

Investigating the Needs of Middle School Educators in Teaching Artificial Intelligence

Danielle Boulden
dmboulde@ncsu.edu

North Carolina State University
Raleigh, North Carolina, USA

Jessica Vandenberg
jvanden2@ncsu.edu

North Carolina State University
Raleigh, North Carolina, USA

Alex Goslen
amgoslen@ncsu.edu

North Carolina State University
Raleigh, North Carolina, USA

Veronica Cateté
vmcatete@ncsu.edu

North Carolina State University
Raleigh, North Carolina, USA

Wookhee Min
wmin@ncsu.edu

North Carolina State University
Raleigh, North Carolina, USA

Bradford Mott
bwmott@ncsu.edu

North Carolina State University
Raleigh, North Carolina, USA

Abstract

Widespread and accessible use of artificial intelligence (AI) has escalated dramatically in recent years, with teachers being among those who need to understand, use, and teach these concepts and technologies. However, teachers' access to training and their interest in learning and using AI vary, often due to limited opportunities to attend rigorous, out-of-school training and to receive on-going classroom support. In this work, we report on thematic findings from a contextual analysis of teacher responses to open-ended survey items as well as interviews with them, which informed the design of a customized and relevant professional development (PD) experience for a group of middle school teachers. Our findings have implications for teacher PD in K-12 AI education.

CCS Concepts

• Social and professional topics → K-12 education;

Keywords

Professional Development, Artificial Intelligence, Middle School

ACM Reference Format:

Danielle Boulden, Jessica Vandenberg, Alex Goslen, Veronica Cateté, Wookhee Min, and Bradford Mott. 2024. Investigating the Needs of Middle School Educators in Teaching Artificial Intelligence. In *Proceedings of the 2024 ACM Virtual Global Computing Education Conference V. 2 (SIGCSE Virtual 2024), December 5–8, 2024, Virtual Event, NC, USA*. ACM, New York, NY, USA, 2 pages. <https://doi.org/10.1145/3649409.3691082>

1 Introduction

An emerging body of research suggests that K-12 teachers have interest in learning about and using artificial intelligence (AI), but that they often hold misunderstandings about AI [8] in addition to having little to no training on the topic [9]. Our own work in this area indicates that students hold more extensive and experiential knowledge of AI than their teachers, often resulting in teachers

feeling ill-prepared to teach AI [7]. Therefore, designing effective professional development (PD) experiences for educators is critical to support the implementation of AI instructional practices.

Context analyses can be a valuable tool and technique to design PD programs that are better aligned to learners' unique needs and teaching contexts [1, 2]. Likewise, recent work around teacher education in AI suggests an in-depth understanding of teachers' prior conceptions and attitudes helps PD providers address the appropriate content, as well as employ the most effective strategies to teach that content [e.g., 3, 9]. Thus, our research team conducted a context analysis to inform the design of PD and support resources to prepare rural, non-computer science (CS) middle school teachers to integrate and teach AI concepts.

2 Methods

We collected data from six teachers who were participating in our PD and research program. These six teachers taught various subjects (e.g., media/library, STEM, CTE) at five different middle schools in a rural county in the southeastern region of the United States. None of these teachers had any prior experience teaching students AI concepts.

Prior to participating in the PD, each participant completed a brief survey with open-ended items. Additionally, they were individually interviewed by members of the research team for approximately 15-20 minutes, using a semi-structured protocol. Both instruments were designed to assess contextual factors such as their backgrounds with CS and AI, knowledge and interest in AI, concerns with teaching AI, and resources that they believed could support their teaching. The survey responses and interview transcripts were independently analyzed by two researchers—using an inductive thematic content analysis process [6]—who identified and discussed the salient themes below.

3 Findings

Four major themes emerged from the analysis that informed the design of the PD experiences and support resources. The title of each theme reflects a participant quote that captured the essence of that theme. Each of these is explored followed by implications for PD and meeting non-CS teacher needs with teaching AI.

Theme 1: "AI is out there." Teacher comments such as, "I mean, it's out there, it is what it is. We just have to adjust, right?" indicated that these teachers were aware of the ubiquity of AI and the need

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

SIGCSE Virtual 2024, December 5–8, 2024, Virtual Event, NC, USA

© 2024 Copyright held by the owner/author(s).

ACM ISBN 979-8-4007-0604-2/24/12

<https://doi.org/10.1145/3649409.3691082>

for educators to adapt to its presence. A few of them even gave examples of how their students already encounter AI on popular apps like SnapChat. Favorably, because of this awareness, they were all motivated to learn more about it and share that knowledge with their students. “It’s obviously trending in that direction in the future, so I think it’s important for students to learn about it and know about it.” Inclusive of this idea was a desire to support responsible student use of AI, “This is where the world is going. Then we need to teach the kids how to use it responsibly.” Responsible use of AI emerged as its own theme that we expound upon in Theme 4.

Theme 2: “I don’t know what I’m doing.” Although the teachers placed value on the integration of AI into the curriculum, they all reported a lack of knowledge on the subject, while also lacking the confidence to teach AI to their students. Comments such as “I may not know all the answers to students’ questions. Students may use a program I introduce them to in the wrong way,” demonstrated that teachers’ concerns focused on the technical aspects of AI. Not surprisingly, they requested highly scaffolded resources to teach AI (e.g., slide decks, scripted instructions, and experts on call).

Theme 3: “AI should supplement thinking, not replace it.” One of the most interesting findings was teachers’ concerns that AI would “become so relied upon that humans can’t think for themselves.” All of the teachers remarked that they feared the presence of AI would hinder students’ ability to think and learn on their own. To highlight their sentiments, a few of them gave specific examples such as students “just copy and paste off of [ChatGPT] and they’re not really learning anything,” and “during math homework, a student asks Alexa for all of the answers instead of working the problems out themselves.” Conversely, the teachers seemed optimistic about the potential of AI to enhance student learning and productivity, and noted some vague examples such as “some students are never going to be able to write a thousand words [essay] so that could help support it.” Only one of the teachers provided a specific example of how he has his students use ChatGPT as an editing tool.

Theme 4: “AI within boundaries.” Finally, related to their recognition of the pervasiveness of AI and their concerns around its potential to stifle student thought processes, another salient theme emerged. All of the teachers noted a profound need for established parameters around AI use in education. Their excitement about AI was qualified by statements of concerns such as, “[AI] is gonna do our world some good as long as we...keep boundaries,” and “Making sure that AI is taught in schools safely and students understand what AI is and how to do it in a proper way.” Several of the teachers illustrated these concerns by referencing anecdotes of knowing about students (not their own) who had handed in assignments that had been generated by AI.

4 Implications and Conclusion

Overall, contextual analysis was a valuable tool to create a more tailored and relevant PD experience for middle school, non-CS educators to teach AI. For example, because the teachers held positive beliefs around the value of teaching AI, we were able to leverage this motivation and immediately commence with the PD content. Knowing they lacked confidence to teach AI, we provided scaffolds such as introducing an established conceptual framework for AI

education [5] and by engaging them in a hands-on unplugged activity to illustrate those core AI concepts before the use of AI-driven computer applications [4]. Additional PD implications follow:

- Capitalize on teachers’ prior knowledge of popular AI technologies to teach how AI functions in those applications (e.g., self-driving cars, Siri, ChatGPT)
- Model how specific classroom resources can be used to teach AI while teachers engage as active learners
- Provide easily accessible resources for teachers, including resource guides and hands-on activities
- Demo current AI applications that enhance student learning and discuss how students can use AI to be more creative and efficient
- Allow teachers time to consider ethical concerns alongside AI demos and the importance of AI literacy for alleviating unethical use of AI
- Provide teachers with resources to teach ethics and develop responsible use guidelines for their classrooms

This poster will provide explicit details on how findings from the contextual analysis were used to design this one-day PD experience, as well as how the data is continuing to provide insights as we design more in-depth PD and classroom support resources. Furthermore, we will engage session participants in a discussion of how these findings have broader implications for non-CS teachers’ adoption of AI.

Acknowledgments

This research was supported by the National Science Foundation under Grant DRL-2148680. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

References

- [1] Seyum Tekeher Getenet. 2020. Designing a professional development program for mathematics teachers for effective use of technology in teaching. *Education and Information Technologies* 25, 3 (2020), 1855–1873.
- [2] Björn Haßler, Sara Hennessy, Andrew Cross, Eness Chileshe, and Brian Machiko. 2015. School-based professional development in a developing context: Lessons learnt from a case study in Zambia. *Professional Development in Education* 41, 5 (2015), 806–825.
- [3] Annabel Lindner and Marc Berges. 2020. Can you explain AI to me? Teachers’ pre-concepts about Artificial Intelligence. In *Proceedings of the 2020 IEEE Frontiers in Education Conference (FIE)*. IEEE, 1–9.
- [4] Annabel Lindner, Stefan Seeger, and Ralf Romeike. 2019. Unplugged Activities in the Context of AI. In *Informatics in Schools. New Ideas in School Informatics: 12th International Conference on Informatics in Schools: Situation, Evolution, and Perspectives*. Springer, 123–135.
- [5] David Touretzky, Christina Gardner-McCune, Fred Martin, and Deborah Seehorn. 2019. Envisioning AI for K-12: What should every child know about AI?. In *Proceedings of the AAAI Conference on Artificial Intelligence*, Vol. 33. 9795–9799.
- [6] Mojtaba Vaismoradi, Hannele Turunen, and Terese Bondas. 2013. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences* 15, 3 (2013), 398–405.
- [7] Jessica Vandenberg, Danielle Boulden, Veronica Catete, Wookhee Min, and Bradford Mott. 2023. Exploring the AI experiences of rural students and teachers: A sociocultural perspective. In *Proceedings of the 17th International Conference of the Learning Sciences*. pp. 1763–1764.
- [8] Johanna Velander, Mohammed Ahmed Taiye, Nuno Otero, and Marcelo Milrad. 2023. Artificial Intelligence in K-12 Education: Eliciting and reflecting on Swedish teachers’ understanding of AI and its implications for teaching & learning. *Education and Information Technologies* (2023), 1–21.
- [9] King Woon Yau, CS Chai, Thomas KF Chiu, Helen Meng, Irwin King, and Yeung Yam. 2023. A phenomenographic approach on teacher conceptions of teaching Artificial Intelligence (AI) in K-12 schools. *Education and Information Technologies* 28, 1 (2023), 1041–1064.