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PREFACE

Preface to the Special Issue on K-12 AI Education

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Abstract
It is widely recognized that AI is beginning to profoundly impact society around the globe. These developments are introducing new opportunities, presenting new risks, and fundamentally reshaping the current and future workforce. As such, we must now answer critically important questions: How can we prepare K-12 students for an AI-permeated future? How do K-12 students conceive of AI and what do they need to know to be effective consumers of AI technologies? What competencies do K-12 students need to acquire to be prepared for workplaces where human-AI teaming is the norm? What do future knowledge workers, including but not limited to those in STEM, need to learn in primary and secondary school to set the stage for their careers, which will no doubt require the ability to effectively interact with AI tools? How can K-12 education best prepare future AI developers, engineers, and researchers? This special issue explores the emerging field of K-12 AI education research.

Keywords AI education · K-12 education · K-12 AI education · Computer science education

While the field of "AI in Education" has long focused on creating innovative AI technologies to support human learning, the goal of this special issue is to stimulate discussion of "AI Education for K-12" i.e., educating K-12 students about AI. In a manner that is analogous to how we educate K-12 students about science or history, we now must develop curricula, pedagogies, and learning technologies (perhaps including AI-based learning technologies) to support K-12 AI education. This spe-

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cial issue features articles that address core challenges in how to envision, design, develop, and implement AI K-12 education.

The special issue opens with an introductory article by Wang and Lester. Beginning with the observations that AI technologies are growing at an unprecedented pace and that they are rapidly beginning to affect every segment of society, the article presents a call to action for K-12 AI education. The article argues that successfully launching the AI education enterprise requires developing a deep understanding of how students can learn AI in age-appropriate ways and how teachers can use the most effective pedagogies in introducing students to AI. It concludes by recommending that we develop a research foundation for K-12 AI education that follows the models of mathematics education research and science education research and builds on developments over the past decade in computer science education research to create evidenced-based principles for K-12 AI education.

The introductory article is followed by seven articles that present emerging work on a broad range of K-12 AI education. First, Touretsky et al. examine how machine learning should be introduced to K-12 students. Based on the AI4K12 initiative, they discuss how the Five Big Ideas in AI provide an organizing framework for K-12 AI learning progressions with a focus on machine learning. Next, Ottenbreit-Leftwich et al. present an investigation of AI education at the elementary school level. Emphasizing grade-appropriate content for elementary school students, they present a co-design approach for AI curricula. The next article by Zhang et al., describes the design of a workshop to develop AI literacy in technical concepts of AI and AI in future careers, with additional focus on ethical and societal implications of AI.

This is followed by an article by Williams et al., who present project-based AI and ethics curricula for middle school. By minimizing prerequisite knowledge required, they endeavor to create curricula that can be widely used. Next, Leitner et al. introduce a game-based learning framework for high school AI education. Exploring the intersection of AI, mathematics, and computational thinking, they present a game that introduces students to AI classical search methods and scaffolds AI-based representations and problem solving. Then, Bellas et al. describe an AI curriculum for high school students that uses an embedded intelligence approach. They present the results of a pilot investigating the curriculum in use and describe teacher feedback. Finally, Tang et al. present a professional development program for STEM education that centers on machine learning. Utilizing a machine learning platform, the program aims to introduce teachers to machine learning so that they can effectively utilize it in their classrooms.

The special issue concludes with a commentary by Lane. Prior to reviewing the articles, the commentary first highlights the unique challenges of K-12 AI education and how the AIED community is well positioned to draw upon its knowledge and experience in AI and its commitment to rigorous educational research. The commentary then discusses the key topics covered by the articles, from teacher professional development to grade band progressions, and it details the contributions of each of the articles on K-12 AI education research agenda.

While the articles in this issue collectively represent an auspicious beginning for K-12 AI education research, they are nevertheless a first step. Much remains to be done to create a theoretical foundation and a body of empirical results that contribute

to evidence-based practices for promoting learning and teaching of AI in K-12 education. We hope that this special issue will help crystallize the nascent field of K-12 AI education research, and we eagerly look forward to seeing it progress, mature, and inform the development of K-12 AI curricula that find broad adoption.

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Data Availability Data and materials created for this research are available upon request. Please direct all inquiries to the corresponding author.

Code Availability Code created for this research is available upon request. Please direct all inquiries to the corresponding author.

Declarations

Conflicts of Interest No potential conflicts of interest.