawing on the theoretical lenses of AI Literacy Framework (Long and Magerko, 2020; OECD, 2025) and Ecological Teacher Agency Theory (Biesta et al., 2015), which provide complementary perspectives for understanding how teachers develop competencies with AI technologies while navigating the contextual factors that shape their professional practice, this research addresses the overarching question: How are teachers engaging with and responding to the rapid emergence of Artificial Intelligence in education? This broad question is broken down into three sub-questions:

1. What are teachers' perceptions and beliefs about the use of AI in education?
2. How have teachers incorporated AI into their teaching practices?
3. What challenges and opportunities do teachers see AI creating in their classrooms?

Through addressing these questions, this study contributes to a more nuanced understanding of AI integration in educational contexts while informing evidence-based approaches for supporting teachers in navigating the evolving landscape of AI-enhanced education.

2 Literature review

Building on the challenges outlined in the previous section, a growing body of empirical research has examined how teachers perceive, adopt, and implement AI technologies in educational settings. Studies reveal significant variations in teacher attitudes toward AI integration, with factors such as technological confidence, institutional support, and perceived usefulness playing crucial roles in adoption patterns (Trinity College London, 2024). Research shows that while teachers express interest in AI's potential, many report feeling unprepared to effectively integrate these tools into their pedagogical practice (Ayyoub et al., 2025). Similarly, teachers often struggle with understanding how to align AI applications with specific learning objectives, leading to superficial implementation (Jauhiainen and Garagorry Guerra, 2024) These challenges appear to be consistent across diverse educational contexts, from European universities (Cukurova et al., 2024) to Australia (Arantes, 2022), suggesting systemic rather than localized barriers to meaningful AI integration.

However, much of this research approaches AI integration from a technology-centered perspective, emphasizing tool functionality and usage metrics while giving limited attention to how teachers' professional identities, pedagogical beliefs, and contextual knowledge shape their interactions with these technologies. This methodological orientation often treats teachers as end-users of technology rather than as professionals whose expertise and context significantly shape how AI tools function in practice (Uygun, 2024). Recent scholarship has begun to critique this approach, advocating for more teacher-centered research that examines how educators actively negotiate, adapt, and transform AI technologies within their specific professional contexts (Aljemely, 2024). Across studies, teacher training and professional development emerge as critical factors influencing AI adoption, though research reveals significant gaps in the approaches in the status quo. Casal-Otero et al. (2023) and Su et al. (2023a) found that teachers who received comprehensive training programs demonstrated greater confidence and more sophisticated use of AI tools compared to those with minimal preparation. However, another study (Tan et al., 2025) revealed that many professional development initiatives focus primarily on technical skills rather than pedagogical integration, leaving teachers uncertain about meaningful incorporation into their teaching practice. Studies across different educational systems highlight similar patterns, with technical training predominating over pedagogical preparation (Luckin et al., 2022). These findings point to the need for more holistic approaches to teacher preparation that address both technical competencies and pedagogical applications while acknowledging teachers' professional expertise.

The ethical dimensions of AI in education represent another emerging area of inquiry, though research remains limited. Research has found that teachers often feel unprepared to navigate these ethical complexities, particularly regarding student data protection and algorithmic transparency (MIT RAISE, 2024; Kamali et al., 2024). Beyond the "ethics" studies in the United States, Canada, Australia, and the United Kingdom, specific contexts reveal teacher concerns about maintaining educational equity when AI tools may advantage some students over others (Li, 2023). These ethical and equity considerations add another layer of complexity to AI integration that extends beyond technical competency. Recent qualitative research provides deeper insights into teachers' lived experiences with AI technologies, moving beyond survey-based assessments to explore how educators conceptualize and interact with these tools. For example, the study done by Kim (2023), where in-depth interviews were conducted with 30 Chinese educators, revealed that teachers often view AI as a potential collaborative partner rather than as a replacement. Studies across different cultural contexts document how teachers develop unique strategies for integrating AI into their pedagogical practice, often adapting tools in ways not anticipated by developers (Taufikin et al., 2024; Nyaaba and Zhai, 2025). Research from Italian contexts (Toci et al., 2025) demonstrates that successful AI integration often depends on teachers' ability to maintain their pedagogical autonomy while leveraging AI capabilities to enhance rather than replace human instruction. These qualitative insights collectively emphasize the importance of understanding teachers' perspectives and experiences in AI system design and implementation processes.

This growing body of international research contrasts sharply with the limited scholarship available from Indian educational contexts. Despite India's significant investment in educational technology and policy initiatives promoting AI integration, empirical research examining teacher experiences remains sparse. The few available studies suggest complex challenges around infrastructure, training, and institutional support, but lack the depth of qualitative inquiry that characterizes research from other national contexts (Chintha et al., 2024). This research gap is particularly significant given India's unique educational landscape, characterized by disparities in resources, infrastructure, and student populations that may influence how teachers experience and integrate AI technologies in ways that differ from patterns documented in other contexts. With the growing development and funding in AI in education in India, both by the government through initiatives like NEP 2020 and AI for All, and by organizations such as OpenAI establishing educational partnerships (Economic Times, 2024; Debbarma and Kumar, 2024), it is imperative to continue conducting research in Indian contexts that centers teacher experiences and perspectives. This study addresses these gaps by examining teacher experiences with AI integration in private schools within the Delhi National Capital Region, contributing to the understanding of how educators perceive, interact with, and integrate AI technologies within India's unique educational context. The following section outlines the two theoretical frameworks that guide this inquiry and explains how they provide complementary lenses for understanding teachers' experiences with AI integration.

3 Theoretical framework

The integration of artificial intelligence into educational practice represents a multifaceted phenomenon operating across technical, pedagogical, and professional dimensions. To capture this complexity, we employ an integrated theoretical framework combining two complementary perspectives: the AI Literacy Framework (OECD, 2025) and an Ecological Teacher Agency lens (Priestley et al., 2015). This dual framework enables a thorough analysis of both the competency dimensions of AI integration and the deeper professional beliefs and identity considerations that shape teachers' engagement with AI technologies. The selection of these particular frameworks is based on their utility in educational technology research and their capacity to address the specific challenges teachers face when integrating AI tools into their pedagogical practice. Together, these frameworks provide the analytical foundation for understanding how teachers in the study's context navigate the complex landscape of AI adoption while maintaining their professional identity and responding to contextual demands.

3.1 AI literacy framework

The AI Literacy Framework provides a comprehensive understanding of the competencies individuals need to effectively and responsibly engage with artificial intelligence technologies in educational contexts. AI literacy has been defined as "a set of competencies that enables individuals to critically evaluate AI technologies; communicate and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace"

(Long and Magerko, 2020, p. 2). Over the past decade, this framework has become foundational in AI education research and has adapted across diverse educational settings, demonstrating its utility in analyzing both student and teacher AI experiences (Ng et al., 2021; Su et al., 2023a; Casal-Otero et al., 2023). The framework comprises four core competency domains: *Understanding AI* (how systems function, applications, strengths, and limitations), *Using AI* (practical interaction skills such as prompt engineering and tool selection), *Evaluating AI* (critical assessment, fact-checking, and bias identification), and *Ethical AI Engagement* (responsible use, privacy, and fairness). This framework directly addresses challenges faced by teachers, including appropriate usage, digital equity, and responsible engagement. The framework's comprehensive approach allows us to explore multiple layers of AI engagements in the educational space, while addressing teacher concerns about student dependency and unethical use of AI. Recent research has demonstrated the framework's effectiveness in identifying AI literacy gaps and developing targeted interventions (Su et al., 2023a; Kong et al., 2024).

3.2 Ecological teacher agency theory

The Ecological Teacher Agency Theory (Biesta et al., 2015) provides an ecological framework to understand teachers' engagement with AI as an outcome of the dynamic interaction between their professional beliefs and contextual environments. Rather than viewing it as an individual trait, this theory conceptualizes "agency" as an ecological achievement shaped by the interaction of what teachers bring (their beliefs, experiences, and professional identity) to the contextual conditions in which they work (influenced by institutional support, available resources, student needs, and technological infrastructure). Teachers' actions and interactions within specific environments are shaped by the intricate interplay of their personal and professional beliefs as well as their interaction with other actors and contexts situated in their environment (Pantić, 2015). Contextually, this would mean that a teacher's beliefs about AI's educational value interact with environmental factors such as school policies, available training, student demographics, and institutional expectations to shape their overall engagement with AI tools. This lens allows for a deeper investigation of teachers' AI interactions, in the backdrop of their beliefs and contexts. Additionally, an ecological framing of teacher agency also brings into play the inherently temporal nature of agency (Emirbayer and Mische, 1998). Arguing that present-day agency is shaped by past experiences with educational technologies and future aspirations for teaching. This temporal dimension is key as we are engaging with a technology that has just recently become accessible in classrooms, while also having massive potential for future developments.

3.3 Integrated framework for analysis

Together, these frameworks provide a multi-layered analysis of teacher-AI relationships across individual and systemic dimensions. While the AI Literacy Framework offers concrete vocabulary for understanding AI competencies and identifying gaps in understanding, usage patterns, and ethical reasoning, the Ecological Teacher Agency Theory provides conceptual tools for interpreting how teachers' beliefs and contextual environments interact to shape their AI experiences. For this study, the frameworks guided the development of research questions, informed the interview schema design, and provided the analytical lens for data interpretation. At its core, this approach recognizes that successful exploration of AI integration depends on both technical competency development and supporting teachers' professional agency and alignment between their educational values and implementation practices.

4 Methods

This study employed a qualitative descriptive research design to explore teachers' perceptions of and engagement with AI in educational settings. A qualitative approach was selected as most appropriate for investigating the complex, multifaceted phenomenon of AI integration in education, which requires a deep understanding of teachers' lived experiences, contextual factors, and the meaning-making processes that shape their professional practice (Creswell and Poth, 2018). Given that AI integration in education represents a relatively new and evolving phenomenon, particularly in the Indian educational context, an exploratory qualitative approach allows for the identification of emergent themes and insights that might be overlooked by a more rigid methodological approach. This acknowledges that teachers' perceptions and practices regarding AI are shaped by their specific institutional contexts, cultural backgrounds, and professional experiences, making it essential to capture the diversity of perspectives rather than seeking to establish universal patterns or causal relationships. The flexible, exploratory nature of the design allows for examination of both the individual competency dimensions emphasized by the AI Literacy Framework and the ecological, contextual factors central to Ecological Teacher Agency Theory. The following subsections detail the specific procedures for participant selection, data collection, and analysis that operationalize this research design.

4.1 Participants and setting

This study involved 20 elementary and middle school teachers recruited from two private schools in the National Capital Region (NCR) of Delhi, India. Following institutional approval, a call for participation was sent to all teachers in both schools, and the study worked with teachers who volunteered to participate. Participants were required to be teachers at the participating schools, teaching academic subjects, and not working in early childhood education. Detailed demographic information about participants is provided in Supplementary Table A1. The purposeful selection of teachers from these established private institutions provided access to educators who had encountered AI technologies in their professional practice and could offer meaningful insights into the integration challenges and opportunities within well-resourced educational environments.

Both schools are private institutions serving middle and upper-middle-class families in the NCR Delhi region. The schools charge annual tuition fees ranging between ?125,000 and ?165,000 (USD 1,500–2,000) and follow the Central Board of Secondary Education (CBSE) curriculum. Each institution enrolls between 1,200 and 1,400 students and maintains adequate technological infrastructure to support digital learning initiatives. Both schools have been operating for over two decades and are recognized for their academic standards and extracurricular programs. The teaching staff at these institutions typically have access to digital tools, smart classrooms, and administrative support for implementing innovative pedagogical approaches, making them appropriate contexts for examining AI integration experiences among teachers with access to necessary technological resources.

4.2 Data collection

Data were collected through semi-structured interviews conducted with each participant between August and December 2024. Each interview lasted ∼45 min and was conducted in person at the participants' respective schools. All interviews were conducted in English and audio-recorded with participant consent to ensure accurate transcription and analysis. The interviews followed a schema-based approach (Appendix B) using a structured interview protocol designed to capture teachers' experiences with AI in education (see Appendix A). The protocol was organized around five key areas: initial feelings about AI integration, high-point experiences, low-point challenges, impacts on students and teaching practices, implementation challenges, and future orientations. The approach began with broad, open-ended questions allowing teachers to describe their overall experiences with AI, followed by requests for specific positive and negative examples, with interviewers monitoring whether all schema areas had been addressed and asking targeted follow-up questions only when needed for completeness or clarification.

This study was conducted in accordance with established ethical guidelines, with Institutional Review Board (IRB) approval obtained as part of a larger approved study on teacher agency. Prior to each interview, participants provided written informed consent with assurance that participation was voluntary and withdrawal was permitted at any time. Confidentiality and anonymity were maintained through pseudonyms, secure storage of audio recordings on password-protected devices, and immediate de-identification of transcripts. Interviews were scheduled at participants' convenience to avoid disrupting professional responsibilities. All interviews were transcribed verbatim by the research team and checked for accuracy before analysis.

4.3 Data analysis

The interview data were analyzed using thematic analysis following the multi-method approach outlined by Braun and Clarke (2012). This method was selected for its flexibility in identifying, analyzing, and reporting patterns within qualitative data while allowing for both inductive and deductive coding approaches. The analysis was guided by the study's integrated theoretical framework, incorporating concepts from the AI Literacy Framework and Ecological Teacher Agency Theory to provide understanding of teachers' experiences with AI integration. The analysis process began with data familiarization, during which all transcripts were read multiple times by the research team to develop an in-depth understanding of the content and context.

The first-level analysis involved open coding of the initial transcripts to identify emerging themes. These initial codes emerged both inductively from participant responses and were influenced by the study's research questions and theoretical frameworks. A rigorous iterative coding process was employed using constant comparison methods for theme development. The first five transcripts were coded using this open coding approach, with each subsequent transcript allowing for the emergence of new themes not captured in previous coding. When new themes emerged, the research team returned to previously coded transcripts to ensure coverage and consistency. This iterative process continued until a stable codebook was established after the first five transcripts. Following the open coding phase, the emergent codes were logically compiled into three main thematic categories, guided by the study's theoretical frameworks. Specifically, the diverse ways in which teachers engaged with AI tools were informed by our exploratory research question as well as the AI literacy framework that guided the analysis. This framework necessitates a layered understanding of AI engagement, enabling us to distinguish between varying levels of familiarity and use. In parallel, the Ecological Teacher Agency framework introduced the critical dimension of examining teachers' beliefs and capacity while engaging with their environments, a theme central to understanding how individual perceptions shape professional agency and decision-making within evolving technological contexts (Supplementary Table A2).

Following codebook development, a systematic dual-coding approach was implemented. Each remaining transcript was independently coded by two researchers using the established codebook. The research team then compared coding decisions to ensure consistency and resolve any discrepancies through discussion and consensus. This collaborative process maintained high inter-rater reliability while allowing for refinement of theme definitions and boundaries. Regular team meetings were held throughout the coding process to discuss analytical decisions, address emerging patterns, and ensure that interpretations remained grounded in the data while maintaining alignment with the study's research questions and theoretical framework. To enhance the rigor and trustworthiness of the analysis, multiple strategies were employed. These included maintaining an audit trail of analytical decisions, conducting peer debriefing sessions among research team members, and ensuring that interpretations remained grounded in the data. Inter-rater reliability was established through independent coding of a subset of transcripts by two researchers following established protocols for qualitative research (Clarke et al., 2023), achieving an agreement rate of 92%, which exceeds the commonly accepted threshold for qualitative research reliability.

5 Findings

Our analysis identified findings (Supplementary Table A3) based on three themes: (a) Teachers' AI Usage Patterns, (b)

Emerging Challenges in Incorporating AI, and (c) Teacher Perceptions and Beliefs About AI in Education. These themes have been further broken down into sub-themes with illustrative evidence to help us understand the different layers in each of the themes.

5.1 Teachers' AI usage patterns

Through our interviews, teachers demonstrated AI integration across two primary domains of their professional practice: administrative functions and pedagogical activities. Administrative functions, as teachers described, encompassed the institutional and bureaucratic responsibilities that support educational work, including writing reports, managing documentation, handling correspondence, and fulfilling regulatory requirements. Pedagogical activities involved the core work of teaching and learning, including designing instruction, creating educational materials, developing assessments, and facilitating classroom experiences that directly shape student outcomes. Analysis revealed a distinctive pattern: while teachers employed AI for administrative tasks primarily as efficiency tools with straightforward applications, their pedagogical use of AI exhibited significant variation in sophistication, ranging from basic content generation to advanced instructional design that integrated AI capabilities with educational theory and practice. The following findings examine administrative applications first, demonstrating their largely foundational character, before exploring pedagogical applications where teachers displayed both basic and advanced usage patterns with clear distinctions in AI literacy development.

5.1.1 Administrative applications

Teachers frequently used AI to assist with various institutional reporting requirements and formal documentation that consumed significant time and energy. These applications included administrative summaries, progress documentation, institutional compliance materials, letters of recommendation for students, and formal institutional correspondence. Teachers appreciated AI's ability to help structure and articulate routine information in professionally acceptable formats, particularly when these tasks required professional language and standardized formats that many found challenging.

> "*For instance, a teacher might be very good in maths or physics or chemistry…they might not be very good with the, you know, the language or all these work plans or all these nitty gritties where we are asked to make announcements and things, which was…taking so much of time*"
>
> Teacher, History, School B

> "*We cannot write as flawlessly as they generate (for) us, you know, generate the basic content for us. So, yes, we do take help from that.*"
>
> Teacher, English, School A

> "*For reports making…And it's good, you know, sometimes you didn't even know the words, and you see those, and the impact of those words is quite good, while we write the reports. And it's very time-efficient, very quick. Okay, we can make report in 5 minutes…*"
>
> Teacher, Science, School A

Similarly, teachers employed AI for managing routine student-related documentation, including attendance communications, absence summaries, and comprehensive student profiles. Creating student profiles represented a particularly significant application area, as these documents required repetitive work to be done.

> "*So now with the AI tool for us, as English teachers, because we as English teachers, we have loads of other things to look into. So the profile writing, especially when it comes to student profile and subject profile, it has become easier, because we know the traits, and we just ask the AI to develop on it, and then it comes. So that is there.*"
>
> Teacher, English, School B

Despite this diversity in administrative applications, all reported administrative usage remained at basic levels of AI engagement, characterized by straightforward prompts and direct task completion without iterative refinement or sophisticated human-AI collaboration. Teachers consistently described these administrative tasks as "repetitive" and "mundane," emphasizing AI's value for efficiency rather than creative or analytical enhancement of their professional responsibilities.

5.1.2 Basic pedagogical usage

All teachers demonstrated fundamental AI usage for basic day-to-day learning and teaching tasks that required minimal pedagogical sophistication or theoretical integration. These applications generally focused on efficiency and routine content creation rather than explicit innovative instructional design or complex educational planning. Teachers frequently used AI for generating basic teaching materials and elementary lesson planning that supported routine instructional activities. These applications included creating simple PowerPoint presentations, developing basic resource materials, producing elementary teaching aids, and generating initial lesson ideas through straightforward brainstorming sessions. Teachers appreciated AI's ability to quickly produce content for standard classroom needs and overcome creative blocks when planning routine lessons. This process typically involved using simple prompts to generate basic activity suggestions, preliminary lesson outlines, and elementary curriculum content without engaging in iterative refinement, sophisticated design considerations, or complex pedagogical integration.

> "*There are days when only 10 to 12 students are present in a class of 25 to 30 students. So then, what are you supposed to do? You will not sit idle. But you cannot, you cannot go again also with your curriculum. So in that case, I will just open my laptop, I will type the topic, I will tell AI to give me some sort of activity, AI will give me that activity within two to three minutes. Until*

> *the time students are connecting my laptop to the projector, the activity is ready.*"
>
> Teacher, History, School B

> "*So when we…ask the AI to make our lesson plan, we ask along a line, along a certain line, like we need to have the introduction of a lesson plan...we have found that GenAI Tool (Y) gives us loads of activities, along with at times a worksheet with just a single prompt*"
>
> Teacher, English, School B

Similarly, we also see evidence of teachers utilizing AI for creating routine assessment materials, including simple question papers, basic quizzes, and elementary test materials that require minimal pedagogical sophistication. These applications focused on generating straightforward questions and basic evaluation tools without incorporating advanced assessment principles or sophisticated educational measurement considerations. Teachers described using AI to produce standard question formats and routine testing materials that met basic institutional requirements while saving time on repetitive assessment creation tasks.

> "*From the same story, you have to frame a lot of questions. So, when you have to come up with some really good questions with a different structure, I think I have used AI for that.*"
>
> Teacher, English, School A

> "*So, Gamma AI, I really loved. So sometimes it happened that I need to make a PPT, some interesting one. So there is a topic cell. I need to make a PPT, and I didn't have the time. So I just put the topic and there was an awesome PPT came out within 2 or 3 minutes.*"
>
> Teacher, Science, School A

Overall, these basic pedagogical applications were characterized by straightforward prompt usage and direct task completion, focusing primarily on efficiency and content generation rather than pedagogical innovation or sophisticated instructional design. A similar approach was employed to regulate students' use of AI in class or homework. Several teachers stated that they had outrightly banned the use of OpenAI tools to generate written assignments or presentations, while many even shared strategies they employed to detect and curb such use.

5.1.3 Advanced pedagogical usage

While most use cases demonstrated basic AI applications, some moved beyond routine task completion to engage with AI in pedagogically sophisticated ways. These actions integrated AI capabilities with educational theory, employed specialized tools strategically, and designed complex learning experiences that enhanced student engagement and educational outcomes.

a) Using Varied Sources in Sync

Some teachers demonstrated sophisticated integration by using varied AI sources and specialized tools in coordination to create comprehensive learning experiences. This included employing AI-generated 3D models through platforms like Sketchfab to help students explore complex anatomical structures and scientific concepts that were previously limited to two-dimensional representations. Teachers also utilized creative engagement tools like Akinator to enable students to create and animate characters, developing both digital literacy and creative expression simultaneously.

> "*When I am, you know, telling them about some, maybe a skeletal system, maybe parts of flour or whatever, you know, earlier there was a picture, 2D picture, and I used to show them like this, you know, we cannot flip it in the 3D way or something. But, like Sketchfab or these tools, AI tools, we are able to show them even internal structures of the ovary, the ovules… Even the skeletal system in the, you know, in book, only 2D view is there… so I ask them to not just use any AI but the ones that help*"
>
> Teacher, Science, School A

> "*I (tell) every student that once play that Akinator game, so what is there in that, suppose it is asking for that cartoon character, to think any cartoon character in our mind…it will tell you that what you have thought about that… it will tell me that I was thinking about that Snow White, that game is very wonderful for students as it gets them to think critically, what is nice is that students are very enthusiastic about that game also.*"
>
> Teacher, Computer Science, School A

b) Theory and Pedagogy Rooted

From a pedagogy standpoint, we see some instances that demonstrate theory and pedagogy-rooted applications that integrate AI capabilities with established educational frameworks and instructional design principles. This included using AI to develop assessment questions specifically aligned with Bloom's Taxonomy principles, enabling systematic targeting of different cognitive levels in student evaluation. Teachers also employed AI strategically when their own creative resources reached saturation, using sophisticated prompting to generate questions with varied structures and complexity levels that maintained pedagogical rigor. These applications reflected a deep understanding of both AI capabilities and educational theory, requiring teachers to make informed decisions about when and how AI could enhance rather than replace their professional expertise.

> "*So sometimes, as teachers, we are unable to find out the correct word for Bloom's Taxonomy. Okay, for example, whether this question is examined or described, all right, or analyzed. So when you put the correct prompt to GenAI Tool (X) or GenAI Tool (Y), and you write the specific learning outcomes, okay, and then you give the statement… So it automatically, it framed a question for me, and then I evaluated it and used it.*"
>
> Teacher, Social Sciences, School B

> "*The textbook is only referring to all the facts…But they have not provided images or case-based questions. But the board is asking all the case-based questions and all the picture-based*

> *questions. So here to fill that gap… we use GenAI Tool (Y) and GenAI Tool (Z), where we will type the specific topic…give me 10 picture-based questions for feminist movement in US…So the AI will help you in giving all these…chronological sort of questions. And this is something that you don't even find in the question banks."*
>
> Teacher, History, School B

c) Flipped Classrooms and Student-Centered Pedagogy

In extended educational pedagogical discussion, some teachers used AI to support flipped classroom approaches and student-centered pedagogy that fundamentally transformed their instructional methods. This included creating interactive lesson plans and assignments that shifted from traditional lecture-oriented classes to activity-based, participative learning environments where students engaged more actively with content. These applications demonstrated a sophisticated understanding of how AI could serve broader pedagogical philosophies rather than simply completing isolated tasks or tasks that teachers were already participating in.

> *"They at times give their inputs that ma'am, this is the AI tool, please use it and we will integrate it into this thing…Like these days, I am taking a flipped classroom activity where the students need to teach…So the students themselves have prepared their PPT using AI tools."*
>
> *"What happens, English is a subject where we tend to become very teacher-oriented, very much lecture method, but using GenAI Tool (X) or GenAI Tool (Y) is breaking that mould. It's giving us time for the teacher to take a back seat. There are activities which are more student-oriented. So that is the way I think that GenAI Tool is helping do some of these teaching ways."*
>
> Teacher, English, School B

d) Evolving Pedagogy

With the integration of AI, teachers adopted several pedagogical changes and strategies to regulate its use among students and curtail their over-reliance on AI. This included reframing assessments to include questions that generative AI tools could not easily answer, shifting toward more discussion-based or oral formats such as viva assessments, and creating classroom activities that required deeper engagement. One teacher even suggested eliminating the concept of homework altogether to limit the use of AI. While many teachers pushed students to work independently of AI, others taught students to critically edit and engage with the AI-generated content through efficient AI "prompt" engineering. These strategies reflected a broader effort to regain pedagogical agency and reassert the role of the teacher in shaping how, when, and why AI is used in the learning process.

> *"So, in class 8, we have given that they have to go and visit an art museum. Okay. Now, the teacher said, Ma'am, no one will go in this, in this weather, and they will all (use) GenAI Tool (X). Okay. So…in place of that, we have given that you have to go to one of the art museums…wherever you are traveling to, and you take a photograph…of yours, along with the artifact, and then write about it. That's our challenge to them. I don't know if GenAI Tool (X) (can) do that…"*
>
> Teacher, Social Science, School B

5.2 Emerging challenges in incorporating AI

Along with the positive instances, teachers also described several challenges they face in navigating the expanding presence of AI in the classroom, many of which have disrupted established teaching practices and pedagogical relationships.

5.2.1 Changing student-teacher relationship

A central concern was the uncontrolled and often uncritical use of AI tools by students. Teachers reported that this pattern not only undermined authentic learning but also made it increasingly difficult to honestly assess students' actual competencies. With students "*blatantly*" using generative AI to complete assignments, essays, and even test preparation, teachers found it challenging to discern the originality and effort behind the work submitted. This, in turn, constrained their ability to provide targeted feedback or adapt instruction to students' learning needs. Teachers also described the strategies they employed to detect unauthorized use of AI for generating content or completing assignments, as well as the measures they implemented to discourage or prevent such practices.

> *"I do not let them do the question-answer at home...I have told them, if you can use GenAI Tool (X), I can also use it. I will just put and the answer will come and I will match...And I know their language. So, (I tell them) your level I am aware of, what is your level of English, and then, you know, the vocabulary you are using."*
>
> Teacher, Science, School A

Teachers, subsequently, described a growing loss of authority in the classroom, as students increasingly questioned their methods and compared teacher-led instruction to AI-generated content. Students often demanded the use of specific AI tools or asked whether teachers had used AI to prepare lessons. One teacher shared how students began using Google or GenAI Tool (X) on the smart screen without permission, disrupting lessons and making it harder to maintain focus. Students, teachers shared that, would also assume teachers have used AI to prepare classroom content, undermining their legitimacy as instructors. Such a shift in student behavior, coupled with students' increasing fluency in digital tools, made it harder for teachers to establish their credibility and maintain a sense of control over the teaching and learning process.

> *"The moment you ask them any, you know, meaning what they will do, is they just move ahead to the smart board and they start looking for the meaning."*
>
> Teacher, English, School A

> *"So, whenever we give them notes, so they say, you know, this ma'am has taken from AI. Because they don't trust our capabilities, obviously. They think that everything is available on AI, and probably parents are letting them use those."*
>
> Teacher, Social Sciences, School A

5.2.2 Learning to work with AI

Compounding these concerns was the challenge many teachers faced in learning to use AI tools themselves. Teachers admitted that, in most cases, their knowledge of AI was self-taught, acquired informally without institutional guidance or structured training. This lack of professional development left many feeling underprepared to engage with rapidly evolving technologies or to integrate AI meaningfully into their teaching. Some expressed frustration at having to keep pace with students who seemed far more adept at navigating AI tools. Without adequate support, teachers struggled to move beyond basic applications of AI, often limiting its use to administrative or time-saving tasks, rather than leveraging its full pedagogical potential.

> *"Students are very smart. Even more smarter, I would say these days, than teachers. They are very smart. They know everything,...it is tough to keep up with them."*
>
> Teacher, Social Sciences, School A

> *"One challenge, I can say that the challenge is that we need to know that how to ask, what are the pointers, that as a department, we are also making a note that these are the, along these lines, otherwise GenAI Tool (X) is a huge, it's an ocean, and you cannot just dive into the ocean rudderless."*
>
> Teacher, English, School B

Lastly, several teachers described a sense of discomfort around their own growing dependence on AI tools. Some admitted that they no longer engaged in the same level of cognitive effort when completing tasks, noting that the ease of AI had led to a decline in their own reflective thinking. Many teachers expressed concern that regular use of AI was diminishing their writing or reading skills, with one teacher sharing how increased use of AI was impacting her overall capabilities:

> *"At times, I feel that it is actually, you know, impacting my capabilities, because I know that I have to do the task, and it's easier for me to go on the, you know, use any of the AIs and complete my task. It's time-saving, it's easier, it's, I don't need to, you know, put in a lot of efforts. So, what is happening with me is I feel at times I'm just losing out on my capabilities and my talent, because obviously in school we need, we have very stipulated time in which we have to give our task."*
>
> Teacher, English, School A

5.3 Teacher perceptions and beliefs about AI in education

Teachers expressed complex and multifaceted beliefs about AI integration that emerged from their lived experiences navigating AI adoption in educational contexts. These beliefs reflected the dynamic interaction between their established professional identities, current contextual realities, and future educational visions. We saw these beliefs manifest across three distinct orientations: confrontational tensions between AI capabilities and traditional teacher roles, collaborative integration of AI within current educational relationships, and projective opportunities for enhanced educational practice.

5.3.1 Beliefs about educator roles

Teachers articulated layered beliefs about the evolving interplay between their roles as educators and the growing presence of AI in the classroom. They expressed a belief that their professional legitimacy was being increasingly tested in AI-integrated classrooms. They felt that students' growing trust in AI tools over teachers reflected a broader shift in authority and expertise. Many believed that students' ability to independently use AI and their expectations for AI-based instruction were subtly displacing the traditional role of the teacher and almost coming at the cost of "traditional education." This, according to them, posed a challenge not only to classroom control but to their identity as educators. At the same time, teachers conveyed discomfort with how students perceived their own use of AI, particularly when it was assumed that teachers relied on the same tools to generate lesson plans or assessments. For some, preserving their credibility meant consciously avoiding the use of AI in front of students. One teacher explained that maintaining a "*positive image*" of the teacher was essential to maintain the perception that a "*teacher knows.*"

> *"I generally avoid using AI in front of my students. . . this is (important) to you know, foster a belief that the teacher knows what she's teaching."*
>
> Teacher, History, School B

Pushing back in some instances, teachers reported beliefs about their professional roles that positioned their capabilities as distinct from AI functions. Many teachers expressed the view that certain aspects of their work could not be replicated by artificial intelligence. Additionally teachers frequently stated that AI could not provide emotional support to students. They described emotional support as a fundamental component of their teaching role that remained beyond AI's capabilities. Teachers described their ability to understand and assess individual student needs as a unique professional capability. They reported believing that AI could not gauge student needs or provide the responsive adaptation that they considered essential to effective teaching. Interestingly, the conversation about being replaced by AI was one that was not prompted by the interviewers but rather organically offered up by teachers.

> *"See, if my child is hungry, I can understand the child is hungry. AI cannot understand. So, it happens many a times."*
>
> Teacher, English, School A

> *"See, I personally feel AI can never replace teachers... Because teaching is a profession where human touch is needed. Because children... need emotional bonding, they need social skills. Most important, they are here to manage themselves emotionally as well. So, I feel like robots cannot do that."*
>
> Teacher, Mathematics, School A

> *"It can never replace a teacher. It is a helper to the teacher. It is a supporter to the teacher. Teachers... they are upgrading themselves. They are, you know, polishing their way of teaching with the help of AI."*
>
> Teacher, Mathematics, School A

Pulling the two together (the fear and the push back), teachers articulated a dual understanding of their evolving role in AI-integrated classrooms, one that both transcends and complements the functions of AI. While they were clear in distinguishing aspects of teaching that could not be replaced by machines, they also emphasized their responsibility in actively shaping how AI is used within learning environments. Several teachers described themselves as "facilitators" or "educators," uniquely positioned to mediate the limitations of AI and foster more holistic student learning. They viewed the classroom as a critical space where teachers could offer the "intellectual framework" necessary for students to meaningfully engage with content generated by AI:

> *"This is something that you mediate through, or mitigate rather, through, that's where the classroom comes in, that's where teachers are not facilitators... because that is where you provide the intellectual framework and wherewithal... to deal with this sort of... mass generated content..."*
>
> Teacher, Sociology, School B

In these instances, rather than seeing AI as a threat, teachers identified its appropriate use as dependent on their own pedagogical intent and oversight. Positioning AI as a supportive tool rather than a central driver, they described their role as essential in cultivating critical thinking, originality, and ethical engagement with AI. Underlying these views was a broader belief that ethical and effective AI use must be taught by teachers who themselves accept AI's presence and model its responsible application.

5.3.2 Contradictory and complex beliefs on AI and student learning

Teachers expressed nuanced, somewhat contradictory beliefs on AI's role in student learning, reflecting on its positive and negative effects. On the one hand, teachers lauded AI's ability to transform learning for students through visualization and experiential instruction. A consistent belief was that AI has the potential to enrich the learning process by making it more engaging and accessible, and by encouraging students to "think" more. Teachers observed that students were often more motivated when learning through AI-enabled tools and described this shift as a promising development in classroom dynamics.

> *"Students, they have, you know, through the AIs can have the hands-on experience..."*
>
> Teacher, Mathematics, School A

> *"Children, they are able to understand using this simulation, this quizzing, or there are 3D models they are able to visualize it making it better learning..."*
>
> Teacher, Science, School A

On the other hand, teachers, across the board, held a strong belief that AI use, if left unchecked, could diminish students' ability to think critically, write independently, and create meaningfully. Many teachers viewed the increasing dependence on AI for tasks such as essay writing and test preparation as symptomatic of a deeper erosion of student effort and originality.

> *"They just copy down the answers (from AI). They don't even know what is the meaning of that particular word or concept or topic."*
>
> Teacher, Science, School A

> *"You're (students) just blindly copying without anything registering into your head. It serves no purpose. Rather, we should discourage such kind of a homework. There's no point in getting registers filled if the brains are empty."*
>
> Teacher, History, School B

This tension gave rise to nuanced distinctions in teacher perspectives. Some teachers firmly believed that the use of AI did not inherently undermine learning, provided that students continued to engage with their material and used AI tools to support, rather than replace, their thinking. These teachers distinguished between what they called "*cheating*" with AI and "*thinking*" with AI, arguing that ethical and purposeful use of technology could still lead to meaningful learning outcomes. One teacher from School B remarked that concerns around originality long predated AI, suggesting that the more important question was whether "*students (are) doing the work themselves.*" Another teacher from School B explained that students who understood the "*context*" and "*content*" of their subjects could benefit from AI as a supplementary aid.

> *"If you don't know the content, if you don't know the context, then relying on GenAI Tool (X) is actually cheating. GenAI Tool (X) is not there to make your life (easy), make you just someone that you will get away with doing nothing. Even GPT expects you to know your content, know your context... (it) is an aid, it's not the master."*
>
> Teacher, English, School B

5.3.3 Beliefs on AI and education in the future

Building off the conclusion of the previous finding, teachers expressed a forward-looking belief in AI's potential to enhance education, provided students and educators are equipped to use it ethically and thoughtfully. They saw AI not just as a convenience, but as a fundamentally transformative tool that should encourage students to "think with AI" rather than depend on it passively. Many viewed AI as a classroom leveler, particularly for students facing structural disadvantages. Teachers shared examples of children with learning disabilities completing writing tasks more easily, and first-generation learners using AI to access information or write in proficient English. For these teachers, AI was a means to bridge systemic gaps, grounded in the belief that "*tools don't differentiate.*"

> "*Of course, there's a positive change because, you know, everybody has access to it, right? So even if we live in a heterogeneous society, right? These tools don't differentiate, right? Anybody who has internet access and has a device, I mean, basic software you can use.*"
>
> Teacher, History, School B

As part of the interviews, teachers were asked what changes or innovations they would like to see in AI for education. In response, several teachers articulated the belief that, in the future, AI's ability to collate and organize reliable information could significantly enhance academic work, particularly in lesson planning and student research. One teacher envisioned the development of a dedicated, AI-driven information platform for students, one that could provide authentic, subject-specific knowledge to address ongoing gaps in access to quality learning resources. Some teachers also expressed the belief that, moving forward, AI could play a valuable role in alleviating the practical demands of their profession.

> "*I think in the coming future, that's five to 10 years, students will be using more and more of GenAI Tool (X) or other AI-generated websites. Teachers are also going to be using it more often.*"
>
> Teacher, English, School B

> "*I look at AI, at streaming down the research process…so I think that if AI used in the right way it can help us save on our time…If I could just get a good re-crisp reading content on this with examples, something that today I have spent like about an hour today if I could have just done it in 10 minutes. So what will happen is that my time I can spend same 60 minutes but I can spend those 60 minutes in reading about more content.*"
>
> Teacher, History, School B

In the context of the future trajectory of AI in education, teachers consistently expressed the belief that its effective integration will depend on a dual emphasis: an ethical awareness and equitable access, both of which, they argued, must become central priorities for schools and institutions. Many believed that ethical considerations should be foundational to how AI is introduced in classrooms, not only for students but also for educators. Their responses highlighted a perceived gap in training and expertise, particularly in relation to the responsible use of AI across a range of academic tasks. Some teachers recommended the development of formal training initiatives aimed at equipping both teachers and students with the frameworks necessary to engage with AI in a principled and informed manner.

> "*Some type of check or constraint should be there…So, I think AI should have some limitations, safety, and security features.*"
>
> Teacher, Computer Science, School A

> "*I would say we want more access to the paid platforms that are 'secure' and actually good…they would help us leverage our teaching to a higher extent.*"
>
> Teacher, Mathematics, School A

6 Discussion

The findings reveal a rich and complex intertwined set of results that allow us to meaningfully respond to and engage with the research questions guiding this study:

(1) What are teachers' perceptions and beliefs about the use of AI in education?
(2) How have teachers incorporated AI into their teaching practices?
(3) What challenges and opportunities do teachers see AI creating in their classrooms?

Through the lens of Ecological Teacher Agency Theory and the AI Literacy Framework, our analysis reveals that teachers' engagement with AI cannot be understood through simple adoption models or linear implementation processes. Instead, teachers navigate AI integration through dynamic interactions between their professional beliefs, contextual constraints, and evolving understanding/usage of AI capabilities and limitations. The discussion proceeds by examining three interconnected themes that emerged from our analysis: the complex and often contradictory nature of teacher beliefs about AI, the varying levels of AI literacy among both teachers and students, and teachers' pragmatic yet hopeful orientations toward AI's future role in education. These themes collectively demonstrate that effective AI integration in education requires approaches that go beyond technical training to address the deeper professional, pedagogical, and ethical dimensions of teaching with AI.

6.1 Teacher beliefs are complex and contextually situated

Our findings reveal that teachers hold sophisticated yet often contradictory beliefs about AI's role in education (both for them and their students), reflecting what an Ecological perspective of Teacher Agency characterizes as the complex interaction between professional identity (Lindner and Berges,

2020), contextual constraints, and future aspirations. What is important is that, rather than viewing these contradictions as inconsistencies to be resolved, it is important to see them as thoughtful professional responses to the genuine tensions inherent in AI integration. Teachers simultaneously embrace AI as a professional tool (Taufikin et al., 2024) while expressing concerns about its impact on student learning, demonstrating what we interpret as adaptive professional reasoning rather than basic confusion or resistance. For example, the same teachers who praised AI's capacity to enhance their lesson planning expressed deep concerns about students using AI for homework completion. This apparent contradiction reflects teachers' complex understanding of different contexts and purposes for AI use (Kim, 2023), aligned with their professional responsibility to distinguish between AI applications that support their pedagogical goals and those that potentially undermine student learning processes. Drawing on Teacher Agency Theory's ecological framework, these contradictory beliefs emerge from the dynamic interaction between teachers' professional values (emphasizing student growth, critical thinking, and authentic learning) and the contextual realities of AI availability and institutional expectations.

The complexity of teacher beliefs becomes particularly evident when examining how teachers negotiate their professional identity in an AI-enhanced educational environment (Toci et al., 2025). Teachers recognize AI's potential to enhance their professional effectiveness while simultaneously protecting pedagogical processes they believe require human guidance and student effort. This demonstrates what Biesta et al. (2015) describe as the temporal dimensions of agency, where past professional experiences inform current judgments about appropriate AI use, present contextual constraints shape implementation decisions, and future educational visions guide strategic thinking about AI's role in teaching and learning. Particularly significant is teachers' conviction that AI cannot replace their fundamental human qualities as educators (their capacity for care, emotional support, and adaptive response to individual student needs) while simultaneously expressing concerns about how AI challenges their traditional authority as knowledge gatekeepers and learning facilitators. This tension connects to broader questions about professional identity in an AI-enhanced world, where teachers must negotiate between leveraging AI's capabilities and maintaining their sense of professional purpose and relevance.

The key takeaway from complexity and apparent "contradiction" is that supporting teachers in AI integration requires moving beyond basic training on tool usage to actually facilitate critical reflection on professional beliefs and values. Rather than attempting to eliminate contradictory beliefs, professional development should help teachers articulate and navigate these tensions thoughtfully, recognizing that holding multiple perspectives simultaneously may be a sophisticated rather than problematic response to AI's multifaceted impact on education (Luckin et al., 2022). Theoretically, this approach aligns with an ecological agentic approach and its emphasis on supporting teachers' capacity to exercise professional judgment within their specific contexts, rather than prescribing universal solutions that may not account for the diverse challenges and opportunities teachers encounter in their particular educational settings. Furthermore, acknowledging the legitimacy of contradictory beliefs can help teachers develop more nuanced and contextually appropriate approaches to AI integration, moving beyond binary thinking about AI as either beneficial or harmful toward a more sophisticated understanding of when, how, and why different AI applications may be appropriate or problematic in educational contexts.

6.2 Differing levels of AI literacy require targeted educational interventions

Our analysis of how teachers have incorporated AI into their teaching practices (RQ2) reveals an emerging broadly positive movement toward AI literacy development among both teachers and students, though this development occurs at varying paces across competency domains. This finding extends existing literature (Ng et al., 2021; Kong et al., 2024), which emphasizes the need to move beyond basic tool usage toward comprehensive competency development. Drawing on the AI Literacy Framework, we observe uneven progress across domains. Teachers demonstrate an increasingly growing competency and comfort in "Understanding AI." While they are actively exploring tool functionality and appropriate use contexts, they also seek deeper knowledge about AI limitations and capabilities. It is clear that most have developed foundational "Using AI" skills for lesson planning and administrative tasks, progressing from initial hesitancy to confident application. However, "Evaluating AI" development remains inconsistent, particularly in critically assessing outputs for accuracy, bias, and appropriateness. "Ethical AI Engagement" represents the most complex developmental area, where teachers grapple with responsible use principles while recognizing their need for structured guidance to help students develop ethical AI interaction frameworks.

Critically, the distinction between AI usage and comprehensive AI literacy emerges as central to understanding both implementation practices (RQ2) and encountered challenges (RQ3). While students rapidly develop facility with AI-generated content, they unsurprisingly simultaneously learn to question output quality and appropriateness of teacher guidance and material. This progression aligns with Long and Magerko's (2020) conceptualization of AI literacy as encompassing critical evaluation, ethical reasoning, and collaborative human-AI interaction beyond mere technical proficiency. Recent empirical work confirms this complexity in educational contexts (Casal-Otero et al., 2023; Su et al., 2023b). The Framework shows that current AI integration and training efforts are nascent steps in a longer learning process, similar to how students develop other skills.

Additionally, these findings directly respond to the challenges and opportunities teachers identify in AI integration (RQ3) while contributing to the growing literature on effective AI literacy education in K-12 contexts. Similar to broader conversations about digital literacy and media literacy (Hobbs and Moore, 2013; Spante et al., 2018), we argue that while teachers and students demonstrate impressive adaptation to AI tools,

supporting their continued development requires intentional focus on comprehensive learning opportunities. This current organic development, though valuable, would benefit from structured support integrating technical understanding with critical evaluation skills and ethical reasoning frameworks, aligning with recent AI education research recommendations (Su et al., 2023b; Kong et al., 2024). Teacher reflections on student AI usage reveal sophisticated thinking about "appropriate" application of AI capabilities and growing awareness of ethical evaluation needs. This suggests, similar to the last section, that teachers' perceptions and beliefs about AI use (RQ1) are evolving through practical implementation experience. This evolution indicates that effective AI literacy education should build on existing engagement foundations while providing systematic support for advanced competencies in critical analysis and ethical reasoning. Such support must recognize and celebrate the adaptive capacity that teachers and students have demonstrated while providing scaffolding for continued growth (Ng et al., 2021; Long and Magerko, 2020). Given that AI technologies and their educational applications continue evolving rapidly, this approach requires ongoing development (in an almost iterative structure) of adaptive and reflective engagement strategies rather than static and rigid instructional models.

6.3 Pragmatic acceptance and future-oriented AI integration

Teachers' perspectives on the future role of AI in education reveal both implicit and explicit understanding that AI is here to stay, with no possibility of returning to pre-AI educational practices. This recognition, which emerged consistently across interviews when teachers discussed future orientations and opportunities (RQ3), reflects what we interpret as pragmatic acceptance combined with strategic thinking about how to meaningfully use AI's potential while mitigating its risks. Rather than expressing resistance or denial about AI's permanence in education, teachers demonstrated sophisticated forward-thinking about how to integrate AI in ways that align with their pedagogical values and educational goals. This perspective aligns with broader literature on technology adoption in education, which suggests that successful integration occurs when educators move beyond initial resistance to develop strategic approaches for leveraging new technologies, something we see teachers doing actively (Fedewa et al., 2025). Teachers' acceptance of AI's permanence, coupled with their active exploration of beneficial applications, suggests a mature professional response that recognizes both the inevitability and the potential of AI integration in educational contexts. This finding extends recent research on teacher attitudes toward AI in education (Kim, 2023; Chen et al., 2020), which has documented the evolution from initial skepticism to a more nuanced understanding of AI's educational potential.

The complexity of teachers' future orientations becomes particularly evident in their sophisticated thinking about present and future AI applications, demonstrating what an ecological perspective of agency would characterize as the projective dimension of agency (Priestley et al., 2015). Teachers are not merely reacting to current AI capabilities but are actively envisioning how AI might evolve and how their professional practice might adapt accordingly. While acknowledging the challenges AI presents, teachers expressed growing confidence in their ability to guide AI integration in ways that enhance rather than replace human elements of education. Additionally, this evolution aligns with the AI Literacy Framework's conceptualization of developing competency, where initial tool usage gradually expands into more complex and pedagogically integrated applications. Teachers' recognition that AI integration requires ongoing learning and adaptation, rather than one-time training, reflects a sophisticated understanding of AI as an evolving technology that will continue to reshape educational practice. This perspective connects to emerging literature on adaptive expertise in technology integration (Darling-Hammond et al., 2017), suggesting that effective AI adoption requires continuous professional development and reflective practice.

Perhaps most significantly, teachers' future visions reveal prospective movement away from viewing AI solely as a tool for administrative efficiency toward recognizing its potential for enhancing core pedagogical activities. This shift from administrative to instructional applications represents a qualitative change in AI integration that aligns with the AI Literacy Framework's progression from basic usage toward more sophisticated and creative applications. Teachers described exploring AI for differentiated instruction, personalized learning materials, and creative lesson design, suggesting growing confidence in AI's potential to support rather than undermine their professional expertise. This progression mirrors broader patterns in educational technology adoption, where initial adoption for efficiency purposes gradually expands into more pedagogically integrated applications as users develop greater comfort and competency (Koehler and Mishra, 2009). Teachers' evolving relationship with AI also reflects what we interpret as growing recognition of AI as a collaborative tool rather than a replacement or independent technology, aligning with recent research on human-AI collaboration in educational contexts (Holstein and Doroudi, 2022). The fact that teachers are independently moving toward more sophisticated AI applications, despite limited formal training or institutional support, suggests both the intuitive appeal of AI's educational potential and teachers' intrinsic capacity for adaptive innovation. This finding has important implications for professional development and institutional support, suggesting that teachers may benefit more from structured opportunities to explore and reflect on AI applications rather than prescriptive and, in some cases, patronizing training on specific tools or techniques.

7 Limitations

While this study draws on experiences from 20 teachers across two private schools in Delhi's National Capital Region, we need to be cognizant of how this specific context shapes our findings. These institutions, serving middle- and upper-middle-class families, represent educational environments where institutional and technological barriers are relatively minimal. Private schools tend to offer more robust infrastructural support in both academic and technological domains, and they frequently

cater to a demographically privileged student (and teacher) sample, predominantly male, upper-caste, and upper-class (Bagde et al., 2022). This relatively homogenous and resource-rich environment provides a valuable analytical baseline for examining teachers' engagements with AI under optimal conditions. However, the patterns observed in such settings cannot be assumed to hold across more diverse educational contexts. Public schools, rural institutions, and those serving students and educators from socio-economically marginalized backgrounds often operate under significant constraints, including limited digital infrastructure and restricted access to technological resources. These contextual differences are critical for further research enquiry, as they shape not only the feasibility of AI integration but also the pedagogical possibilities and limitations that emerge in its use. Additionally, the small sample size and use of purposive and snowball sampling, while appropriate for exploratory qualitative research, means our findings offer strong context-specific insights rather than broad generalizations about teacher experiences with AI integration. Finally, this study's qualitative approach, while enabling rich contextual understanding, introduces limitations related to researcher interpretation and subjective interview data. Our focus on three specific dimensions of teacher engagement may not capture the full complexity of AI integration experiences. Additionally, the rapidly evolving nature of AI technology means that documented teacher experiences may shift as new tools emerge. Given these constraints, our findings offer strong context-specific insights into AI integration in relatively well-resourced settings rather than universal principles.

8 Conclusion

Within these limitations, our analysis reveals three key insights about teacher engagement with AI integration: Teachers' beliefs about AI are contextually constructed and dynamically evolving rather than fixed dispositions. AI literacy remains unevenly developed, with stronger competencies in understanding and using AI tools but weaker development in evaluation and ethical engagement. Finally, teachers demonstrate pragmatic acceptance of AI as a present educational reality and are actively adapting their practices while looking toward future possibilities. These findings position teachers as active agents in shaping AI's educational role, revealing sophisticated navigation of pedagogical and strategic choices within their contexts. This has important policy implications: AI integration initiatives must move beyond technical training to honor teacher agency and expertise, ensuring that implementation strategies are responsive to diverse institutional contexts rather than applying uniform approaches. Policymakers should prioritize collaborative frameworks that position teachers as "agents of change" (Pantić, 2015) whose interaction with AI informs, shapes, and propels AI integration, emerging from teacher-led adoption and implementation. Additionally, as teacher training programs for AI and generative AI use in classrooms become more prevalent, it will be important to evaluate not only the quality of these training programs, but also whether they are accessible to all teachers or limited to a select few.

Building off the policy recommendations, future research must address this study's limitations through comparative investigations across diverse educational settings. Critical next steps include longitudinal studies tracking AI integration trajectories, mixed methods studies that combine qualitative insights with quantitative measures of implementation outcomes, comparative analyses between public and private institutions, examinations of resource-constrained environments, and investigations that simultaneously collect and analyze both student and teacher voices to understand the relational dynamics of AI integration. Such research requires participatory methodologies that position teachers as co-researchers, ensuring that AI integration frameworks emerge from diverse educational realities rather than assumptions derived from privileged contexts. This study offers these insights not as a final definitive set of conclusions but as an urgent call for deeper exploration of how teachers navigate AI's evolving role across diverse educational contexts.

Data availability statement

The raw (anonymised) data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Monk Prayogshala Institutional Review Board (IRB) for a lager study, under which this was a part. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

TT: Project administration, Writing – original draft, Conceptualization, Writing – review & editing, Supervision, Methodology. SS: Writing – review & editing, Writing – original draft, Data curation, Formal analysis. VS: Writing – review & editing, Investigation, Data curation. PB: Writing – review & editing, Funding acquisition, Project administration, Validation. CR: Supervision, Funding acquisition, Writing – review & editing, Project administration.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that Gen AI was used in the creation of this manuscript. We also acknowledge the use of generative AI tool (Claude Sonnet 4) to assist with proofreading and refining the clarity of the written content.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2025.1651217/full#supplementary-material

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