The Educator as an Embedded AI Designer: Faculty Agency in Generative AI-Enhanced Pedagogy

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***Abstract*—Generative artificial intelligence (GenAI) is rapidly reshaping higher education, yet existing research remains largely focused on student use and institutional governance. The role of faculty as active designers of AI-enhanced pedagogy rather than passive adopters remains underexplored. In this paper, we introduce the *Embedded AI Designer Framework*, where educators serve as co-designers who incorporate disciplinary reasoning, ethical norms, and pedagogical intent into GenAI systems, instead of acting as passive users of AI tools. We describe how this framework was applied across three disciplines at the National University of Singapore. These implementations demonstrate how faculty agency is exercised in three stages: *Intentional Design*, *Orchestrated Mediation*, and *Reflective Alignment*. Rather than replacing instructors, the use of GenAI allows them to exercise professional judgment, transforming AI from a mere automation tool into a medium of pedagogical intentionality. In other words, we propose a *pedagogy-first* paradigm in employing AI in higher education, where human expertise and design literacy drive responsible and meaningful integration.**

***Index Terms*—generative AI, faculty agency, educational technology, AI design, higher education pedagogy**

I. Introduction

The rapid growth of Generative Artificial Intelligence (GenAI) presents a critical moment for higher education, prompting a deep re-evaluation of teaching practices, assessment design, and the very nature of disciplinary knowledge. While the potential for GenAI to transform learning environments is clear, a more fundamental question arises: *how do we preserve pedagogical wisdom and professional discernment amid this technological shift?*

Current practices and scholarship predominantly focus on student adoption, institutional governance, and policy frameworks, while the pivotal role of faculty as active designers and implementers of AI-enhanced pedagogy remains underexplored [1]. Although data confirm the rapid uptake of GenAI among educators, with approximately 22% of higher education faculty in the United States reporting use as of Fall 2023 [2], this adoption often remains fragmented and reactive, and lacks a conscious connection to deep instructional intentionality and disciplinary rigor [3]. This reveals a crucial gap: faculty are typically positioned as passive users of external systems rather than as active architects of learning. As AI becomes increasingly ubiquitous, we are concerned that such a passive stance may erode the judgment, agency, and pedagogical thinking of our educators, eventually restricting their role to that of managing efficiency rather than innovating and leading learning.

In this paper, we address this gap by introducing the *Embedded AI Designer Framework*, developed by the AI Centre for Educational Technologies (AICET), and iteratively refined through collaborations with faculty across the National University of Singapore (NUS) [4]. Our framework redefines the role of educators as co-designers who deliberately translate disciplinary reasoning, ethical commitments, and pedagogical expertise into the operational logic of GenAI systems, while ensuring that technological innovation remains grounded in human judgment and educational purpose.

Building on this foundation, we argue that faculty agency must be exercised across three interlinked dimensions of practice: (i) *Intentional Design*, where professional knowledge and pedagogical intent are articulated and encoded as LLM constraints and prompts; (ii) *Orchestrated Mediation*, where the human–AI interaction is carefully structured and contextualized in the learning environment; and (iii) *Reflective Alignment*, where emergent data from AI dialogues is used as evidence to continuously inform and improve teaching methods.

Our contribution lies not only in the development of the

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Embedded AI Designer Framework but also in its empirical validation across distinct disciplinary contexts at NUS. In this paper, we illustrate the application of our framework with three case studies: (i) legal education (simulated witness examinations requiring procedural and ethical compliance), (ii) nursing education (empathetic communication training for end-of-life care), and (iii) computer science education (guided reasoning and reflective assistance for programming). These case studies show that with a dynamic pedagogy–AI co-evolution loop, educators can actively shape AI behavior to reflect pedagogical intent and disciplinary values.

Ultimately, we propose a *pedagogy-first* paradigm for AI integration, which opens a new path for educators not only to adapt to AI, but to redefine how human insight and machine intelligence co-evolve in service of meaningful learning.

II. Related Work

The integration of GenAI in higher education has renewed focus on faculty agency as a central force in shaping ethical and effective pedagogy.

Conceptually, Kahn *et al.* [5] reconceptualize teacher agency as a responsive and culturally mediated activity, characterized by educators' adaptive negotiation of students' expanded epistemic agency in the era of AI. Complementing this view, Jin *et al.* [6] provide a global policy analysis showing that many universities now explicitly define the roles and responsibilities of instructors, administrators, and students to ensure the ethical and effective use of AI in classrooms, often including guidance and support for faculty development. These developments indicate a growing focus on teacher agency in ensuring that AI is used in responsible and meaningful ways in the classroom.

Empirically, faculty attitudes toward GenAI are differentiated, with the majority adopting an optimistic or critically reflective perspective. Educators recognize potential benefits, especially improved equity, but face considerable barriers, most notably low AI literacy among themselves and students, alongside ongoing ethical uncertainty [7]. Drawing on the Technological Pedagogical Content Knowledge (TPACK) framework, Yang et al. [8] find that teachers' technological-pedagogical expertise is a strong predictor of their willingness to adopt GenAI, while negative emotions such as anxiety may hinder adoption. These findings highlight the importance of both institutional and emotional support in strengthening instructors' confidence, competence, and self-directed use of AI in teaching.

At the ecosystem level, the Ithaka S+R report [9] catalogs over 100 GenAI tools in higher education, classifying their roles across discovery, understanding, and creation phases of learning. It warns of market consolidation that could constrain faculty choice and pedagogical experimentation. A recent systematic review in *TechTrends* [10] highlights GenAI's pedagogical applications, including automated feedback, adaptive tutoring, and critical-thinking enhancement across disciplines such as writing and computer science. Together, these studies suggest a need for shared emphasis on human-in-the-loop designs, to ensure that there is faculty oversight to address potential AI errors and biases.

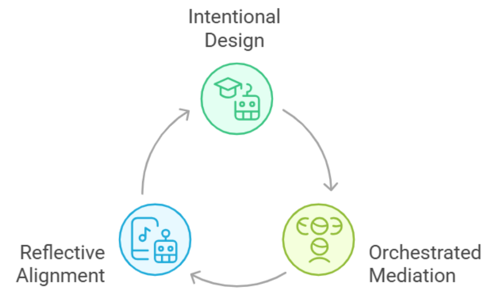

Fig. 1. The *Embedded AI Designer* framework showing three interdependent stages (Intentional Design, Orchestrated Mediation, Reflective Alignment) in a continuous Pedagogy-AI Co-evolution Loop.

In summary, existing research provides valuable insights into faculty attitudes, institutional policies, and classroom applications of GenAI. However, educators are still predominantly regarded as adopters or users of AI tools rather than active designers of AI-enhanced learning systems. To address this gap, our *Embedded AI Designer Framework* introduces a *pedagogy-first design paradigm* that enables faculty to encode disciplinary reasoning and pedagogical intentions directly into GenAI systems, advancing a model of faculty-driven approaches to AI integration.

III. Conceptual Framework: From AI Adoption to AI Co-Design

We conceptualize faculty agency in AI-enhanced pedagogy as operating across three interdependent stages: Intentional Design, Orchestrated Mediation, and Reflective Alignment. These stages form a continuous pedagogy-AI co-evolution loop as shown in Fig 1. This framework positions educators not as users of ready-made tools, but as architects of the pedagogical systems through which AI operates, interacts, and derives meaning.

Stage 1: Intentional Design (Encoding Pedagogical Intention). Educators translate disciplinary logic into machine behavior by articulating pedagogical specification as LLM prompts, consisting of (i) a task model defining what counts as progress, (ii) a discourse policy governing how the AI may respond, and (iii) an evidence schema outlining what qualifies as acceptable reasoning or data. In practice, educators create structured templates, model and counter-model examples, and rubric-aligned prompts to ensure the system emphasizes reasoning over answers and grounds its explanations in the logic and standards of the discipline. This transforms the prompt from instructional text into a pedagogical contract, where roles, goals, boundaries, and failure modes (e.g., when to refuse, defer, or request clarification) are explicit and testable. By encoding pedagogical judgment as design parameters, educators make AI an extension of instructional intent, rather than a substitute for it.

Stage 2: Orchestrated Mediation (Designing and Guiding Human–AI Interaction). Once deployed, AI chatbots operate autonomously. Faculty therefore cannot control the AI's outputs directly, but they can only manage the learning environment surrounding the AI. This orchestration occurs at three moments:

- **Preparation**: teaching students how to question, critique, and verify AI responses;
- **In-class facilitation**: leveraging AI dialogues to prompt peer discussion and collaborative reasoning;
- **Follow-up guidance**: addressing misconceptions or ethical issues that arise from AI interactions.

In this stage, the instructor acts as a meta-mediator, curating when and how AI interactions feed into human dialogue.

Stage 3: Reflective Alignment (Using AI Feedback to Refine Pedagogy). The final stage involves using the collected data and student interactions to refine the pedagogy. Instructors analyze logs, student reflections, and system outputs to examine how learners reasoned with AI and where misunderstandings occurred. This "reflection-with-data" allows instructors to iteratively recalibrate prompts, feedback rubrics, and classroom design. In this way, AI becomes a diagnostic lens for teaching practice: instructors can see more precisely how students think, struggle, and learn, transforming machine feedback into professional insight.

Together, the three stages form a dynamic Pedagogy–AI Co-evolution Loop: *Design* $\rightarrow$ *Mediate* $\rightarrow$ *Reflect* $\rightarrow$ *Redesign*, where AI evolves as pedagogy evolves, with faculty judgment guiding every iteration.

IV. Cross-Disciplinary Implementation Cases

In this section, we illustrate how the *Embedded AI Designer Framework* was applied in real teaching contexts across three disciplines, law, nursing, and computer science, at the National University of Singapore (NUS).

A. Legal Education: Simulated Witness Examinations

A persistent challenge in legal education is to provide students with authentic and scalable opportunities to practice courtroom examinations [11]. To address this issue, the law faculty at NUS collaborated with AICET to create two GenAI mock trial roleplay bots on the *ScholAIstic* [13] platform, thereby allowing students to conduct live witness examinations in a simulated courtroom setting.

Intentional Design: Encoding Legal Pedagogy. The chatbots were designed for two complementary modules - Examination-in-Chief (EIC) and Cross-Examination (CE) - each governed by clear procedural and ethical rules. In the EIC, the AI assumed the roles of Witness (Defendant) and Judge; in the CE, it took on the roles of Prosecution Witness, Prosecutor, and Judge. Instructors first identified the key learning outcomes: (i) maintaining courtroom decorum, (ii) applying evidentiary reasoning consistent with the Singapore Evidence Act, (iii) avoiding leading questions in the EIC; and (iv) using leading questions to elicit admissions in the CE. These outcomes were then embedded into AI behavior through a structured learning objective schema that defined three elements: (i) the task model for measuring progress in questioning, (ii) the discourse policy guiding how the AI should respond, and (iii) the evidence schema describing what counts as valid reasoning.

The Witness personas were intentionally programmed to make factual errors or exhibit lapses in memory, providing students with opportunities to clarify and reframe their questions. In the EIC, the Judge persona monitored procedural compliance and intervened when students used declarative or leading questions. In the CE, the Prosecutor persona functioned as a procedural adversary, monitoring students' input for argumentative or irrelevant phrasing and issuing objections in realistic legal form (e.g., "Objection, Your Honour. The question is speculative."). These interruptions reinforced procedural vigilance and offered opportunities for students to justify or revise their lines of inquiry. In this way, the prompt functioned as a pedagogical contract, where every AI response reflected the underlying legal reasoning. Embedding learning objectives directly into AI behavior turned prompt design into a scaffold for disciplinary thinking rather than merely serving as a means of content delivery.

Orchestrated Mediation: Structuring Human–AI Interaction. In class, students took on the role of examining counsel and interacted directly with the AI-generated characters. Faculty acted as meta-mediators who guided how students interpreted and reflected on AI behavior. Each session involved three phases: (i) preparation, where students reviewed case facts and anticipated inconsistencies; (ii) simulation, where they adjusted their questioning in response to AI's reactions; and (iii) debrief, where the instructors facilitated discussion on procedural accuracy and ethical reasoning. The educational value depended not only on the realism of AI behavior but also on the way instructors framed and discussed it, turning AI dialogues into collective reasoning cases that deepened students' understanding of advocacy ethics and courtroom logic.

Reflective Alignment: Using AI Interactions as Pedagogical Evidence. After each session, instructors reviewed the AI–student transcripts to identify reasoning patterns such as uncorrected factual mistakes or improper phrasing. These findings have informed preliminary revisions to prompt design, judge intervention rules, and evaluation rubrics. The simulation is intended to evolve into a data-driven reflective tool that supports both student learning and faculty development, with further iterations planned for the upcoming semester. The resulting AI dialogues, as shown in Fig. 2, serve as preliminary pedagogical evidence, offering educators insight into the reasoning processes of students and inform future refinements in instructional design.

B. Nursing Education: Empathic Communication and End-of-Life Care

Teaching empathy and communication in palliative care is one of the most complex challenges in nursing education. Traditional role-plays with human actors are logistically de-

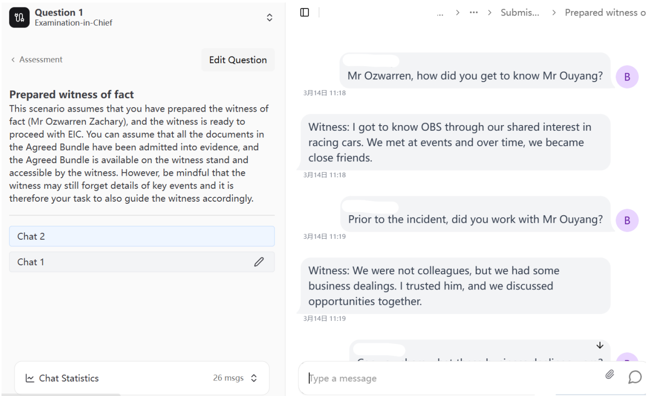

Fig. 2. A classroom interaction between a student and the AI Witness on the *ScholAIstic* platform.

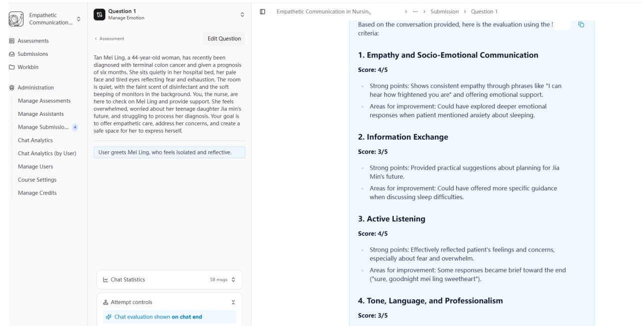

Fig. 3. AI-generated multi-dimensional feedback report evaluating students' communication performance on the *ScholAIstic* platform.

manding and emotionally inconsistent across sessions [12]. To create a scalable yet emotionally authentic experience, nursing faculty collaborated with AICET to develop a GenAI role-playing agent to simulate a virtual patient diagnosed with terminal colon cancer. This simulation, implemented on the *SchoIAIstic* [13] platform, enables students to practice active listening, empathetic dialogue, and supportive care in emotionally charged contexts.

Intentional Design: Encoding Empathy and Realism into AI. Instructors first articulated the pedagogical goals: (i) cultivating emotional presence, (ii) ethical sensitivity, and (iii) patient-centered communication. These intentions were embedded into the chatbot's design by defining both behavioral logic and emotional depth. The AI persona was assigned a detailed biography, evolving affective states, and calibrated difficulty levels. At the beginner level, she openly expressed fear and sadness, offering clear emotional cues; at the advanced level, she became guarded, evasive, or withdrawn, requiring students to adjust tone and questioning strategies. This design turned every session into a structured empathy exercise where students learned to detect subtle emotional cues and respond with affective precision. In this way, abstract goals such as "teaching empathy" were translated into concrete design parameters that could be evaluated and iterated over time.

Orchestrated Mediation: Framing AI Encounters as Reflective Practice. In-class implementation followed a structured sequence of pre-briefing, simulation, and debriefing. Before each session, instructors taught students essential communication skills in palliative care and guided them to articulate communication objectives and anticipate emotional responses. During simulation, students interacted directly with the AI patient, applying empathetic techniques in real time. Afterward, the instructors facilitated reflection on specific moments, such as how students applied active listening, managed pauses, or responded to emotional cues, turning each dialogue into an opportunity for collective reasoning about communication ethics and empathy in clinical care.

The AI system acted as a consistent emotional mirror that exposed students to a broad range of patient responses. Faculty presence remains central: they contextualize the emotional and ethical implications of each exchange, ensuring that the AI served pedagogical rather than purely technological purposes.

Reflective Alignment: Using AI Feedback to Refine Pedagogy. After each session, the system automatically generated a multi-dimensional feedback report that analyzed student–AI interactions (see Fig. 3). The report, generated by GenAI, scored each student across five pedagogical dimensions:

- Empathy and Emotional Sensitivity: acknowledgment and validation of patient emotions;
- Information Exchange: clarity, relevance, and responsiveness to patient needs;
- Active Listening: paraphrasing, probing, and follow-up questioning;
- Professional Tone and Language: clear, compassionate, and jargon-free communication;
- Patient-Centeredness: maintaining focus on patient needs and perspectives.

The AI-generated report provided both quantitative scores and qualitative feedback, highlighting specific moments where students could refine their responses. Faculty also reviewed these results after class to adjust their teaching strategies and identify common areas for improvement. This reflection-with-data process transformed AI output into pedagogical evidence, enabling both teachers and students to iteratively recalibrate their understanding of empathetic communication.

C. Programming Education: Scaffolded Inquiry and Reflective Learning Support

Teaching programming effectively has always required balancing support with productive struggle; we aim to guide students to reason through bugs without removing the intellectual challenge of problem solving. Traditional automated graders and hint systems often fail to maintain this balance: they either over-assist by providing direct code fixes or under-assist by offering vague and generic hints [14]. To address this gap, computer science instructors at NUS collaborated with AICET to develop a GenAI tutoring agent [15], which was deployed on the *Coursemology* [16] platform as the *GetHelp!* feature, as shown in Fig. 4. The chatbot acts as a friendly, peer-like

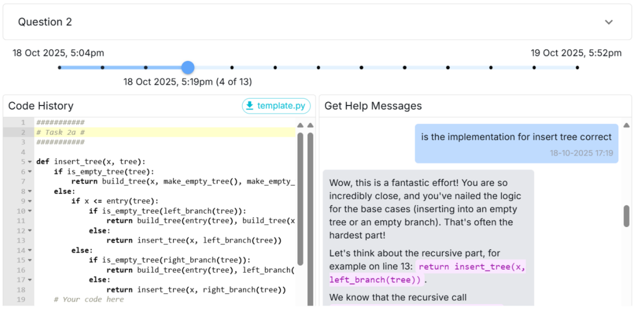

Fig. 4. Example of a student–AI dialogue with the *GetHelp!* tutoring agent.

teaching assistant that guides students through debugging and conceptual reasoning while deliberately withholding explicit solutions.

Intentional Design: Encoding Pedagogical Judgment into AI. The instructors began by defining the pedagogical contract that governs how the AI should behave. The system's prompt was structured to embed instructional constraints: (i) it must never reveal the actual code fix, (ii) instead, it should guide students with leading questions (e.g., "What happens if this variable changes?"), and (iii) it must affirm correct reasoning before offering a next step. Each response was generated in a two-layer response structure (an internal reasoning trace for instructors; an external conversational reply for students). This design ensured transparency and control. The instructor can audit the AI's internal logic while maintaining a human-like, supportive tone externally. In this sense, the instructor's pedagogical philosophy became directly encoded in machine behavior, transforming abstract teaching principles into operational design parameters.

Orchestrated Mediation: Extending Instructor Presence through AI Dialogue. In practice, *GetHelp!* was integrated into programming tutorials as a peer-like dialogue partner. Students engaged with the chatbot to troubleshoot errors and test hypotheses, while instructors reviewed conversation logs to trace reasoning paths and identify common misconceptions. These insights allowed instructors to address recurring challenges during subsequent tutorials. Through this design, the AI chatbot functioned as a shared cognitive scaffold: it did not replace human instruction but rather extended teacher presence into moments of independent reasoning.

Reflective Alignment: Extracting Pedagogical Insight from AI Logs. At the reflection stage, instructors analyzed chatbot transcripts to refine both the AI's design and their own teaching strategies. The structured output of the transcripts allowed for granular analysis of reasoning trajectories, hint usage, and question patterns. For instance, the instructors were able to identify instances when students tended to give up prematurely or when their conceptual errors repeated across sessions. These findings informed both prompt revision and classroom redesign, such as embedding metacognitive checkpoints or guided reflection prompts in lab activities. Through this iterative loop of design, mediation, and reflection, *GetHelp!* evolved from a debugging assistant into a diagnostic lens for understanding the gaps in the students' understanding.

This case illustrates how a pedagogy-first approach to AI tutoring can promote guided autonomy and metacognitive growth. By embedding disciplinary reasoning, ethical boundaries, and instructional intentionality within AI dialogue, *GetHelp!* demonstrates that AI can serve as a mirror for human teaching and make the pedagogy observable. It is then much easier to improve and optimize what we can measure.

V. Discussion and Implications

The cross-disciplinary implementations illustrate how the *Embedded AI Designer Framework* transforms the educator's role from a user of GenAI systems into an architect of pedagogical intent. Across law, nursing and computer science, the framework operationalizes a continuum of human intentionality—from encoding disciplinary reasoning into AI behaviors, to orchestrating interactional scaffolds, to reflecting on the traces that emerge from those interactions. These cases demonstrate how educators' agency is enacted, mediated, and recursively examined through intentional design.

A. Theoretical Implications

Our framework extends existing conceptions of human–AI collaboration in education by exercising agency not at the point of use but at the point of instructional design. In the law simulation, the educator's prompts became a *pedagogical contract* that encoded procedural justice and evidentiary ethics into machine dialogue. In the nursing scenario, the designer instantiated empathic communication patterns and affective variability as parameters for AI behavior, allowing emotional authenticity to be computationally enacted. In the programming tutor, the instructor embedded debugging heuristics and scaffolding cues into the AI's feedback logic, enabling the system to model expert reasoning rather than merely provide answers. Together, these case studies demonstrate that AI can serve as a medium through which educators project and exercise their pedagogical agency and embed human epistemic and moral standards into systems that act, respond, and evolve within designed boundaries.

Our approach to the deployment of AI for teaching redefines as a reflective extension of the educator's intellectual and ethical framework, rather than allow AI to act as an autonomous agent, thus ensuring that machine responses remain tethered to human-defined purposes and adapt dynamically to the nuances of real-world teaching contexts. In essence, our framework elevates pedagogical design from static planning to a living process, where intentional encoding becomes the foundation for sustainable AI integration, ultimately reimagining education as a symbiotic dialogue between human discernment and computational adaptability.

Moreover, the reflection stage reframes data not as a measure of correctness but as a trace of reasoning. When teachers examine AI–student interactions, they are in fact observing the manifestation of their own design logic in practice. This recursive visibility of intention—how a teacher's encoded norms unfold in unpredictable student exchanges—offers a new epistemology of instructional design grounded in transparency and iteration.

B. Pedagogical and Institutional Implications

Pedagogically, our approach redefines the nature of teaching expertise. Faculty who design AI behaviors move beyond task delegation toward *epistemic translation*: they translate tacit disciplinary judgment into computational rules of interaction. Such design work demands the same interpretive sensitivity that underlies expert teaching—understanding nuance, anticipating misconceptions, and representing the discipline's moral center. The practice of *prompt engineering* thus matures into *pedagogical modeling*, where every instruction to the underlying LLM is also a declaration of what counts as valid reasoning and ethical engagement.

Institutionally, supporting educators as embedded AI designers requires structural recognition. Professional development no longer focus solely on tool usage but on *design literacy*: the capacity to articulate, encode, and audit pedagogical intention within AI systems. Universities need to create design repositories, ethical review channels, and credit structures for AI-augmented innovations. When such infrastructure is in place, AI classroom becomes not only a site of technological disruption, but a laboratory for epistemic stewardship.

C. Challenges and Future Directions

Despite its promises, our approach is not easy to implement. Designing AI behaviors that reflect disciplinary depth requires time, iterative testing, and cross-functional collaboration between educators, engineers, and edtech specialists. The scalability of faculty-driven design also depends on accessible interfaces that lower technical barriers while preserving design transparency. Moreover, the reflexive power of the framework raises ethical considerations: data from AI–student interactions must be treated as sensitive pedagogical artifacts, not as performance surveillance.

Future work should explore how collective intelligence can emerge when educators share and remix AI designs across disciplines. Such networks could evolve into living repositories of pedagogical reasoning, where prompts, feedback schemas, and evaluation rubrics circulate as open educational resources. Longitudinal studies are also needed to determine how engagement with AI systems reshapes teacher cognition. It would be interesting to determine whether designing, monitoring, and interpreting AI responses will help cultivate deeper meta-pedagogical awareness. Ultimately, the goal is not to perfect the machine, but to deepen human discernment through intentional design.

VI. Conclusion

In this paper, we propose a pedagogy-first paradigm for generative AI in higher education by positioning faculty not as users of existing tools, but as embedded designers who encode disciplinary reasoning, ethical norms, and instructional intent into AI systems. We show that our Embedded AI Designer Framework is broadly applicable to different disciplines including law, nursing, and computer science. By operationalizing the three stages of intentional design, orchestrated mediation, and reflective alignment, instructors can transform GenAI into a medium for pedagogical agency. As AI continues to evolve, the future of teaching will depend not on better automation, but on the educators' capacity to shape the behavior of the AI systems used for teaching and learning.

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