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Not peer-reviewed version

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Posted Date: 9 April 2026

doi: 10.20944/preprints202604.0660.v1

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Article

AI-Mediated Teaching in K–12 Classrooms

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Abstract

This qualitative study investigates how AI applications that support or replace instructional tasks influence teachers’ professional judgment, cognitive load management, and sense of agency. Drawing on interviews with 23 high school teachers from multiple countries using diverse AI platforms, the study explores teachers’ lived experiences of working in AI-mediated environments. Data were analyzed thematically using Cognitive Load Theory (CLT) as an analytical lens to examine shifts in intrinsic, extraneous, and germane cognitive load. The findings indicate that while AI tools reduce workload and streamline planning and assessment, they also displace diagnostic reasoning, instructional sequencing, and evaluative judgment. Teacher agency persists but becomes conditional, shaped by institutional pressures, algorithmic opacity, and professional confidence. Ethical and equity concerns related to transparency and authority emerged as everyday cognitive and emotional challenges. By extending CLT to teachers’ work, the study highlights the need for AI integration that preserves reflective practice, professional judgment, and sustainable teacher agency.

Keywords: AI in education; teacher expertise; cognitive load theory; professional agency; AI-mediated teaching

Introduction

AI has rapidly shifted from a peripheral innovation to an infrastructural presence in contemporary education. Adaptive learning platforms, intelligent tutoring systems, and generative AI applications are now embedded in everyday classroom practice, reshaping how teaching and learning are organized across diverse educational systems (Holmes et al., 2019; Zawacki-Richter et al., 2019). These technologies are frequently presented as solutions to persistent challenges such as increasing teacher workload, learner heterogeneity, and demands for efficiency and accountability. As a result, AI is often framed as a technical response to structural problems in education. Yet alongside these promises, a growing body of scholarship has begun to interrogate what may be lost when core instructional decisions are increasingly delegated to algorithmic systems.

Existing research on AI in education has largely concentrated on student outcomes, system performance, and patterns of adoption. Studies demonstrate that intelligent tutoring systems and adaptive platforms can enhance learning by diagnosing misconceptions, adjusting task difficulty, and providing immediate feedback (Aleven et al., 2016; VanLehn, 2016). Recent work on generative AI highlights its potential to reduce routine workload and support lesson planning and assessment design (Mollick & Mollick, 2022). While these contributions are valuable, they tend to position teachers as implementers, supervisors, or beneficiaries of AI rather than as cognitive professionals whose expertise, judgment, and identity are actively reshaped by sustained engagement with these technologies. Consequently, relatively little empirical attention has been paid to how AI transforms the cognitive work of teaching itself (Author, 2026a).

Teaching is not merely the execution of instructional tasks. It is a cognitively intensive professional practice grounded in expert judgment, interpretive reasoning, and reflective decision making developed through experience (Shulman, 1986; Berliner, 2004). Teachers continuously

manage instructional complexity by diagnosing student understanding, sequencing content, adapting explanations, and generating feedback in response to contextual cues. These practices require ongoing management of cognitive load, not only for learners but also for teachers themselves. CLT has long demonstrated that effective instruction depends on balancing intrinsic load, reducing extraneous load, and fostering germane load that supports schema construction and deep learning (Sweller, 1988; Sweller et al., 2011; Rind, 2026). Traditionally, teachers have been central to this orchestration.

The integration of AI fundamentally alters this cognitive ecology. Adaptive systems increasingly determine pacing and sequencing, analytics dashboards identify learning gaps, generative tools produce lesson plans and feedback, and virtual simulations replace physical experimentation. While these systems may reduce extraneous demands and support instructional clarity, they also assume responsibility for cognitive processes that have historically contributed to the development and exercise of teaching expertise. Scholars have therefore raised concerns about pedagogical deskilling, diminished professional autonomy, and the erosion of reflective practice when instructional judgment is embedded in algorithmic logic rather than human reasoning (Luckin & Holmes, 2016; Selwyn, 2019; Perrotta & Selwyn, 2020; Rind, 2026).

At the same time, the implications of AI for teaching are neither uniform nor deterministic. Emerging research suggests that teachers can appropriate AI tools in ways that preserve professional agency, particularly when they critically reinterpret algorithmic outputs rather than accepting them uncritically (Selwyn et al., 2023; Frøsig & Romero, 2024). These findings underscore the importance of examining not only whether AI is used, but how it is integrated into everyday professional practice and how it reshapes cognitive engagement over time.

Despite these advances, significant gaps remain in literature. First, there is a lack of empirical studies that focus explicitly on teachers' cognitive and professional experiences of working with AI across multiple platforms and contexts. Second, while CLT is widely applied to student learning and instructional design, it has rarely been used to analyze how AI redistributes cognitive responsibilities within teaching itself. Third, ethical and equity concerns related to algorithmic opacity, authority, and surveillance are often discussed at the policy level (Rind, 2026), but insufficient attention has been given to how these issues manifest as cognitive and emotional pressures in teachers' daily work (Williamson & Piattoeva, 2019; OECD, 2024).

This study addresses these gaps by examining how AI applications that support or replace instructional tasks influence teachers' professional expertise, cognitive engagement, and sense of agency. Drawing on qualitative interviews with teachers from multiple countries who use a range of AI platforms, the study foregrounds teachers' lived experiences of working within AI-mediated instructional environments. CLT is employed as an analytical lens to examine how intrinsic, extraneous, and germane cognitive loads are redistributed when instructional judgment, sequencing, feedback, and assessment are increasingly mediated by algorithms.

By centering teachers' voices, the study makes three contributions. First, it provides empirically grounded insights into how pedagogical deskilling unfolds as a gradual cognitive process rather than an immediate loss of competence. Second, it extends CLT beyond its traditional application to student learning by illuminating how AI reshapes teachers' own cognitive work and professional development. Third, it integrates ethical and equity concerns into a cognitive framework, demonstrating how issues of opacity, algorithmic authority, and institutional pressure shape professional judgment and agency in everyday teaching practice. Guided by these aims, the study addresses the following research questions:

1. How has the use of AI-enabled tools altered teachers' roles in managing intrinsic, extraneous, and germane cognitive loads?
2. In what ways does AI integration support or undermine teachers' professional expertise, instructional judgment, and reflective practice?
3. How do teachers experience changes in professional agencies, identity, and emotional engagement when instructional tasks are increasingly mediated by AI systems?

4. What ethical and equity-related tensions emerge when cognitive responsibilities shift from teachers to algorithms, and how do these tensions shape teachers' cognitive and professional experiences?

2. Literature Review

The growing presence of AI in education has generated an expanding body of research examining its implications for teaching and learning. Early studies largely focused on the technical capabilities of AI systems and their potential to improve student outcomes through personalization, automation, and scalability (Holmes et al., 2019; Zawacki-Richter et al., 2019). Intelligent tutoring systems, adaptive platforms, and automated feedback tools have been shown to support learning by diagnosing misconceptions, adjusting task difficulty, and providing immediate responses to student input (Aleven et al., 2016; VanLehn, 2016). These findings have contributed to a dominant narrative that frames AI as an efficiency-enhancing solution to instructional complexity and teacher workload.

More recent scholarship, however, has begun to problematize this instrumental framing by examining how AI reshapes pedagogical relationships, professional roles, and educational governance. Critics argue that AI systems embed particular assumptions about learning, efficiency, and control that may narrow pedagogical possibilities and standardize instructional practice (Selwyn, 2019; Perrotta & Selwyn, 2020). From this perspective, AI is not merely a neutral tool but a sociotechnical system that redistributes authority and decision making within classrooms. This shift has raised concerns about pedagogical deskilling, where instructional judgment and professional expertise are gradually displaced by algorithmic processes (Luckin & Holmes, 2016; Soomro et al. 2025).

Central to these concerns is the recognition that teaching is a cognitively demanding profession grounded in expert judgment and reflective practice. Research on teacher cognition emphasizes that expertise develops through sustained engagement with instructional design, diagnostic reasoning, and adaptive decision making in response to learners and contexts (Shulman, 1986; Berliner, 2004; Rind, 2016a). These practices are not reducible to routine execution but involve continuous interpretation, uncertainty management, and professional learning. When AI systems assume responsibility for sequencing content, diagnosing readiness, or generating feedback, they intervene directly in the cognitive processes through which teachers construct and refine expertise.

CLT provides a valuable framework for analyzing these transformations because it foregrounds the cognitive architecture underlying instructional design and learning. CLT distinguishes among intrinsic load, which reflects the inherent complexity of tasks, extraneous load, which arises from unnecessary or poorly designed demands, and germane load, which supports schema construction and deep learning (Sweller, 1988; Sweller et al., 2011). Traditionally, teachers have played a central role in managing these loads through pedagogical content knowledge and contextual judgment. Effective instruction requires not only reducing extraneous load but also calibrating intrinsic load and deliberately fostering germane engagement (Kirschner et al., 2006; Paas & Sweller, 2014).

AI-enabled instructional systems increasingly automate aspects of this cognitive orchestration. Adaptive platforms such as intelligent tutoring systems dynamically adjust task difficulty and pacing, thereby managing intrinsic load through algorithmic sequencing (Aleven et al., 2016; VanLehn, 2016). Generative tools automate lesson planning, assessment design, and feedback generation, substantially reducing extraneous cognitive demands associated with preparation and evaluation (Mollick & Mollick, 2022). While these affordances can enhance efficiency and consistency, they also risk constraining teachers' engagement with the very cognitive activities that sustain professional expertise.

Research on instructional design highlights that planning and assessment are not peripheral tasks but sites of professional reasoning where teachers integrate knowledge of content, learners, and context (Clark & Mayer, 2016). When these tasks become template-driven or automated, opportunities for reflective judgment and creative problem solving may diminish (Rind, 2026; 2016a). Empirical studies on automated feedback and writing support tools suggest that while such systems

improve surface-level performance, they may also encourage mechanical engagement when not mediated by teacher interpretation (Rind & Ning, 2020; Fitria, 2021; Zhai & Ma, 2022). These findings align with broader concerns that AI may reduce germane cognitive engagement by short-circuiting reflective processes.

In science education, virtual laboratory platforms illustrate similar tensions. Simulations can reduce intrinsic load by visualizing complex processes and providing safe environments for experimentation, thereby expanding access to scientific learning (Graesser et al., 2005). However, research on expert performance emphasizes that procedural knowledge and diagnostic skill develop through engagement with error, failure, and uncertainty, conditions often minimized in virtual environments (Berliner, 2004). Without deliberate teacher mediation, reliance on simulations may therefore weaken both student and teacher engagement with the epistemic practices of science.

Beyond cognitive considerations, scholars have increasingly emphasized the ethical and governance dimensions of AI in education. Algorithmic opacity, data-driven surveillance, and platform-based accountability systems raise concerns about transparency, fairness, and professional autonomy (Williamson & Piattoeva, 2019; OECD, 2024). These issues are often discussed at the policy level, yet emerging research suggests that they also manifest as cognitive and emotional burdens for educators who must interpret algorithmic outputs without insight into underlying logic (Gillani et al., 2023). Such conditions may increase extraneous cognitive load for teachers, complicating instructional decision making rather than simplifying it (Rind, 2026).

At the same time, recent studies caution against deterministic interpretations of AI's impact on teaching. Evidence suggests that teachers can exercise agency by critically engaging with AI systems, selectively adopting recommendations, and reasserting professional judgment in instructional decisions (Selwyn et al., 2023; Frøsig & Romero, 2024). These findings point toward the possibility of hybrid intelligence, where human and algorithmic cognition complement rather than replace one another. However, sustaining such arrangements requires institutional support and professional cultures that value reflective practice over speed and compliance.

Despite these developments, important gaps remain in literature. Empirical studies that examine teachers' cognitive and professional experiences of working with AI across multiple platforms and contexts are still limited. Moreover, while CLT has been widely applied to student learning and instructional materials, it has rarely been used to analyze how AI redistributes cognitive responsibilities within teaching itself. Ethical and equity concerns are frequently treated as external policy issues rather than as integral to the cognitive conditions of professional practice.

This study responds to these gaps by foregrounding teachers' experiences of AI-mediated instruction and applying CLT to examine how intrinsic, extraneous, and germane cognitive loads are reconfigured in teaching. By focusing on teachers rather than systems or outcomes alone, the study contributes to a more comprehensive understanding of how AI reshapes professional expertise, agency, and identity. In doing so, it moves beyond efficiency-centered narratives and situates AI integration within the cognitive and ethical foundations of teaching practice.

3. Methodology

We adopted a qualitative research methodology to examine how the use of AI applications to support or replace instructional tasks reshapes teachers' professional expertise, cognitive engagement, and sense of agency. A qualitative approach was particularly suited to the aims of the study because it allowed for in-depth exploration of teachers' lived experiences, professional judgments, and reflective interpretations of working in AI-mediated instructional environments. Rather than seeking causal generalization, the study aimed to generate analytically rich insights into how teachers make sense of changes in their cognitive work and professional roles, an approach consistent with interpretivist traditions in educational research (Creswell & Poth, 2018; Tisdell, Merriam, & Stuckey-Peyrot, 2025).

The study was guided by an interpretivist epistemological stance, which assumes that professional expertise, cognition, and identity are socially constructed and contextually situated

(Rind, 2016b). From this perspective, teachers' accounts of working with AI systems were treated as meaningful narratives through which participants articulated how instructional judgment, cognitive effort, and professional meaning were being reconfigured. This stance aligns with established research on teacher cognition, which emphasizes that professional knowledge is revealed through reflection on practice rather than through observable behavior alone (Kelchtermans, 2009; Borg, 2015; Ning, et al., 2020).

Participants were recruited using a snowball sampling strategy. At the outset of the study, we were aware that AI tools were being adopted unevenly across schools and contexts, but it was not possible to identify in advance which teachers were actively using specific AI applications in sustained instructional practice. Snowball sampling was therefore selected as a pragmatic and theoretically appropriate approach for accessing information-rich participants within a partially visible population (Patton, 2015). The recruitment process began with two high school English language teachers in Dubai who were known to be using MagicSchool AI. Through their professional networks, we were subsequently connected with additional teachers within the same school, including one more English language teacher and one science teacher. Two of these participants were actively engaged in international teacher communities using similar AI tools and facilitated contact with colleagues in other countries.

Through successive referrals, we reached to 23 high school teachers from diverse educational contexts across five countries: the United States, the United Arab Emirates, Egypt, the United Kingdom, and Bahrain. Participants taught mathematics, science (including physics and chemistry), and language subjects in both private and community school settings. The sample comprised male (56%) and female teachers with sustained experience using AI-enabled instructional tools in their everyday teaching practice. Specifically, five mathematics teachers from the United States reported using Khanmigo; seven science teachers from the UAE, Egypt, and the UK used Century Tech; five science teachers from Bahrain and the United States employed Labster for virtual laboratory instruction; four science teachers from the United States used Brisk Teaching for assessment and feedback; and four teachers from the UAE (three language teachers and one science teacher) reported regular use of MagicSchool AI for lesson planning and instructional design. To ensure confidentiality, all participants were assigned pseudonyms, and identifying institutional details were anonymized (See Annex-1 for participants details).

Data were collected through semi-structured interviews, which enabled participants to describe their experiences in depth while allowing the researchers to pursue emerging themes related to cognition, expertise, and professional identity. Nineteen interviews were conducted online using video conferencing platforms, while four interviews were conducted face to face with teachers based in Dubai. Interviews ranged from 45 to 70 minutes, with an average duration of approximately 55 minutes. All interviews were conducted in English, audio recorded with participants' informed consent, and transcribed verbatim for analysis.

The interview protocol was designed to elicit detailed accounts of how teachers used AI tools in their everyday instructional practice. Participants were asked to describe the specific AI applications they used, the instructional tasks supported or replaced by these tools, and how AI use influenced planning, assessment, classroom interaction, and professional judgment. Teachers were encouraged to provide concrete examples and to reflect on both the benefits and challenges of AI-supported work. The semi-structured format allowed interviews to remain flexible and responsive, particularly as participants introduced unanticipated issues related to cognitive effort, emotional engagement, and professional identity.

An important methodological consideration involved our initial limited operational familiarity with the full range of AI platforms used by participants. Although we were broadly familiar with AI in education, we did not possess detailed hands-on experience with every software system reported by teachers. As a result, a substantial portion of several interviews was devoted to participants explaining the functionality, dashboards, and automated features of the tools they used. While this extended interview time, it proved methodologically valuable by revealing how teachers themselves

understood and interpreted AI systems. These explanations provided insight into which functions teachers perceived as most influential and how they conceptualized shifts in instructional responsibility and cognitive effort.

Given that participants were using a variety of AI applications with different instructional functions, we undertook an additional analytic step to systematically document the characteristics of these tools. Based on teachers’ interview accounts, a comparative table was constructed summarizing the AI platforms reported by participants (see Table 1). This table was developed inductively from participants’ descriptions rather than from platform documentation or marketing materials. This approach ensured that the categorization reflected teachers’ lived experiences of AI use rather than assumed system capabilities. The table also supported the analytic application of CLT by clarifying how different AI systems redistributed intrinsic, extraneous, and germane cognitive demands within teaching practice.

Table 1. AI platforms used by participants and their implications for teacher roles and cognitive load.

AI Software / Platform	Typical grade levels used	Where used	How It Helps in Teaching (Description)	Traditional Teacher Role Replaced / Altered	Cognitive Load Addressed (from CLT)	Impact on Teachers' Cognitive Development and Expertise
Khanmigo (Khan Academy)	K-12	Oklahoma & Michigan USA	Provides guided tutoring, personalized explanations, and adaptive questioning across multiple subjects.	Takes over scaffolding and sequencing decisions, diagnosing readiness and adjusting difficulty.	Intrinsic Load (scaffolds complexity by sequencing tasks); partly Germane Load when prompting reflection, though risks oversimplification.	Erodes diagnostic reasoning, teachers engage less in calibrating task complexity and lose reflective practice in pacing and scaffolding. Over time, schema-building in instructional design declines.
MagicSchool AI	K-12	Private School, Dubai (UAE)	Generates lesson plans, assessments, rubrics, and IEPs aligned to standards.	Replaces lesson planning and curriculum design, traditionally based on teacher judgment.	Extraneous Load (reduces design burden on teacher); potential reduction of Germane Load if over-automated planning limits reflective practice.	Reduces pedagogical creativity and design fluency. Teachers depend on templates instead of constructing learning sequences, weakening their expertise in instructional design and curriculum judgment.
Brisk Teaching	K-12	Private schools of Texas & Wisconsin, USA	Integrates with Google Docs/Classroom for AI-generated grading, rubrics, and feedback.	Automates evaluation and feedback, a cognitively demanding teacher function.	Extraneous Load (streamlines grading and feedback); may weaken Germane Load by replacing reflective teacher commentary.	Teachers' evaluative cognition deteriorates; less practice in interpreting student misconceptions and linking assessment with pedagogy. Encourages mechanical rather than reflective feedback habits.

Century Tech	K12	Private school of Dubai, UAE Private school of Cairo, Egypt Community School of Basingstoke, UK Primary School of Southampton, UK	Adaptive platform that tailors instruction and identifies learning gaps using analytics.	Takes over diagnostic and remedial instruction.	Intrinsic Load (personalized pacing); may increase Extraneous Load if opaque or data-heavy.	Teachers' diagnostic reasoning and data interpretation autonomy decline; dependence on algorithmic dashboards diminishes reflective instructional judgment.
Labster	K12	Two High Schools of California, USA	Simulates virtual science labs for safe experimentation.	Replaces lab and demonstration supervision.	Intrinsic Load (manages task complexity safely); potential Germane Load gain through interactive visualization.	Can enhance teachers' conceptual visualization skills if co-used reflectively; otherwise, risk of reduced procedural expertise and hands-on diagnostic ability.

Data analysis followed an inductive thematic analysis approach (Braun & Clarke, 2006). Transcripts were read repeatedly to develop familiarity with the data, after which initial open codes were generated focusing on descriptions of AI use, cognitive effort, instructional judgment, emotional responses, and professional identity. Codes were iteratively compared across transcripts and gradually clustered into broader categories. Through successive rounds of refinement, higher-order themes were developed that captured shared patterns and meaningful contrasts across participants and AI platforms. Analytic memo writing was used throughout the process to document emerging interpretations and to support reflexive engagement with the data.

Ethical considerations were addressed throughout the study. Ethical approval was obtained prior to data collection, and all participants provided informed consent. Participants were assured that their identities and institutional affiliations would remain confidential and that they could withdraw from the study at any time without consequence. Pseudonyms were used in all transcripts and reports and identifying details of schools were anonymized. Given the sensitivity of discussing professional competence and reliance on AI systems, the study was framed as exploratory rather than evaluative, emphasizing understanding rather than judgment.

4. Findings

The findings are organized thematically to reflect recurring patterns in participants' experiences, perceptions, and practices related to the use of AI-enabled tools in their teaching. Themes were generated through an iterative coding process and are grounded directly in the interview data, with illustrative excerpts used to capture the diversity and depth of participants' perspectives. The chapter focuses on describing these patterns as they emerged from the data, without interpretive framing, which is taken up in the subsequent discussion chapter.

4.1. Automation and the Loss of Instructional Judgment

Teachers across contexts spoke about how AI platforms had begun to take over key instructional decisions that once required professional judgment. The shift was most visible among users of Khanmigo and Century Tech, where adaptive algorithms determine task sequence, difficulty, and feedback pacing. James, a mathematics teacher from Oklahoma, explains "when are my students ready for the next topic is now determined by it (Khanmigo) [...] At first, it seemed wonderful. But I start realizing that I am not really reading students' confusions the way I used to. Now there is a system that reads it all for me." John, another maths teacher from Michigan added, "I used to spend hours planning the order of topics and predicting where they would struggle. Now Khanmigo does that in seconds, and I just monitor progress. [...] It is efficient, but I feel my own diagnostic muscles getting weaker."

These reflections illustrate what emerged as a shared sense of pedagogical deskilling. Teachers recognized that Khanmigo successfully managed intrinsic load by sequencing content and adjusting difficulty, yet in doing so, it removed the need for teachers to perform those cognitive calibrations themselves. Over time, this seemed to weaken the schema-building processes that underpin instructional expertise.

Teachers using Century Tech echoed similar experiences. The software's analytics dashboards and automated recommendations simplified instructional complexity but also displaced teacher interpretation. Layla, a science teacher from Cairo, explains this "When I open the dashboard, I see every student's gaps, but I no longer must find those gaps myself. The system shows me, and I just follow what it suggests." While such systems reduced the cognitive burden associated with diagnosing readiness and scaffolding learning, they also limited teachers' reflective engagement. One participant described this as "teaching by dashboard," noting that constant reliance on algorithmic indicators narrowed her ability to interpret student understanding through observation and dialogue.

The pattern was consistent across other tools. MagicSchool AI, used for lesson planning and rubric generation, appeared to reduce the extraneous load of planning but at the cost of germane cognitive engagement. “This (MagicSchool) saves me hours,” said Hassan, a Dubai language teacher. “But when it gives a full lesson plan, I just fill in my name and class. It looks perfect, but it is not mine anymore.” Sama, another language teacher from same school added, “It feels like the software plans for me, not with me [...] I spend less time thinking about how the lesson connects to what students already know.” This shift, as several participants noted, made lesson preparation faster but less intellectually demanding. Teachers described feeling detached from the creative and analytical thought that once shaped curriculum design, suggesting a slow erosion of pedagogical design fluency.

Teachers using Brisk Teaching reported a similar trade-off in assessment. The system’s automatic grading and feedback features simplified evaluation, but many felt it replaced the interpretive reasoning that once connected assessment to learning. “It (Brisk) gives me comments like ‘good use of evidence’ or ‘expand your argument,’” said Mona, a science teacher from Texas. “The problem is, I don’t always know why it wrote that, and students think the comment is mine.” Deanna, a science teacher from Wisconsin added, “After a few weeks I stopped reviewing each essay. I just checked the grades it (Brisk) gave [...] It is scary how quickly you stop practicing the skill of feedback.” These narratives underscore how automation diminishes reflective and evaluative cognition. Teachers no longer need to interpret misconceptions or link assessment back to instruction, leading to more mechanical feedback practices (Rind, 2022).

In science subjects, teachers using Labster described a subtler but equally important shift. The platform’s immersive simulations managed complex lab procedures safely, thus reducing intrinsic load, but teachers felt that this automation weakened their procedural and diagnostic expertise. “Students love the virtual experiments,” said Adil, a Bahraini chemistry teacher. “But when a real burner or pipette is in their hand, they panic [...] I realize I also stopped demonstrating small errors, because this (Labster) never makes mistakes.” Asim, a physics teacher from the same school said, “I used to explain why an experiment fails [...] Now, in this (Labster) simulation, nothing fails [...] such perfection makes my teaching easier but less real.”

Teachers’ comments across platforms point to a cognitive trade-off: AI systems successfully simplify tasks and manage cognitive load, yet they remove the iterative reasoning and uncertainty through which teachers build professional insight (Ambady, 2025). The more the software optimizes the process, the less opportunity remains for the teacher to engage in reflective decision-making, the core of instructional judgment (Gerlich, 2025). Several participants summarized this paradox succinctly. For example, Sara, a UK science teacher using Century Tech, maintains “AI keeps me efficient but makes me shallow, [...] I do not get tired anymore, but I do not grow either.”

The data therefore reveal a deep professional concern: teachers gain convenience at the expense of cognitive depth. They are relieved of some burdens but also deprived of the learning that comes from wrestling with complexity. Across contexts, participants felt their expertise was slowly being reshaped, from designers and diagnosticians to monitors and implementers of algorithmic logic.

4.2. Cognitive Relief and Emotional Strain

Teachers often described AI as offering immediate relief from their heavy workload. Automated planning, grading, and feedback systems reduced repetitive effort and gave teachers what they called “mental breathing space”. Yet beneath this relief lay a quieter unease. They spoke of feeling detached from the deeper cognitive processes that once defined their practice, producing a tension between efficiency and expertise, comfort and meaning.

4.2.1. Relief from Cognitive Overload

Across contexts, teachers valued AI’s capacity to minimize routine cognitive effort. For many, MagicSchool AI functioned like a personal assistant that produced entire units or assessment rubrics in seconds. For example, Hassan, highlighted “Before, I would spend evenings designing lesson

flows and activities [...] Now I type a few prompts, and it (MagicSchool) gives me a full plan aligned to outcomes. It feels like my mind can finally rest.”. This quote shows that teachers effectively reduce extraneous load for students by removing the labor of formatting and aligning materials through automation. At the same time, it also dulled their reflective thinking which is required to adapt lessons to their own students in a particular context. Aisha, another language teacher from Dubai said “It’s (use of MagicSchool) freeing, but sometimes I realize I’ve accepted the plan without thinking [...] The AI gives me something neat, and I don’t feel like challenge it.” Such accounts suggest that while AI alleviates surface-level cognitive stress, it risks narrowing opportunities for germane processing, the deeper effort through which teachers refine pedagogical judgment (Gerlich, 2025).

4.2.2. From Efficiency to Emptiness

Teachers using Brisk Teaching shared similar experiences with grading and feedback automation. The system streamlined evaluation and released them from the exhaustion of repetitive commenting. “After a long day, it (Brisk) feels like a lifesaver,” said Mona. “It grades essays fast and gives comments students can read right away. My evenings used to vanish in grading; now I can breathe”. However, other teachers found that efficiency produced its own emotional discomfort. The feedback sounded professional but felt impersonal. For example, Elena, a Wisconsin science teacher, highlighted “Students still come to me with questions [...] I read what Brisk wrote and realize it doesn’t sound like me [...] I start doubting if I’m still their teacher or just a messenger for the software.” Over time, this emotional distance appeared to reduce teachers’ evaluative cognition, their habit of interpreting student thinking and connecting it to future instruction. Deanna described how she now “scans the AI’s comments instead of student work,” noting that it “saves time but kills connection.”. These narratives illustrate that AI replaces one kind of strain (manual workload) with another (emotional detachment). Teachers felt cognitively lighter yet personally diminished.

4.2.3. Subtle Cost of Cognitive Relief

Participants’ responses highlighted that the relief provided by AI came with long-term professional costs. Teachers recognized they were engaging less with the mental processes that sustain instructional expertise. Hassan said “It (MagicSchool) saves my energy, but it also saves me from thinking deeply [...] I worry that I’m becoming dependent on a template.” Mona reaffirms it by saying, “AI (Brisk) takes away the stress of marking, but also the joy of discovery when you see how a student reasons. Now everything is quick, correct, and forgettable.” This highlights that AI lowers design effort but diminishes creative fluency and curriculum judgment. Although it simplifies assessment yet weakens teachers’ interpretive feedback skills. Teachers described this as a quiet erosion of the cognitive and emotional texture of their work. “It’s strange,” said Elena. “I’m less tired, but also less alive in class. The challenge that once sharpened my mind is gone.”

4.2.4. Emotional Ambivalence and Professional Identity

A recurring sentiment across interviews was ambivalence. Teachers felt gratitude for the time saved but guilt for the thought lost. They experienced comfort mixed with anxiety about their future relevance. “AI makes me calm but also nervous,” admitted Aisha. “I finish faster, but I keep wondering what happens if one day the system does everything better than me”. This tension reveals how cognitive relief can coexist with emotional strain. By removing demanding tasks, AI not only reduces workload but also strips away opportunities for professional reflection, the very process through which teachers derive meaning and growth (Korthagen & Vasalos, 2005).

The teachers’ accounts show that AI’s promise of efficiency is double-edged. Automation reduces extraneous load and helps teachers manage fatigue, yet it undermines germane engagement, creative design, and emotional fulfillment. As cognitive complexity shifts from humans to algorithms, teachers experience a paradoxical state: cognitively lighter but existentially burdened.

Their expertise risks flattening into procedural management, where relief replaces reflection and productivity replaces professional depth.

4.3. *Negotiating Expertise and Professional Identity*

As teachers became increasingly embedded within AI-supported classrooms, many found themselves questioning what it now meant to be an expert. Participants' responses revealed a subtle but pervasive struggle: teachers were learning to navigate between their human judgment and the algorithmic authority of AI systems. This negotiation was shaped by the subject matter, institutional culture, and how far each tool automated cognitive functions once central to teaching.

4.3.1. Expertise Re-Defined by Data

Teachers who used Century Tech described a growing dependence on analytics dashboards that presented continuous updates about student performance and engagement. While these dashboards appeared to enhance objectivity, teachers noted that they gradually replaced the intuitive and diagnostic reasoning that had defined their expertise. Layla suggested that "The dashboard tells me who is 'struggling' or 'ready'. [...] Before, I would notice that through observation or dialogue. Now, I click on a color chart. It's fast, but I no longer think the same way." Sara reflected, "I used to design short quizzes to understand what my students grasped. Now the system runs diagnostics automatically. I've stopped creating those small checks, and I miss that mental puzzle. [...] I mean I can still do it, but then I wonder why when the system does it for me". This shows that AI manages intrinsic load through adaptive pacing but weakens teachers' diagnostic autonomy. Participants described feeling less like interpreters of learning and more like monitors of algorithmic outputs. "It feels like the data knows my students better than I do," said Rasha from the UAE. "When I disagree with it, I start doubting myself, not the system."

The authority of data reshaped teachers' sense of professionalism. We found the similar results conducted for the prospective teachers (Rind et al., 2026). Expertise became linked to technological literacy, knowing how to interpret dashboards, rather than pedagogical insight. Some expressed pride in this new skill; others viewed it as a sign of diminished intellectual agency. "Our training now is about reading graphs, not about understanding how students think," observed Layla. "That tells you what kind of teachers we are becoming."

4.3.2. Disappearing Craft of Hands-On Knowledge

In science classrooms, Labster transformed laboratory work by replacing physical experimentation with virtual simulation. Teachers appreciated the safety, precision, and visual clarity the system offered. Yet they consistently worried that both they and their students would lose touch with the craft of experimentation. For example, Adil suggests "It (Labster) shows everything working perfectly and safely [...]. In the real lab, things break, spill, or burn. Those mistakes teach judgment [...] The software gives the answers but not the instincts". Joyce, a physics teacher in California, shared, "I've noticed I demonstrate less now. The AI (Labster) runs smoothly, so I stand aside. My hands feel out of practice. I never thought that could happen to a teacher."

These accounts hint a decline in procedural and diagnostic expertise. While AI effectively manages intrinsic load, it risks suppressing teachers' own experiential cognition. Participants sensed that repeated reliance on perfect simulations subtly retrained their expectations of learning, steering them away from uncertainty and experimentation, the very spaces where professional intuition grows (Selwyn, 2016). "When everything works flawlessly," explained Adil, "you forget how to think through failure. [...] and failure is where teachers learn too."

4.3.3. Balancing Algorithmic Authority and Human Judgment

Many participants described trying to reclaim agency within AI-mediated systems. They sought to combine the precision of algorithms with their contextual understanding of learners. Rasha

describes it as “AI (Century Tech) gives me the numbers, but not the story. I use the numbers to start conversations. I ask students why they think the system rated them that way. That’s where my teaching still lives”. Joyce echoed this approach: “I let it (Labster) introduce the concept, then I design a messy experiment so students can see the gap between simulation and reality [...] it keeps my role alive.”

These examples show that teachers were not passive victims of automation. Some turned AI data into conversation starters rather than directives, using it to spark reflection rather than compliance. Their strategies reflected an emerging identity: teachers as cognitive orchestrators who mediate between human judgment and machine-generated efficiency. Still, this resistance required effort and institutional support. Teachers noted that when school policies valued speed and data accuracy, it became difficult to justify slower, discussion-based instruction. Layla reflected on it by saying “The principal wants to see graphs of improvement. She doesn’t see value in a 15-minute discussion that doesn’t produce numbers. Unfortunately, AI fits that culture better than I do”.

4.3.4. Professional Identity Under Negotiation

Teachers’ narratives revealed a broader identity tension. They took pride in mastering new technologies but feared being reduced to technical operators. Sara said, “Sometimes I feel like an assistant to the system. It tells me what to teach, when to assess, and what feedback to give. I click and confirm. That’s not why I became a teacher.” Others described subtle forms of internal conflict, admiring AI’s intelligence while mourning their diminishing autonomy. For example, Adil acknowledged “the system is so smart it humbles you, but the more you rely on it, the smaller you feel.” Across contexts, teachers framed this negotiation as ongoing rather than concluded. They were learning to balance respect for AI’s analytical power with the conviction that human insight remained essential for learning. Rasha summarized it by saying “I’m trying to stay the thinking part of the classroom. The AI can handle the routine, but I must keep the reflection alive.”

This theme reveals that AI integration reconfigures professional expertise into a hybrid form, where algorithmic efficiency coexists with human intuition but rarely on equal terms. Tools like Century Tech and Labster reduce cognitive effort yet reassign authority to systems that cannot perceive nuance, emotion, or context. Teachers’ expertise becomes reactive rather than reflective, conditioned by the data they receive instead of the learning they observe. Those who actively re-interpret AI outputs demonstrate emerging models of cognitive orchestration, but sustaining this stance requires critical awareness and institutional recognition.

Ultimately, teachers are renegotiating what it means to know, judge, and teach in algorithmic environments. Their narratives warn that when efficiency becomes the new marker of expertise, the profession risks losing the intellectual struggle that once made teaching an art.

5. Discussion

This study examined how the use of AI applications to support or replace instructional tasks reshapes teachers’ professional expertise, cognitive engagement, and sense of agency. The findings indicate that AI integration does not simply enhance or diminish teaching practice but reconfigures the cognitive architecture of teaching itself. Across diverse educational contexts and AI platforms, teachers described a redistribution of instructional responsibilities that altered how they planned, evaluated, and interpreted learning. These changes have important implications for understanding expertise, professional judgment, and agency in AI-mediated education.

A central insight emerging from the findings is that many AI systems assume responsibility for instructional functions that have traditionally contributed to the development and enactment of teaching expertise. Tasks such as sequencing content, diagnosing readiness, generating feedback, and monitoring progress were frequently described as being partially or fully automated. From the perspective of CLT, these shifts represent a relocation of intrinsic and extraneous cognitive load from teachers to algorithmic systems (Sweller, 1988; Sweller et al., 2011). Teachers reported relief from time pressure and routine workload, particularly in planning and assessment, which aligns with prior

research demonstrating the efficiency benefits of AI-supported instruction (Aleven et al., 2016; Mollick & Mollick, 2022; Rind et al., 2026).

However, the findings suggest that reducing cognitive effort does not necessarily support the forms of germane engagement through which professional expertise is sustained (Rind & Ning, 2020). Research on teacher cognition emphasizes that instructional planning, diagnostic reasoning, and evaluative feedback are cognitively generative practices that enable teachers to refine pedagogical schemas and professional judgment (Shulman, 1986; Berliner, 2004). When these practices are repeatedly automated, teachers engage less frequently in reflective decision making, leading to a gradual weakening of instructional fluency and professional confidence. Importantly, this process does not imply immediate loss of competence but reflects a form of deskilling through disuse, consistent with concerns raised in the literature about the routinization of professional judgment in technology-mediated teaching (Luckin & Holmes, 2016; Hughes, 2021).

The findings also highlight that AI integration reshapes not only what teachers do, but how they understand their professional role. Several participants described a shift from being instructional designers and diagnostic decision makers to monitors and validators of algorithmic outputs. This repositioning aligns with sociotechnical critiques that characterize AI as redistributing authority within classrooms rather than merely augmenting existing practices (Perrotta & Selwyn, 2020; Selwyn, 2019). Teachers' accounts reveal how algorithmic recommendations can subtly acquire epistemic authority, particularly when presented through dashboards, performance indicators, or adaptive pathways that appear objective or data-driven.

At the same time, the study demonstrates that teacher agency is not eliminated by AI but becomes conditional and effortful. Some participants actively resisted automation by treating AI outputs as provisional and reasserting interpretive control over instructional decisions. These practices align with emerging research on hybrid intelligence, which emphasizes the complementary potential of human judgment and algorithmic support when teachers retain decision-making authority (Selwyn et al., 2023; Frøsig & Romero, 2024). However, such agency was often constrained by institutional expectations related to efficiency, standardization, and accountability. Where speed and data visibility were prioritized, teachers reported limited space to justify reflective practices that diverged from algorithmic recommendations.

An important contribution of this study lies in extending CLT to account for the cognitive consequences of AI integration for teachers themselves. While CLT has traditionally been applied to student learning and instructional design, the findings show that AI-mediated teaching introduces new forms of extraneous and emotional cognitive load for educators. Teachers described uncertainty, self-doubt, and cognitive strain when their professional judgment conflicted with algorithmic outputs, particularly when system logic was opaque. Prior research on algorithmic governance and transparency suggests that such opacity increases cognitive burden by requiring users to interpret outputs without insight into underlying mechanisms (Williamson & Piattoeva, 2019; Gillani et al., 2023; OECD, 2024). The present findings demonstrate that these ethical and governance issues are experienced not only at the policy level but as everyday cognitive pressures embedded in teaching practice.

Rather than advancing causal claims, the study offers a process-oriented account of how sustained engagement with AI reshapes professional routines and cognitive habits. Teachers did not describe abrupt transformations but gradual shifts toward reliance on automated recommendations and reduced engagement in instructional reasoning. This gradualism aligns with practice-based and sociocultural theories of professional learning, which emphasize that expertise evolves through repeated participation in particular forms of practice (Schön, 2017). In this sense, AI functions as an infrastructural force that redefines what counts as legitimate cognitive work in teaching, privileging efficiency and compliance over interpretive judgment and reflective struggle.

The consistency of patterns across multiple AI platforms strengthens this interpretation. Despite differences in functionality among adaptive tutoring systems, generative planning tools, analytics dashboards, and virtual laboratories, similar changes in cognitive engagement and professional

positioning were observed. This suggests that the effects identified in this study are not tool-specific but function-related, arising from the automation of core pedagogical judgments. Such convergence supports broader critiques that AI integration reshapes teaching at a structural level rather than through isolated technological features (Perrotta & Selwyn, 2020; Selwyn, 2019).

Taken together, the findings underscore the importance of reframing AI integration as a pedagogical and professional challenge rather than a purely technical one. CLT offers a powerful lens for evaluating not only how AI supports learning efficiency but also how it redistributes cognitive authority within instructional systems. When AI reduces extraneous load at the expense of teachers' germane engagement, efficiency gains may carry long-term professional costs. Conversely, when teachers retain interpretive control and use AI selectively, technology can function as an extension rather than a replacement for expertise.

8. Conclusion

This study examined how the integration of AI-enabled tools reshapes teachers' cognitive work, professional expertise, and sense of agency within contemporary instructional environments. By foregrounding teachers' lived experiences and applying CLT as an analytical lens, the study moves beyond dominant efficiency-oriented narratives and offers a teacher-centered account of AI integration in education. Rather than portraying AI as either a solution or a threat, the findings demonstrate that AI functions as a powerful cognitive reallocator, altering what teachers attend to, practice, and ultimately become.

The study shows that AI systems consistently reduce extraneous cognitive demands associated with planning, assessment, and routine instructional tasks. However, this reduction is accompanied by a redistribution of intrinsic and germane cognitive responsibilities away from teachers and toward algorithmic systems. Over time, this shift constrains opportunities for diagnostic reasoning, instructional design, and evaluative judgment, the very processes through which professional expertise is developed and sustained. Importantly, this transformation is not experienced as an abrupt loss of competence but as a gradual reshaping of professional habits, where efficiency increasingly replaces reflective struggle as the dominant logic of practice.

A key contribution of the study lies in extending CLT beyond its traditional application to student learning by demonstrating how AI-mediated instruction also reorganizes teachers' cognitive architecture. The findings highlight that when AI systems automate pedagogical judgment, they do not simply support teachers but redefine the boundaries of professional agency. Teachers' authority becomes conditional, requiring deliberate effort to reinterpret, resist, or contextualize algorithmic outputs. Where institutional cultures prioritize speed, standardization, and data visibility, such effort is often difficult to sustain, increasing the risk that professional judgment becomes secondary to algorithmic recommendation.

The study also illuminates the ethical and emotional dimensions of AI integration as lived cognitive experiences rather than abstract policy concerns. Algorithmic opacity, perceived data authority, and surveillance pressures were experienced as sources of uncertainty, self-doubt, and emotional strain, adding new forms of extraneous cognitive load for teachers. These findings suggest that ethical issues surrounding AI are inseparable from questions of cognition, professionalism, and instructional quality.

At the same time, the study demonstrates that teacher agency is not eliminated in AI-mediated environments. Some participants actively repositioned themselves as cognitive orchestrators, using AI outputs as starting points for dialogue, reflection, and contextual decision making. These practices point toward the possibility of hybrid professional models in which AI supports efficiency without displacing human judgment. However, sustaining such models requires intentional design choices, professional development, and institutional recognition of reflective practice as legitimate and valuable work.

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