

Empowering Educators in AI: Insights from Co-Designing an AI Microcredential with and for K-12 Educators

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Abstract

This paper examines the co-design process for a foundational AI microcredential course targeting K-12 teachers' knowledge, agency, and effectiveness in integrating AI into their classrooms. We collaborated with six K-12 teachers and instructional coaches to ensure the course's relevance and practicality. Using conjecture mapping and memoing, we systematically captured and analyzed insights from the collaborative process. These methods helped us pinpoint essential themes and requirements for effective professional development (PD) that meets the unique challenges and opportunities of teaching about and using AI in K-12 classrooms. Themes included concerns about in-class monitoring for unethical impacts of AI integration and the desire for empowerment in evaluating and selecting AI tools that they can best leverage to meet state and national standards. Educator requirements centered on the creation of quick, easily accessible, and asynchronous learning activities. In addition, educators requested just-in-time AI integration resources and learning opportunities that can be leveraged throughout the year, rather than being limited to PD sessions. This study contributes to AI education by providing a framework for designing teacher professional development programs that are responsive to the evolving educational landscape and the specific needs of K-12 teachers.

Introduction

The rapid evolution of artificial intelligence (AI) is transforming classrooms, the workforce, and our daily lives. AI's role is expanding, influencing various aspects of education, including providing new tools for personalized learning (Graesser, Conley, and Olney 2012), automating administrative tasks (Murphy 2019), offering innovative ways to enrich student learning (D'Mello et al. 2024), and opening up opportunities for diverse learners (Song et al. 2024). Concurrently, the workforce is experiencing a shift where AI skills are becoming increasingly valuable, and individuals' personal lives are being reshaped by AI-driven technologies. Teachers are uniquely positioned to guide students through these changes, fostering an understanding of AI's impact and potential - no matter their content area (e.g., science, history, computer science, etc.). To fulfill this role effectively, teachers need professional development (PD) that

equips them with practical AI knowledge and integration strategies. However, current PD options for AI education are limited (Luckin et al. 2022).

To ensure that we meet the needs of K-12 educators, we co-designed an Introduction to AI microcredential with teachers and instructional designers. Co-design is a participatory process that involves stakeholders in the design and development of solutions, ensuring that the outcomes are relevant and practical for those who will use them (Roschelle, Penuel, and Shechtman 2006). In the context of AI in K-12 education, co-design is particularly useful as it empowers teachers to contribute their expertise and insights, resulting in educational products that are directly aligned with their real-world challenges and goals (Holstein, McLaren, and Alevan 2019). Despite its potential, there has been limited use of co-design in developing PD opportunities for teachers in prior research. By involving teachers in the co-design process, we aim to create learning experiences and resources that are not only informative but also highly practical and tailored to the unique needs of educators.

In this study, we adapted established co-design techniques in the development of our CS Everyone Center's AI Microcredential series to address the unique challenges of integrating educator insight into AI-based curricula with educators who have differing prior background knowledge of and experience with AI. This paper presents findings from this process targeting: **what professional learning do teachers anticipate they need in order to support the integration of AI in their classrooms?** We leverage conjecture mapping (Sandoval 2014) to help describe the novel features of the resulting PD design and inductive coding to identify key themes representing these professional learning needs. The aim of this paper is not to describe empirical evidence of teacher AI needs, but to provide precedent knowledge on co-constructing professional learning needs of K-12 teachers in AI with teachers to support PD designers and researchers as we collectively create important AI PD resources for K-12 educators.

Literature Review

Evidence consistently shows that involving teachers in the design and development of educational tools, materials, and resources is crucial for effective and sustainable classroom implementation (Reiser et al. 2000; Shrader et al. 2001; DiS-

alvo and DiSalvo 2014; Könings, Seidel, and Van Merriënboer 2014). To build on these insights for the design and development of an Introduction to AI in K-12 Education for pre-service and in-service teachers, we employ co-design, a collaborative process where educators and researchers work together to systematically create and develop educational innovations (Penuel, Roschelle, and Shechtman 2007).

Co-design approaches have demonstrated significant benefits for teachers. These include: (1) empowering teachers by giving them a voice in shaping technology that impacts their practice (DiSalvo et al. 2017), (2) aligning educational goals and teachers' instructional strategies (Barab and Luehmann 2003), (3) creating actionable insight from student results that leverages preferred instructional practices of teachers (Hutchins and Biswas 2023), (4) supporting teacher learning and skill development (Penuel, Roschelle, and Shechtman 2007), and (5) supporting the creation of relevant and usable materials for teachers' sustainable use in their classrooms (Barab and Squire 2004). As we develop PD opportunities integrating AI into K-12 classrooms, this approach can support a clearer understanding of relevant teaching activities, processes, and goals resulting in evidence-based design decisions (e.g., Matuk et al. 2016).

However, challenges have limited the application of this approach in the creation of AI-based educational innovations (Holstein, McLaren, and Aleven 2019). Teacher ideas on the role of technologies such as AI in education are often unclear or inconsistent (Hutchins and Biswas 2023), with many teachers holding different perspectives. Logistical issues such as time constraints and the need for additional AI training to support teachers in making meaningful contributions surrounding AI hinder co-design implementations (Martinez-Maldonado et al. 2016). This may be exacerbated by the need to involve both pre- and in-service teachers, with different prior knowledge and experiences, to the co-design of AI education training (Yim and Su 2024). While there are examples of end-to-end co-design for AI-based tool development, to our knowledge limited guidance is provided on the role of teachers in contributing to PD design and development, particularly surrounding AI in and for K-12.

AI in the K-12 education space is fairly new, but quickly evolving. This presents a unique challenge for teachers because many lack prior training and will now be expected to implement the advancements (Cukurova et al. 2024). Co-design offers a research-based approach to support the development of effective, practical, and actionable PD for K-12 educators. Their involvement ensures that the training is relevant, addresses their specific needs, and equips them with the tools and knowledge necessary for successful AI integration. This study describes a novel application of this approach in the design of our Introduction to AI in and for K-12 microcredential and presents key findings to inform future AI PD and learning experiences.

Methods

This paper reports on three co-design sessions aimed at creating a lesson sequence and accompanying formative evaluations for an Introduction to AI in and for K-12 education

microcredential. The microcredential is to be globally available to all teachers, regardless of background experience, and does not target any specific AI-based educational tool or software.

Initial Conjecture Map

Figure 1 shows our research team's initial conjecture map linking design elements of our proposed introduction to AI microcredential to our desired outcomes. This framework is composed of four primary components: High-Level Conjecture, Embodiment, Mediating Processes, and Outcomes.

Our High-Level Conjecture assumes that effective AI literacy learning and collaborations with colleagues can support teacher agency in modernizing their classrooms on their terms and in support of their pedagogical preferences. We believe that features of such effective training (Embodiment) include activities targeting AI curriculum usage and development, lesson planning experience, and discourse simulations on AI Literacy topics and practices. The AI Curriculum includes tools and materials like Learning Management Systems (LMS) and various resources, focusing on experiential AI applications and simulations. Lesson Planning provides lesson templates and other instructional materials, encouraging the use, modification, and creation of AI-related lesson plans. Discourse Simulations utilize forums and discussion boards for collaborative learning, incorporating reflection assignments to help teachers and students critically evaluate and understand AI applications and their implications.

The Mediating Processes detail the interactions and processes that bridge the embodiment to the desired outcomes of the AI teacher preparation program. These processes involve understanding core AI concepts, types, and concerns; connecting AI knowledge to classroom needs and applications; reflecting on preferred pedagogical processes and the impact of AI; and discussing AI applications in relation to student knowledge construction and problem-solving.

The Outcomes represent the goals and impacts of our introduction to AI microcredential for pre-service and in-service teachers. These outcomes include customizing AI applications to specific teaching needs, noticing the impact of AI on student learning and behaviors, engaging in AI literacy discussions with students, parents, and administrators, and reflecting on one's own practice to identify AI integration options. This framework aims to foster a learning environment where teachers can continuously evaluate and enhance their teaching methods through the integration of AI, ultimately improving student engagement and learning outcomes.

Co-Design Process

Six participants (4 middle school teachers and 2 instructional facilitators) participated in the co-design sessions. Three of the middle school teachers identified basic experience in using an AI tool either for or in their classroom (one used quiz applications that provide feedback, all used a generative AI tool such as ChatGPT). The remaining teacher expressed that they have explored AI tools via online resources, but had not used any for their classroom. Each edu-

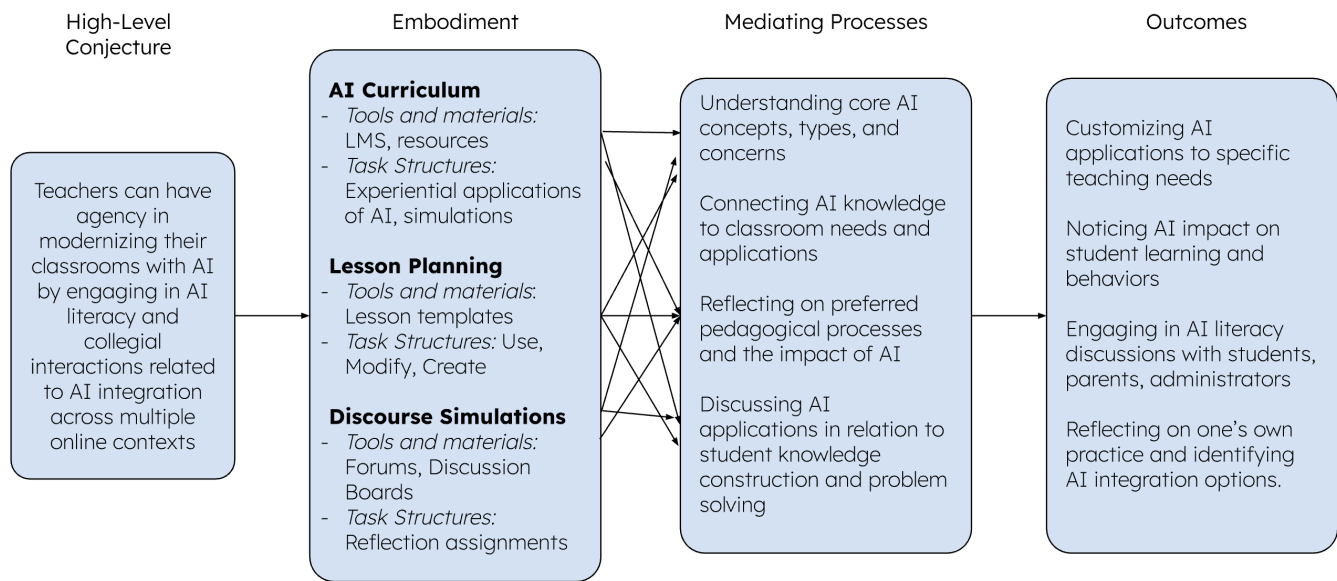


Figure 1: Initial conjecture map for our Introduction to AI Microcredential

cator consented to take part in the research of this University of Florida IRB approved study.

Educators completed a series of semi-structured focus group interviews and an accompanying card sorting activity focused on professional learning goals inspired by the Teacher Superpowers activity (Holstein, McLaren, and Alevan 2019). In this activity (illustrated in Figure 2), educators were tasked with identifying the professional learning statements that are most to least important to them in terms of the Introduction to AI microcredential. In other words, what aspects of professional learning were most important to them when it comes to completing an AI PD course and utilizing content from the course in their teaching. The task was framed in terms of four viewpoints: “I can...” statements that identified what prior knowledge they already have coming into the course, “I want to...” statements that describe activities or features of the microcredential they want to experience, “I will...” statements that describe the skills and abilities they will have following the completion of the course, and “I need...” statements that highlight critical concerns or needs that must be addressed in the course.

Data Collection

Each design session lasted for one hour. The audio of the sessions was transcribed using an IRB-approved audio transcription software. The final co-design activity products were deidentified and stored for researcher-only access.

To analyze the audio, we used inductive coding methods (Charmaz 2006) and created memos (Hatch 2002) to help us compare the feedback of the teachers. This approach was used as opposed to theoretically developed codes due to the exploratory nature of the work and a dearth of prior research examining educators’ preferences and needs for the integration of AI in their classrooms. In the evaluation of our memos, we reviewed the literature on AI PD for educa-

tors to refine our understanding and help us define emerging patterns. We noticed the recurrence of similar PD requirements (e.g., multiple memos identifying the need to experience approaches for identifying and mitigating the negative impacts of AI on student learning) and leveraged these recurrences in the identification of AI PD themes. In addition, we recognized the use of this conjecture mapping and coding approach is subjective, and alternate interpretations may be possible. It is important to note again that the intention of this work is not to provide empirical evidence for the approach, but to offer insight to develop and support future co-design of PD/PL approaches in AI for K-12 educators.

Results

We made several changes to our conjecture map during the design sessions (identified in green in Figure 3). In the AI Curriculum section, the tools and materials now explicitly mention resources that can be “Taken to the Classroom,” emphasizing practical, ready-to-use resources for educators. Additionally, the task structures now include the term “Short” to specify the type of experiential applications of AI and simulations, indicating a focus on concise, actionable learning activities.

In the Mediating Processes section, the phrase “Connect AI knowledge to real-world needs and applications” has been added to highlight the importance of practical relevance and application of AI concepts in everyday teaching scenarios. The reflection process now includes “district-level limitations,” acknowledging the need to consider local educational constraints and how they affect the integration of AI. Furthermore, discussions about AI applications now encompass “behavioral changes,” expanding the focus to include the broader impacts of AI on student behavior, in addition to knowledge construction and problem solving.

The Results section has been significantly enriched. A

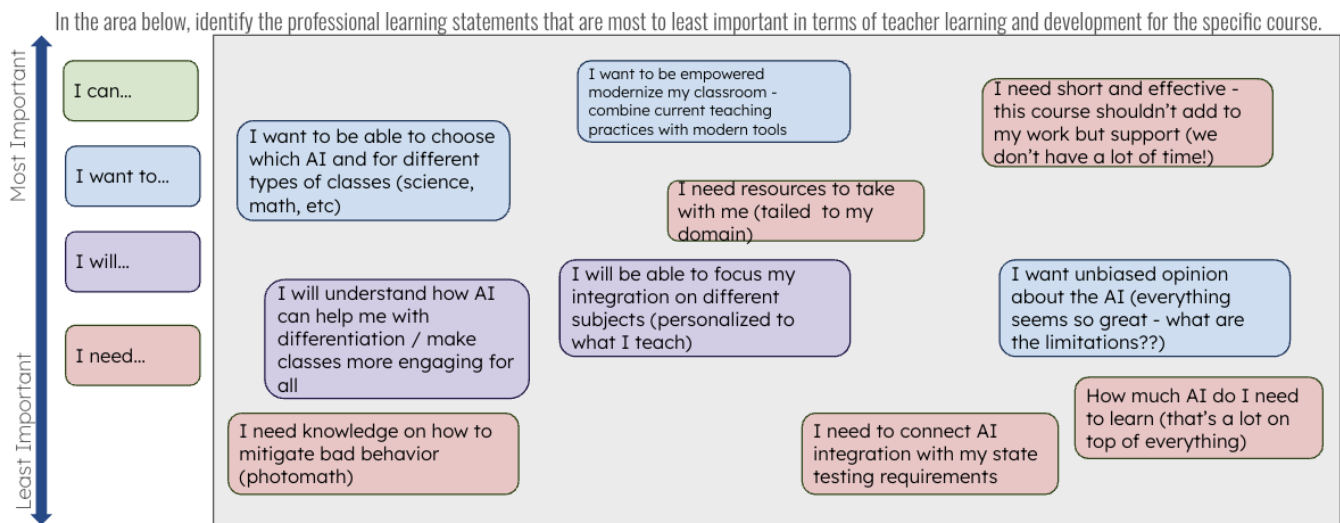


Figure 2: Example product from an AI Teacher Superpowers card sorting activity

new outcome, “Creating an unfiltered, unbiased opinion about AI in Education,” underscores the goal of fostering a balanced and objective perspective on AI among educators and students. The customization of AI applications is now extended to include “life outside of the classroom,” broadening the scope of AI’s relevance beyond the educational environment. Finally, reflection on one’s practice has been expanded to include “making modernization changes that integrate AI when applicable”, highlighting the importance of continuous improvement and adaptation in teaching practices through thoughtful integration of AI.

Themes Identified

Key themes were identified through the analysis of the discourse from the co-design sessions that supports a framework for the development of AI PD for teachers:

Teach to Ethical AI Integration in K-12: All of the participating educators expressed a concern about how to monitor for unethical impacts of AI integration and wanted additional training on what to look out for in their classrooms. An instructional coach participating in the co-design highlighted their feedback from teachers on AI by noting that:

“Like the very first thing that we want to talk about ... is what is AI and what is not. But then their main question is how do I use this in my classroom without it being a problem with ethics and they want to know more about that.”

In other examples, teachers asked what they should look out for or how would they know if a student has been negatively impacted by a chatbot or personalized learning experience, especially as they are still addressing and monitoring differences in how students manage their emotions, anxiety, or stress post-pandemic. For example, what are key student activities or reactions that teachers can monitor for to identify that a student has developed a dependence on an AI technology?

Another educator described that the introduction to AI course should include “the steps to creating ethics and rules in their classroom when using AI.” This practice is especially important as we as a community are still learning the various impacts of AI integration in the classroom.

AI Agency is Not Full Agency for K-12 Teachers: While educators want to feel empowered to evaluate and select tools that are best for their classroom, there are district limitations as to what AI tools can be used in the classroom. The instructional coaches and two teachers acknowledged that even if a district does not allow for an AI tool to be used, teachers must still be prepared or made knowledgeable of AI tools that could be used at home (both for their own professional needs and by students). This can have a particular impact on PD programs as only a small number of states have created AI integration guidelines, K-12 learning standards are limited, and differences in AI regulations make it difficult to prepare all potential teacher PD participants on AI usage for their classrooms.

Similarly, the participating teachers expressed the need to help them use AI to meet state and national standards. For instance, a middle school science teacher identified that they want to “use AI to make standards and learning goals more student-relevant,” while another highlighted a different perspective that they wanted to “personalize my AI usage to my state [and] classroom needs.” From this perspective, “agency” in the usage of AI still requires the effective meeting of standards and testing requirements, and an understanding of how to use such AI-based tools to meet those requirements as best as possible.

Unfiltered, Unbiased AI Knowledge and Experience Needed: Three teachers expressed that they need AI PD that is unfiltered and unbiased. For instance, the middle school teacher who created the card sorting activity in Figure 2, identified that “everything seems so great - what are the limitations?” While all educators identified negative consid-

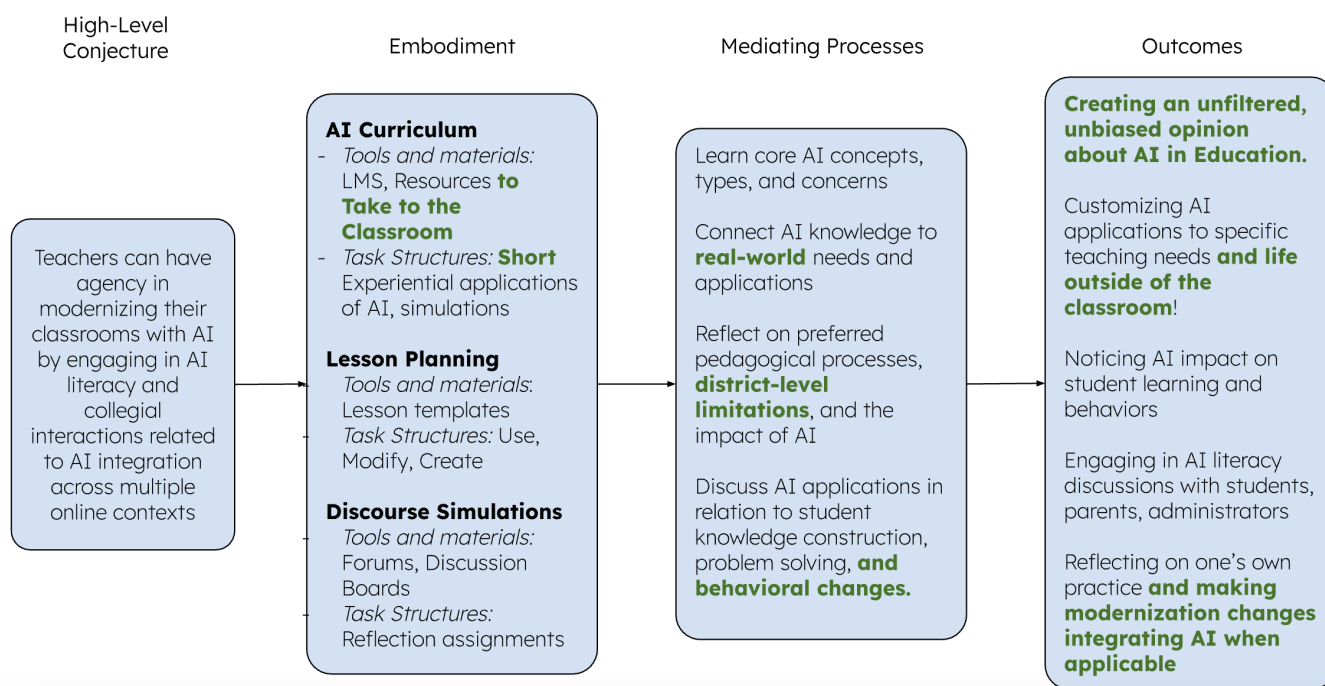


Figure 3: Updated conjecture map for our Introduction to AI Microcredential based on educator feedback

erations brought to their attention (e.g., data privacy, copyright issues), their concern centered on practical considerations of AI usage (e.g., how could it negatively impact their teaching practice, their students’ learning behaviors, etc.). To these teachers, the AI PD resources often market products to them instead of truly understanding what AI is, how it is used by the product, and what limitations exist for its usage. In addition, this may include a comparison of how to do similar tasks with different tools – or no AI-based tools. For instance, a teacher described that they want experimental access to these tools to mess up, try it out, and truly understand the tools limitations from their perspective as a teacher and from the perspective of a student.

Modernization On Their Terms: Three teachers described that they want frameworks or resources from their PD programs that help them orchestrate the modernization of their classrooms on their terms. To them, this meant that these frameworks would allow them to leverage their own existing pedagogical practices and preferences, even if they required paper-based activities. Their aim is to integrate technology-enhanced and AI-based learning systematically to support differentiation in their lesson plans and to better engage themselves as teachers in their students’ learning in ways that they feel prepared and able to excel at. One teacher identified that they “need to know what all AI can do in the classroom - level it up to improve student creativity, critical thinking skills.” In this case, both teachers in this discussion focused the majority of the discussion on generative AI tools such as ChatGPT, but then realized that they could not identify more AI usage opportunities that did not directly involve such recent generative AI software. As such, they expressed

the need for actionable insight, and for learning “more about AI in a way that can improve my usage of it.”

Professional Learning in AI Needs to Be Continuous - and Quick!: Similar to research in computer science PD (Yadav et al. 2016), educators want just-in-time AI integration resources and learning opportunities that they can leverage when they have time and that they can access or use as resources throughout the year (not just a summer PD session). For instance, an instructional coach identified a prior experience related to computational thinking PD in which the program didn’t only offer “a learning tool [lesson plan]” and instead teachers were “demonstrating implementation” in order to earn credit for the micro-credential. This opportunity allowed educators to take skills with them to the classroom to help them modify their lesson plans to the needs of the classroom. Similarly, a middle school math teacher described that “I need short and effective - this course shouldn’t add to my work but support [it].”

Case Study: From Thought to Action

Based on these recommendations, we have developed a series of learning modules for the microcredential equipped with short, actionable videos (less than 5 minutes each) and activities to ensure that the *Professional Learning in AI Needs to Be Continuous - and Quick*. We describe two activities co-developed for the Introduction to AI microcredential.

Exploring Bias in AI-based Tools

First, in a recommendation by one of our instructional coaches, we have designed an initial task for the first mod-

ule of the Introduction to AI microcredential in which teachers engage in the Teachable Machine online tool by Google. This activity targets (1) *Teach to Ethical AI Integration in K-12, Unfiltered, Unbiased AI Knowledge and Experience Needed*, and (3) *Professional Learning in AI Needs to Be Continuous - and Quick*.

In this activity, teachers are provided with a training set of images in which there are equal ripe fruit and unripe fruit. They are provided with instructions on how to upload their images to train the image model, train the model, and then test it with images that they take or that they find on the internet. Then teachers are provided with a new training set in which there are unequal amounts of ripe and unripe fruit images. Again, teachers are provided with instructions on how to upload, train, and test their models. In both cases, teachers are asked reflection questions about the accuracy of the model and, for the biased training set, teachers are also prompted to reflect on what that means if AI does not receive sufficient training data for different student demographics, experiences, or needs.

This task targets *Teach to Ethical AI Integration in K-12* in that it directly engages teachers with an AI tool in a way that explores what happens if there is bias in the data that AI is trained on. The aim of this activity is to aid teachers in their process of evaluating and questioning how AI is used and what data it needs for implementation in the classroom. The task targets *Unfiltered, Unbiased AI Knowledge and Experience Needed* in that it has teachers engaging in AI tools that are useful to the classroom quickly - in a low-stakes environment with resources for if they do something wrong. Finally, it tackles *Professional Learning in AI Needs to Be Continuous - and Quick* in that it provides a detailed activity that can be done from any browser and is estimated to take less than 15 minutes.

Initial anecdotal feedback on this activity from a group of 8 elementary educators identified that while the instructions were detailed, some misunderstandings about how to download images from a link (e.g., downloading one image at a time versus downloading a zipped file) and uploading it for the task needed further elaboration and exploration. We will continue to refine it.

Defining AI in Ways that Improve AI Engagement and Literacy

Throughout our conversations with teachers and the co-construction of the learning modules, we identified a unique discrepancy in how AI is defined. As an overarching reflection activity, teachers are tasked with defining AI based on their experience.

To start this reflection task, teachers are provided with definitions of artificial detailed in Figure 4. The goal of this activity is to demonstrate that there may be multiple interpretations of what AI is and that teachers have agency in determining their view of AI and how they want to engage with it based on what they learn throughout the course. For instance, an educator may focus on the idea that AI tools are created by humans and that the reasoning that occurs is based on algorithms made by a human. An educator may also better align with the definition that AI centers on the

artificial intelligence: a machine-based system that can, for a given set of **human-defined objectives**, make predictions, recommendations, or decisions influencing real or virtual environments.

(White House Executive Order on the Safe, Secure, and Trustworthy Development and Use of AI)

<p>artificial (ar-ti-fi-cial) [adjective]: humanly contrived</p>	<p>intelligence (in-tel-li-gence) [noun]: (1) the ability to learn or understand or to deal with new or trying situations : REASON also : the skilled use of reason (2) the ability to apply knowledge to manipulate one's environment or to think abstractly as measured by objective criteria (such as tests)</p>
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artificial intelligence: the capability of computer systems or algorithms to imitate **intelligent human behavior**
(Merriam-Webster Dictionary)

Figure 4: Definitions of artificial, intelligence, and AI presented to teachers

ability of machines to think like humans. This minor difference is discussed in cohorts and added to activity reflection assignments in an effort to expand teachers' views, interpretations, and relationships with AI-based tools. In turn, our aim is to align with the need for AI teacher PD to support teachers' *Modernization On Their Terms*.

Mitigating Ethics Concerns in the Classroom

As an extension to targeting *Teach to Ethical AI Integration in K-12*, we developed two formative activities for teachers to practice identifying ethical concerns of AI usage and responding to these concerns.

Throughout the course, microcredential participants learn about and explore key concerns when it comes to AI, including: Bias, Transparency, Accountability, Fairness, Privacy, Environmental Impact, Copyright concerns, and more. In our third module, *AI Critical Eye*, microcredential participants dive deeper into these issues and more specifically, examples of how these concerns may appear in school. For example, participants target Data Privacy, Safety, and Security, Ethical Use of Generative AI, and Student Self-Perception and AI Dependency. Then participants are provided with different classroom scenarios in which they have to identify which type of concern the scenario brings up and, af-

ter answering, the system responds with feedback on how they may address or respond to the situation. For example, one scenario includes: “A student becomes heavily reliant on an AI tutoring system for their homework, gradually losing confidence in their ability to solve problems independently.” After selecting whether the scenario concerns Dependence, Bias, Copyright, or Privacy, participants are recommended to “Observe the student’s problem-solving approaches and provide opportunities for them to complete tasks without AI assistance. Encourage the development of critical thinking and independent problem-solving skills.”

In the subsequent module, participants are provided new scenarios that demonstrate an example of an AI impact in the classroom and are asked to provide what they would say to the person (e.g., a student, colleague, administrator) to mitigate any negative impact, in a format similar to Teacher Moments (Benoit et al. 2021). An example scenario is: “You have noticed that a student is feeling increasingly discouraged due to the feedback they receive from an AI-powered grading system. The student feels the AI is harsh and that their efforts are not being fairly recognized, which is affecting their self-esteem and motivation.” Participants are asked to “Write or record a response on how you would discuss this concern with the student. Consider how you would validate their feelings, explain the role of AI in grading, and suggest strategies to help them improve their work and regain confidence.” For these modules, our microcredential grading team will review the responses based on pre-defined rubrics and provide participants with feedback on their approaches.

Discussion

The themes identified in our results align well with the existing literature. There is a growing body of research emphasizing the necessity of incorporating AI ethics into AI curricula (Akgun and Greenhow 2022; Adams et al. 2023; Williams, Kaputsos, and Breazeal 2021; Walsh et al. 2023). Building upon prior studies, our findings underscore that in order to teach students AI ethics effectively, it is paramount to equip teachers with the relevant knowledge. This preparation enables educators to foster a critical mindset in students which is crucial for understanding the societal and ethical implications of AI techniques in the classroom. Similarly, AI agency has been extensively discussed in the literature (DiPaola et al. 2023; Lan and Chen 2024). Our study not only supports these discussions but also expands the concept of agency beyond the classroom setting and various approaches.

Moreover, our findings about pedagogical practices resonate with recent calls from several systematic reviews (Zhai et al. 2020; Jia, Sun, and Looi 2024; Heeg and Avraamidou 2023), which highlight that while current studies often focus on developing AI systems, they frequently overlook the pedagogical integration of these technologies. Our study contributes to this discourse by examining the underlying rationale and strategies for professional learning activities to better support teachers in purposefully and effectively integrating AI into their instructional practices.

Conclusion and Future Work

In conclusion, this paper underscores the pivotal role of co-design in crafting impactful professional learning opportunities for educators, such as microcredentials. Teachers, positioned at the frontline of AI integration in classrooms, offer invaluable insights and experiences that must be harnessed to embed AI in education ethically and effectively. This paper provides essential precedent knowledge on designing AI teacher PD tailored to the unique needs of K-12 educators and contributes to the AIED field by highlighting the importance of collaborative, context-sensitive approaches to PD in the evolving landscape of AI in education.

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