AI-Supported Educational Decision-Making: Aligning Teacher Expertise Development and AI Teaming Levels

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Abstract

The increasing integration of AI into education demands a precise understanding of how teachers develop the situation-specific skills required to team productively with increasingly autonomous systems. Central to this teaming is explainability: without it, complementarity between teachers and AI cannot be achieved. Explainability is not an optional feature but a prerequisite that enables teachers to perceive system outputs, interpret their pedagogical relevance, and decide how to act on them. When explainability is absent or misaligned with teachers' expertise, human–AI teaming becomes fragile, and prone to error. This paper examines the alignment between five levels of teaming between AI and teacher, and the teachers' developing capacities to perceive, interpret, and decide in AI-supported contexts. We introduce the Teacher-AI Expertise Matrix, which articulates how different forms of human–AI teaming impose distinct cognitive and pedagogical demands on teachers, and how explainability requirements systematically vary across expertise levels and teaming configurations. Crucially, the matrix demonstrates that misalignment has consequences: upward misalignment (e.g., exposing novices to highly autonomous or synergistic AI without sufficient explanatory support) risks over-reliance, misinterpretation, and disrupts the development of professional judgment, while downward misalignment (e.g., constraining proficient or expert teachers to overly simplistic systems) leads to frustration, underuse, and reduction of pedagogical agency. By making explainability explicit as a mediating mechanism between teacher expertise and AI autonomy, this framework offers a developmental lens for researchers, designers, and policymakers. It shifts the discussion from whether AI should explain itself to for whom, at what level, and with what consequences if it does not, thereby supporting more responsible and competence-aligned deployment of AI in education.

Keywords

teacher professional development, teacher-AI complementarity, skill acquisition,

1. Introduction

AI is becoming ubiquitous in education through an expanding array of AI-supported tools such as adaptive systems, intelligent tutoring systems, generative conversational agents, and learning analytics dashboards. Productive integration requires teachers to interpret, regulate, and critically appraise AI outputs, and to deploy these systems in ways that align with pedagogical intent. Without intentional development of teacher skills, AI risks remaining a collection of technically available tools [1]. Even though AI has been widely deployed to enhance student learning, comparatively little attention has been paid to how teachers learn with AI as a resource for their own professional growth. This imbalance calls for rethinking how teachers are prepared to engage with AI as a partner in their own professional growth. AI-integrated teacher professional development (PD) refers to learning activities in which AI technologies are deliberately embedded to offer teachers opportunities to learn from AI, for instance, through automated feedback, modelling expert practices, or supporting the analysis of instructional data [2]. Yet teachers' ability to benefit from such opportunities depends on how well these AI-supported activities align with their developing professional competence.

Momentarily, the existing evidence suggests that teachers' preparedness to benefit from these opportunities remains limited [2]. Riegel et al. [3] found that although educators surveyed expressed general awareness of AI, their actual use and deeper understanding of AI technologies were limited, indicating a gap between surface familiarity and practical or technical competence. In addition to this, teacher PD programmes tend to overestimate what teachers can accomplish independently by relying on the usability of AI tools rather than developing the competencies required to make sense of AI outputs. Consequently, they are prone to two risks: over-reliance on AI when their ability to critically evaluate its outputs is underdeveloped, and disengagement when those outputs do not support deeper pedagogical reasoning. From this perspective, meaningful AI use requires more than procedural tool operation: it depends on whether teachers can activate their situation-specific skills in the moment. When these skills are weak or underdeveloped, AI technologies risk outpacing teachers' current readiness, leading to miscalibrated trust, superficial use, or avoidance.

This tension reflects a broader misalignment between what contemporary AI tools afford and the level of expertise teachers need to use them meaningfully. To articulate this misalignment more precisely, recent work has begun to distinguish between different levels of AI–teacher teaming, each of which places distinct cognitive and pedagogical demands on teachers [4]. These are demands that current PD rarely addresses. To understand how these differing forms of human–AI teaming could be aligned with teacher expertise, we draw on the Dreyfus model of skill acquisition [5]. The model conceptualizes professional growth as a progression from novice to expert. This developmental trajectory provides a useful lens for examining what kinds of sensemaking demands AI places on teachers. By mapping AI–teacher teaming levels onto the stages of the Dreyfus model, we aim to clarify which forms of AI teaming are realistically attainable at different points in teachers' PD, and where misalignments arise when AI affordances outpace teachers' interpretive and decision-making capacities. This alignment reveals the gap between teachers' current capabilities and the capabilities of AI systems, thereby identifying what needs to be developed to support more advanced and

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reflective forms of human–AI teaming.

2. Theoretical Background

2.1. Teacher Readiness

A recent systematic review of AI-integrated teacher PD [2] highlights several limitations in teachers' preparedness to use AI tools effectively. The review shows that teachers often begin PD programs with limited technical knowledge. Despite its accessibility, many teachers struggle to make meaningful use of AI-generated outputs: they frequently regard AI-produced reports as summaries rather than actionable guidance, and they question the practical relevance of AI suggestions for real classroom contexts. AI is widely used in structured, data-driven activities such as automated feedback, but far less in reflective or collaborative practices, where teachers express skepticism about AI's ability to support deeper professional reasoning. These findings indicate that while teachers can operate AI tools at a basic level, their preparedness to interpret outputs and integrate them meaningfully into professional practice remains limited. [2]

2.2. Sensemaking in Teaching: Situation-Specific Skills and the PID Model

In Blömeke et al.'s framework [6], competence is conceptualized as a continuum: it begins with underlying cognitive and affective-motivational dispositions and progresses toward skills that are enacted in real situations. Building on novice–expert research in cognitive psychology, these situation-specific skills are further articulated in the PID model, which distinguishes three interrelated processes. Perception involves identifying elements or suggestions that are pedagogically relevant; interpretation concerns making sense of these elements, suggestions, and understanding their implications; whereas decision-making entails anticipating possible student responses or selecting appropriate pedagogical actions. Together, these skills describe how teachers notice, reason about, and act upon classroom events, and thus provide a useful lens for analysing the sensemaking demands that AI places on teachers.

2.3. Skill Acquisition: From Novice to Expert

Effective teaching depends not only on what teachers know, but on how they perceive, interpret, and decide in the moment. This focus on the situated enactment of competence aligns closely with the developmental perspective offered by the Dreyfus model of skill acquisition. The Dreyfus model [5] characterizes how these skills evolve over time from a novice who relies on rule-based procedures to the fluid, intuitive judgment of expert practitioners. **Novices** perceive elements in isolation and depend heavily on explicit guidance, while **advanced beginners** and **competent** teachers gradually learn to prioritize between different elements, coordinate multiple demands, and make contextually grounded decisions. **Proficient and expert** teachers, in turn, develop an increasingly holistic view of learning situations and can respond adaptively without deliberate analytical effort. A clearer understanding of how AI shifts the demands on teachers' abilities to perceive relevant cues, interpret AI-generated information, and make instructional decisions can be gained by examining the emerging literature on AI–teacher teaming levels.

2.4. AI Teaming Framework

Research on human–AI interaction in education has begun to frame teacher engagement with AI in terms of teaming levels that vary in the degree of autonomy, adaptivity, and shared responsibility between teachers and AI systems [4]. Cukurova states that at lower levels—**transactional and situational teaming**—teachers interact with AI primarily as a source of outputs, requiring limited interpretation beyond basic monitoring, relying on surface-level or procedural explanations that support use rather than understanding. More advanced levels—**operational and praxical teaming**—assume teachers can iteratively evaluate AI suggestions, integrate them with pedagogical knowledge, and adjust decisions in response to evolving classroom conditions which in turn presupposes access to explanations that make system reasoning inspectable, contestable, and pedagogically meaningful. The most complex form, **synergistic teaming**, requires a capacity for reflective judgment and epistemic trust, enabling teachers and AI systems to co-construct analyses or pedagogical decisions; here, explainability shifts from supporting interpretation to enabling mutual model shaping, where teachers critically interrogate, refine, and influence AI behaviour over time. This implies that higher teaming levels demand increasingly more sophisticated teacher competencies—not only technical fluency, but the ability to perceive, interpret, and decide based on AI outputs in situ.

Synergistic teaming, as defined in recent conceptual work [4], requires teachers not only to evaluate AI-generated propositions but to engage in reciprocal model shaping. This involves not only challenging AI suggestions and providing corrective feedback, but also responding to the alternatives or disagreements generated by the system. In such interactions, the AI may surface patterns, interpretations, or recommendations that conflict with the teacher's initial judgment, effectively introducing epistemic pushback. For teachers, this requires the capacity to critically assess whether such pushback constitutes meaningful evidence or reflects limitations of the system. Rather than accepting or rejecting AI responses outright, teachers must interpret them in the light of their pedagogical goals, compare them with their own understanding, and decide whether to revise, refine, or maintain their original judgment. In this sense, synergistic teaming depends on a bidirectional process in which both teacher and system can influence and challenge one another's reasoning. When teachers possess the professional competence to do so, such interactions can produce genuine augmentation; however, when novice teachers attempt to operate at this level, the risks multiply. With limited capacity to scrutinize AI reasoning, novices may potentially inadvertently reinforce flawed assumptions, encode misleading pedagogical patterns, or drift into uncritical acceptance of system outputs. In the worst case, synergistic systems can amplify novices' misconceptions by incorporating their unexamined judgments into the underlying models that guide future recommendations. At the same time, the opposite problem also emerges: when highly competent or expert teachers are restricted to lower teaming levels—such as transactional or tightly constrained situational systems, can AI become even obstructive. In these cases, the system fails to meet teachers at their level of professional vision, generating frustration, bypassing, or even disengagement.

Together, these upward and downward risks underscore a profound threat: without careful scaffolding and design taking user competence into consideration, AI systems may either demand more interpretive work than teachers are ready to perform or constrain the judgment of those capable of more sophisticated teaming. Consequently, any movement toward synergistic teaming must be matched with an equally rigorous approach to teacher PD and system design, ensuring that only those with sufficient interpretive, evaluative, and reflective capacities to critically engage with AI explanations as well as recognise their limits are positioned to shape AI systems that, in turn, shape their practice.

Teacher Skill Acquisition/ Teacher AI Teaming Level	Transactional	Situational	Operational	Praxical	Synergistic
Novice	Can execute AI-assisted routine tasks but may overtrust automation. PD: Boundary awareness, human-in-the-loop exercises.	Finds dashboards confusing; interprets outputs literally. PD: Scaffolded translation of data into classroom actions.	Goal formulation unclear; AI guidance misaligned. PD: Guided goal-setting and pedagogical reasoning.	Reflective and procedural overload.	Unable to engage in reciprocal interaction; treats AI outputs as fixed rather than open to evaluation or revision.
Advanced Beginner	Employs automation effectively within concrete contexts. PD: Strengthen interpretive judgment and confidence calibration.	Begins noticing data trends but over-relies on surface indicators. PD: Practice contextual reasoning and uncertainty management.	Partial understanding of model–goal relations. PD: Transparency and bias literacy.	Lacks iterative feedback mindset.	Misinterprets co-creation as enhanced automation; does not recognise need for evaluation or iterative feedback.
Competent	Uses automation selectively; aware of limits. Potential frustration: tool under-challenges teacher judgment; redundancy with existing routines.	Links analytics to learning design effectively. PD: Reflection on decision justification.	Aligns instructional goals with AI operations. PD: Deepen understanding of model mechanisms.	Sustained evaluation is difficult to maintain; may alternate between over-reliance and premature rejection of AI. PD: Structured comparison of AI and teacher-generated decisions, guided reflection on when to rely on or override AI outputs, and practice in evaluating AI-generated alternatives in relation to instructional goals.	Evaluation remains primarily teacher-driven; limited readiness to incorporate AI-generated alternatives or respond to system pushback. PD: Strengthen stable evaluation in reciprocal settings through structured comparison of teacher and AI alternatives, reflection on when to revise or maintain decisions, and practice in responding to AI-generated challenges.
Proficient	Integrates automation strategically to optimise time and consistency. PD: Share orchestration strategies, mentor peers. Likely frustration: AI imposes unnecessary structure, slowing intuitive workflow.	Engages with analytics critically and iteratively. Likely frustration: AI imposes unnecessary structure, slowing intuitive workflow.	Balances human–AI task division dynamically. Requires high-quality explanations to sustain engagement; may disengage when AI reasoning cannot be meaningfully interpreted.	Mutual adaptation emerges; teacher integrates and selectively responds to AI-generated alternatives.	Emerging synergy: teacher engages in iterative exchange with AI, evaluating and occasionally integrating system-generated alternatives, reliance on own judgment remains dominant. PD: Develop explainability literacy; support feedback loops that enable teachers to test, refine, and selectively adopt AI-supported strategies.
Expert	Understands task boundaries and evaluates outputs critically. Potential frustration: tool restricts expert reasoning; reduces value of AI as augmentation.	Uses situational analytics as evidence for strategic reflection. Potential frustration: tool restricts expert reasoning; reduces value of AI as augmentation.	Customises operational AI; adjusts system settings to fit the context. Disengagement risk: expert bypasses the tool entirely.	Actively guides AI behaviour; evaluates system outputs while simultaneously reflecting on pedagogical and epistemic implications.	Engages in reciprocal, evidence-based co-reasoning: selectively revises or maintains judgments based on relevance. PD: Support informed oversight and system shaping through design feedback, critical interrogation of AI reasoning.

Figure 1: Teacher-AI Expertise Matrix linking teacher skill levels with transactional-to-synergistic AI teaming modes to identify characteristic teacher behaviours, common breakdowns, and targeted PD supports for safe and meaningful human–AI teaming

3. The Teacher-AI Expertise Matrix

The Teacher-AI Expertise Matrix 1 articulates how different levels of teacher expertise intersect with the cognitive and pedagogical demands of the five AI teaming levels. The following sections describe how teachers at each developmental stage engage with AI, the vulnerabilities that arise when teaming levels exceed or remain below their interpretive capacity, and the types of PD that can meaningfully support progression across teaming levels.

3.1. Novice Teachers (T1)

Novice teachers typically rely on explicit rules and external guidance, reflecting early stages of expertise development. At the transactional and situational levels of human–AI teaming, novices can operate AI tools procedurally but often struggle to interpret the meaning of AI-generated information. Similar to classroom contexts, where novices describe events without deeper interpretation [7], they may struggle to distinguish between relevant and misleading AI-generated information. Prior work in teachers engaging with learning analytics (e.g., [8]) solidifies this potential hazard by showing that less experienced teachers are more likely to overestimate the quality of observed student work, are more willing to rely on dashboard data for grading, and are less likely to revise their initial judgments based on additional data. This suggests that novices might be more susceptible to uncritical reliance on AI. When placed in more advanced collaborative roles prematurely, their limited experience may also lead them to misjudge or reject effective practices, resulting in feedback that can steer adaptive systems toward suboptimal behaviour. *For novices, key professional development priorities therefore include recognising the limits of AI systems and developing the ability to critically evaluate the accuracy and usefulness of their outputs.* From a design perspective, this also implies the need for safeguards that constrain how strongly novice feedback influences system adaptation.

3.2. Advanced Beginners (T2)

Advanced beginners begin to recognize contextual cues, yet their reasoning continues to be guided by surface features. At situational and operational teaming levels, they may detect relevant elements but misinterpret their significance for student learning and instructional decision-making. Evidence from Kasepalu et al. [8] suggests that less experienced teachers can notice discrepancies in dashboard data but often fail to revise their initial judgments accordingly, instead relying on prior observations or intuitive impressions. This indicates a developing but still fragile capacity to integrate analytic evidence into pedagogical reasoning. *Professional development at this stage should therefore focus on supporting responsible interpretation of AI-generated information by helping teachers recognise uncertainty, question assumptions embedded in explanations, and learn how to weigh and decide upon conflicting sources of evidence, rather than treating outputs or explanations as self-explanatory.*

3.3. Competent Teachers (T3)

Competent teachers can coordinate multiple cues, compare AI outputs with pedagogical intentions, and make deliberate decisions. They are well positioned for operational and praxical teaming, where teachers are capable of actively coordinating their instructional goals with how AI systems generate and present information. At this stage, AI systems do not merely provide answers but introduce alternative instructional strategies that teachers must assess and selectively integrate. To support such evaluation, system outputs must be accompanied by explanations that make their underlying reasoning visible in pedagogical terms by clarifying why a strategy is suggested and under what conditions it is applicable. In this way, explainability transforms AI from a source of recommendations into a basis for reflective comparison and informed instructional decision-making. Such interaction can potentially lead to an expansion of teachers' pedagogical repertoires: teachers begin to adopt and reuse strategies proposed by the system, while disregarding others that do not align with their intentions or contextual constraints [9]. This pattern reflects a shift from passive use toward evaluative integration, where AI functions as a source of potential interventions rather than one singular action to follow. However, competent teachers may experience reflective fatigue, especially when AI challenges their expectations, leading to undertrust or inconsistent engagement. *For competent teachers, developing an understanding of how AI systems generate outputs is essential for moving from accepting recommendations to critically evaluating and refining them.*

3.4. Proficient Teachers (T4)

More experienced teachers are more willing to revise their initial judgments when presented with analytic data, recognising the limits of their own situational awareness [8]. When less experienced teachers may notice discrepancies in the data but still rely on their initial impressions suggesting that proficient teachers are better able to integrate AI-generated evidence into their reasoning, using it to update rather than defend their judgments. However, because proficient teachers operate with an integrated, intuition-driven grasp of classroom dynamics, lower-level AI teaming structures—such as transactional or overly constraining situational systems—can become increasingly frustrating. These systems often impose procedural steps, generic cues, or rigid interaction patterns that interrupt the fluid reasoning characteristic of the practice of proficient teachers. As a result, proficient teachers may experience such tools as unnecessarily restrictive, and adding friction to professional routines. Knowing that as teachers gain expertise, their processing of classroom information shifts from descriptive accounts toward knowledge-based interpretation and predicting likely consequences of events [7]. Building on this, evidence from AI-supported classroom studies suggests that teachers do not simply adopt system-generated suggestions, but engage in a more gradual process of reflection and selective integration, often requiring time to evaluate how such suggestions align with their pedagogical intentions [10].*For teachers, this implies moving beyond accepting AI explanations at face value toward actively interrogating them by asking why a particular recommendation is made instead of alternatives, recognising what information may be omitted, and interpreting outputs in relation to instructional goals. Research on explainable AI suggests that explanations are most useful when they support causal understanding rather than merely presenting probabilities [11]. This enables a shift from passive interpretation toward active sensemaking, where teachers evaluate, adapt, and selectively integrate AI-generated suggestions. In this way, explainability functions not as a persuasive feature, but as a support for professional judgment, enabling more informed and context-sensitive instructional decision-making.*

3.5. Expert Teachers (T5)

Expert teachers demonstrate highly developed professional vision, enabling them to rapidly identify what is relevant, interpret classroom situations in relation to student learning, and predict likely consequences of different instructional actions [7]. Experienced teachers are also more willing to revise their initial judgments when relevant evidence is presented that coincides with their standards of learning goals [9]. This capacity for selective attention and evidence-based revision enables teachers to evaluate, integrate, and update their decisions which is an essential condition for higher-level, synergistic human–AI teaming. Because expert reasoning is holistic and experience-driven, lower levels of AI support which are characterised by generic recommendations or rigid interaction structures may be experienced as constraining rather than helpful. Such systems can interrupt established professional routines without adding meaningful insight. *Accordingly, professional development priorities for expert teachers extend toward informed oversight and contribution by engaging in system refinement, providing design-oriented feedback, and critically reflecting on the pedagogical and ethical implications of AI in educational practice.*

4. Conclusion and Future Work

By articulating how teacher expertise intersects with the cognitive demands of various AI–teacher teaming levels, the matrix clarifies where AI autonomy and its associated explanatory demands may exceed teachers' interpretive capacity and where under-stimulation may constrain expert practice. Effective AI–teacher teaming requires bidirectional alignment between teacher expertise and AI autonomy. Upward misalignment occurs when teachers are positioned in higher-autonomy teaming modes without the interpretive, evaluative, or reflective capacities required, increasing the risks of overtrust, misinterpretation, and unintended model degradation; downward misalignment arises when capable teachers are confined to low-autonomy, procedural systems that constrain judgment and disrupt intuitive practice. Therefore, the matrix defines both developmental ceilings and floors for AI autonomy, positioning professional development as the mechanism that enables safe upward progression while preventing the professional costs of under-aligned AI use. The framework supports the safe and productive deployment of AI in educational contexts, helping ensure that human–AI teaming enhances rather than compromises teaching and learning. The matrix shifts the discussion of AI in education from technology adoption to competence-aligned deployment. It demonstrates that meaningful and safe teaming with AI requires sustained investment in teachers' interpretive, evaluative, and reflective capacities, not merely preparing teachers to operate the tool or provide solely surface-level transparency. Future research should investigate how teachers progress through teaming levels over time, how professional development interventions can accelerate this progression, and how specific AI systems and their explainability features map onto the developmental and teaming pathways described here.

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Declaration on Generative AI

During the preparation of this work, the authors used ChatGPT (OpenAI) to support language refinement. All outputs were critically evaluated, revised, and validated by the authors. The authors take full responsibility for the content of the manuscript.

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