International Society of the Learning Sciences

Exploring Teachers' Perspectives on Enacting Context-based Learning of Artificial Intelligence (AI) and Data Science to Support Students' Engagement and Learning

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Abstract: This paper presents an empirical study of high school teachers' perspectives on context-based learning about Artificial Intelligence (AI) and data science. Four teachers were interviewed after they had enacted a curriculum contextualized in healthcare. The data were coded for teachers' perspectives on what students learned; on the kinds of tasks that engaged students; and on the challenges and needs in teaching and learning about these fields. While context-based learning has the potential to promote students' career awareness and appreciation of AI and data science, future research needs to examine how best to sequence and structure tasks to help students develop requisite knowledge and how best to curate complex data sets.

Importance

Understanding how Artificial Intelligence (AI) and data science work and their potential impact, including any bias, is crucial to leverage technological advances appropriately and address related challenges (NEA, 2024). Emerging research foregrounds examining learning experiences and curriculum design approaches for promoting AI literacy (Casal-Otero et al. 2023). This study expands the existing research by elucidating teachers' perspectives on teaching about AI and data science in specific contexts and how these disciplines could be made accessible to students with varied prior knowledge and aspirations (Almasri, 2024).

Conceptual framework

To help students learn about AI and data science, it is important to frame instruction in contexts that are meaningful to them (Lee & Perett, 2022; Ottenbriet-Leftwich et al., 2023). Context-based learning recommends selecting contexts that highlight core concepts and that relate to students' lives and more broadly to societal issues. Healthcare context, including bias in healthcare, is relevant to students' personal lives and potential educational and career pathways. Healthcare problems often have a social and global reach, yielding complex data which may be used in predictive and generative ways to inform sustainable solutions. The following attributes are key in context-based learning (Gilbert et al., 2011). The *setting* is a social situation within which students are introduced to a specific context, and it relates to a community of practice. The *background knowledge* refers to the general knowledge required for students to participate in the setting. The *behavioral environment* includes tasks related to the context that exemplify the main concepts and practices (Finkelstein, 2005). Finally, the *specific language* represents discourse about key concepts and representations, such as graphs and visuals. The research question for this study was: *What do teachers think are the impact, challenges, and needs in supporting students' learning of AI and data science through a context-based approach?*

Methods

This study focuses on a curriculum about AI and data science contextualized in healthcare datasets. The *setting* involved a cross-disciplinary community of AI practitioners, data scientists, and healthcare professionals interacting with students and teachers about healthcare datasets. Students and teachers participated in discourse and interacted with a cross-disciplinary community of practitioners during in-class activities and an out-of-class datathon. The *behavioral environment* included tasks for coding, generating visualizations, working with databots (sensor device to collect data), building regression and decision tree models, and simulating algorithms. The *specific language* included discourse about accuracy and bias in healthcare datasets.

Participants

Data were collected from teachers in four high schools in a state in northeastern U.S. who taught this course as an elective. The students from their classes belonged to different grades (9-12). They brought varied prior experiences and aspirations in pursuing computer science, data science, and biomedical pathways. The teachers were thus serving heterogenous classes in terms of students' educational needs and interests.

Data Sources and Analyses

Semi-structured interviews were conducted with the teachers after they had enacted the context-based curriculum. Transcripts of the interviews were analyzed as per four codes (indicated in bold) capturing teachers' perceptions of: **students' learning**; **students' engagement**; **challenges** of teaching about AI and data science in specific contexts; and (**teacher and student) needs**. This analysis was guided by a broader coding scheme that was developed and applied through consensus coding (Saldaña, 2021). Three members of the research team first coded the transcripts individually, assigning a single code or multiple codes as appropriate to each teacher response. The codes were then finalized through discussion and consensus among the coders.

Findings

Three attributes of context-based learning (in italics) organize the findings derived from the coded data (codes indicated in bold text). Regarding *behavioral environment*, context-based tasks supported various aspects of **students' learning** of AI and data science. Students appreciated how these fields affect society and how bias in data can affect AI. They explored applications of AI that went beyond thinking of computers simply in terms of internet search engines, which was important from a career awareness perspective. They also experienced a tighter integration among STEM fields, which may help them understand how the fields inform one another.

> *I think there might have been a level of cross-pollination that was going on, and show the students, particularly on the healthcare side, that there's this whole branch in healthcare that involves computer science, and they're not mutually exclusive fields.*

To promote **students' engagement**, hands-on activities involving the use of personal data were appealing to them, such as data about temperature, pulse, and carbon dioxide they were breathing. Students appreciated working with digital tools to manipulate variables and properties, examine changes to discover quantitative relationships, and work with immediate results.

> *[Students] liked it when they could either work with stuff with their hands, or they'd get a sort of an immediate result. Some things that come to mind were the data bots, where we could actually capture data, and a lot of time it was their own personal data.... There were some of the tools we liked... where ... they could drag out different properties or variables, and then see how the graph would change and see if they could discover a relationship.*

Teachers also noted **challenges** in serving students who bring varied prior experiences and aspirations about educational or career pathways. Related to *specific language*, one challenge was about balancing multiple cognitive demands, such as introducing basics of coding; medical terminology; AI concepts, such as supervised and unsupervised learning; and data science practices, such as interpreting box plot graphs. Related to *behavioral environment*, large data sets may not always show clear trends that could be explored further for correlations and statistical significance. And related to *background knowledge*, students may not always have sufficient knowledge of when and how to use data visualizations appropriately.

Finally, specific **needs** regarding *behavioral environment* included designing activities to help students develop a solid framework including more generic examples on training AI engines, so students could incorporate new information from tasks involving examples from a particular (medical) context and with more data and specific (medical) terminology. And another need was to "*exaggerate*" the data sets in a way "*that you can really see how a box plot is useful and how you can compare box plots for different categories... and then maybe as you go through the course... we teach them that there are more subtle differences.*"

Discussion

These initial findings suggest that while teachers see how context-based learning can promote students' understanding and engagement with AI and data science, there is also a need for further research on attributes of contexts selected to frame instruction about these fields. Namely, future research may investigate how best to sequence and structure tasks, so students with varied prior knowledge and aspirations can develop knowledge to work with more context-specific content and how best to curate complex data sets, so students can explore patterns in data more deeply.

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Acknowledgments

This material is based upon work supported by the National Science Foundation (NSF) under Grant No. 2148451. We are also grateful to the teachers and students who join this research.