2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC
Host Sponsor UNC Charlotte
ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION
Paper ID #51129

Developing a stack of AI micro-credentials for K-12 educators

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Hengtao Tang is an associate professor of Learning Design and Technologies at the University of South Carolina. His research interests address the intersection of self-regulated learning, multimodal data analytics, and artificial intelligence (AI) in education. Specifically, Hengtao applies multimodal data analytics to understand how learners regulate their learning and their collaborative problem solving in technology-enhanced learning environments and thereby creates AI-driven scaffolds to facilitate learners' STEM learning outcomes.

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Abstract

Micro-credentials are digital certifications that verify an individual's competence in a specific skill or set of skills, showing the promise of serving as a powerful tool for personalized professional development in PK-12 education. In response to the urgent nationwide demands for integrating AI into K-12 education, micro-credentials can be an alternative option to engage K-12 educators in developing competence and readiness for understanding, evaluating, and integrating AI in their own courses. This proposal showcased an interdisciplinary initiative of creating a stack of AI micro-credentials for K-12 educators in a southeastern state of the United States, following an evidence-based approach. An interdisciplinary team, including educational scholars and practitioners, K-12 educators, and AI specialists, developed a stack of micro-credentials focused on human-centered, ethical integration of AI in K-12 education. Each micro-credential included a key method for learning and demonstration of mastery, method components with required activities, empirical evidence that shows mastering the competency benefits teaching and learning, and resources to support or extend learning. Explicit rubrics on determining K-12 educators' mastery of competence were provided as references. The proposal will also discuss the motivating context and the implementation of the initiatives in detail and propose recommendations for future endeavors of integrating micro-credentials to support teacher professional development in AI education.

Introduction

Artificial Intelligence (AI) has been rapidly reshaping classrooms, curricula, and the ethical landscape of K-12 engineering education in K-12 settings. Accordingly, teacher preparedness in integrating AI literacy in their instruction becomes a pressing priority. Scholars and reviews argue that AI literacy for K-12 must move beyond basic tool use to include conceptual understanding, critical appraisal, and ethical awareness so teachers can guide students to interact with AI responsibly [1], [2]. Recent systematic reviews and frameworks emphasize that educators need concrete, practice-oriented training in AI concepts, classroom applications, and the socio-ethical implications of AI in schooling to avoid deepening existing inequities [3], [4].

Micro-credentials are competency-based, evidence-reviewed certifications of specific professional skills [5], [6]. Micro-credentials are an especially well-suited professional learning model for meeting this need because they combine focused skill development with performance-based assessment and flexible, on-demand delivery. Research and national initiatives have highlighted that micro-credentials enable teachers to demonstrate classroom-ready competencies. Moreover, micro-credentials scale more rapidly than traditional workshop models while supporting stackable, career-long learning pathways [7], [8]. Therefore, micro-credentials are increasingly adopted by districts and states as PD and licensure options. Embedding AI content within micro-credential frameworks is promising to offer a pragmatic pathway to equip K-12 teachers with the knowledge, practices, and dispositions required for AI-integrated teaching and learning.

Literature Review

Microlearning has emerged as an innovative PD model that delivers competency-based instruction in small, manageable units [9], [10]. Micro-credentials, as part of this approach, provide educators with personalized learning pathways and just-in-time knowledge acquisition [11]. Unlike traditional PD workshops, which require extended time commitments, micro-credentials offer a flexible, self-paced alternative that enables teachers to acquire targeted skills aligned with their professional growth [6]. Additionally, micro-credentials support differentiated learning by allowing educators to focus on specific competencies relevant to their instructional needs [12].

A key advantage of micro-credentials is their emphasis on demonstrated mastery through competency-based assessments, ensuring that educators acquire practical, applicable knowledge that directly enhances their teaching practices [5]. These digital certifications are particularly valuable for educators seeking continuous learning opportunities that align with evolving technological advancements. Furthermore, micro-credentials foster a culture of lifelong learning by enabling teachers to progressively build expertise in AI concepts, applying their skills in real-world classroom scenarios [13]. By leveraging microlearning strategies, micro-credentials empower educators to stay current with industry trends, ultimately enhancing the quality of STEM education.

Development

Developing effective micro-credentials requires a strong foundation in both pedagogical and subject matter expertise. Ideal micro-credential developers should possess a deep understanding of their field, ensuring that the competencies covered are both relevant and rigorous. Additionally, they must be able to identify and analyze the specific skills required to demonstrate proficiency, ensuring alignment with industry standards and educational best practices. The ability to design meaningful evaluation tools is also essential, as assessments should accurately measure learners' mastery of the targeted competencies. Furthermore, micro-credential development is a collaborative process, requiring a willingness to work closely with peers to refine content, integrate feedback, and ensure coherence across the credential stack. This requires the development team to be dedicated to maintaining high-quality standards and ensuring that the micro-credentials serve as valuable, evidence-based professional learning tools.

For this project, an interdisciplinary team of educators and engineers collaboratively developed a structured stack of micro-credentials to cover essential competencies in AI. The development process began with a two-day collaborative session where educators, industry professionals, and instructional designers worked together to determine the content areas and topics to be covered in the micro-credential stack. This collaborative approach ensured that the micro-credentials were aligned with both educational standards and industry needs.

Each micro-credential within the stack consists of several structured sections. The Key Methods section defines the essential competencies required to integrate AI concepts into classroom instruction. These objectives align with national and state educational standards, ensuring their applicability to the broader K-12 curriculum. Each micro-credential clearly outlines the specific knowledge and skills teachers will develop, from understanding automation processes

to implementing real-world applications. The Supporting Rationale and Research section outlines the literature support that justifies the importance of a competence and allow the audience who are interested to read more about relevant research on the competence. The Resources section provides teachers with supplementary materials that enhance their understanding and instructional implementation. These include curated industry case studies, instructional videos, interactive toolkits, best-practice guidelines, and access to AI simulations. The Submission Guidelines section introduces the procedures and requirements for the audience to submit relevant materials, followed by a section focused on artifacts and rubrics. This section establishes clear performance expectations through structured rubrics that assess teachers' proficiency in integrating AI concepts. These rubrics measure factors such as lesson plan effectiveness, the integration of technology into pedagogy, and the overall impact on student engagement and understanding. Then the last section engages the audience in reflection of their professional learning experience and articulate their professional growth by responding to preset question prompts.

Work-in-progress Updates

This project adopts a stacked micro-credential design intentionally structured to scaffold learning across increasing levels of complexity aligned with the five big ideas by AI4K12.org [14]. Each micro-credential functions as a competency benchmark to form a coherent pathway aligned with the project's AI-integrated curriculum. The team will co-design micro-credentials with teachers and relevant stakeholders ensures the learning experiences are relevant and tailored to educators' specific needs [13], [15]. Research suggests that professional learning is most effective when it is participatory, contextually embedded, and aligned with teachers' instructional goals [16], [17]. By actively involving teachers in the design and iterative refinement of micro-credentials, this ecosystem empowers teachers as co-creators of their professional learning pathways and thereby reinforces teacher agency and expertise in AI adoption [18], [19]. Furthermore, engaging multiple stakeholders in collaborative co-design fosters a collective vision for AI integration and creates a shared understanding of best practices across school districts [20], [21]. The AI micro-credential stack is organized around the AIK-12 Five Big Ideas for AI Education (e.g., Perception, Representation and Reasoning, Learning, Natural Interaction, and Societal Impact). Rather than treating these ideas as abstract concepts or isolated content topics, the project operationalizes each Big Idea as distinct micro-credential tiers, with clearly articulated competencies that integrate AI knowledge, pedagogy, and disciplinary teaching practice. In this design, each micro-credential corresponds to what pre-service teachers should understand, enact, and demonstrate when integrating AI into instruction.

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