Researching the Impact of Artificial Intelligence Curriculum on Teachers' Thinking

Terri L. Kurz
Arizona State University
terri.kurz@asu.edu

Suren Jayasuriya
Arizona State University
sjayasur@asu.edu

Kimberlee Swisher
Arizona State University
kimberlee.swisher@asu.edu

John Mativo
University of Georgia
jmativo@uga.edu

Ramana Pidaparti
University of Georgia
rmparti@uga.edu

Abstract:
Artificial intelligence is a continually growing field that should be part of the educational process. Middle school teachers received two- to three-weeks of training across two states that emphasized image processing and machine learning using visual media. Personal Construct Theory (Kelly, 1955) was used to explore what changes in thinking occurred in relation to artificial intelligence. Dendrograms and descriptive statistics showed changes in thinking in relation to artificial intelligence. The dendrograms indicated shifts in constructs across the clusters.

Keywords: Artificial Intelligence, Middle School Teachers, STEM, Personal Construct Theory

Overview

Artificial intelligence (AI) has been describe as "*the* driving technological force of the first half of this century" (Holmes et al., 2020, p.1). AI can be seen in self-driving cars, face recognition software and a plethora of other examples. The technology advancements are occurring at a very rapid pace with ideas that seemed impossible ten years ago, that are now a reality. And while AI continues to globally advance, schools, school systems, teachers and K-12 educational systems have not embraced AI. Perhaps one of the challenges is that AI does not rely on a single subject. Rather, there is a focus on integrated curriculum including science, mathematics, and data science. Because teachers generally have no experience with AI, it is all but impossible for them to integrate content into their classes. Additionally, there are no national or state standards that emphasize AI as a topic. However, there has been very recent educational incentives that encourage topics like AI (Wong et al., 2020). For example, AI4K12 (AI4K12, n.d.) created some guidelines regarding the use of AI in the K-12 school setting. Individuals have also developed some ideas to encourage lessons that highlight AI through project based learning emphasizing STEM (Chassignol et al., 2018; Zimmerman, 2018).

To address the lack of AI experiences for teachers and their students, we developed a program entitled ImageSTEAM. It is a technology-infused workshop experience centered on computer vision that engages teachers and students in learning modules that target AI critical skills. Middle school teachers along with middle school student learn AI content with a specific focus on computer vision. For this study, our research question was: How did in-service middle school teachers alter their perceptions of AI after engaging in an online professional development computer vision training?

Methods

This research was conducted across two universities, one located in Arizona and the other in Georgia as part of a National Science Foundation grant. Data were gathered from in-service teachers in both states that primarily taught in Title I schools or districts. There were 12 participants total; six in Arizona and six in Georgia. Of those participants, eight completed all survey instruments connected to Personal Construct Theory (Kelly, 1955) data collection procedures. Participants in Arizona participated in construct elicitation through pairwise comparisons. Because of the timeframe of professional development, it was not possible for Georgia participants to complete pairwise comparisons at the same time as Arizona. Data from Arizona were used to create the repertory grid for both states. The constructs used for the repertory grid can be seen in **Table 1**. Constructs were ranked using a 5-point Likert scale (from strongly disagree (1) to strongly disagree (5)). Participants completed both the pre-professional development repertory grid and the post-professional development repertory grid. All grids were force complete, so there were no missing data that had to be addressed in our analyses. Missing data (starting with 12 participants and ending with eight participants) were a result of the in-service teachers not starting or completing the data surveys. IRB approval was received and all participants consented to participate in the study.

Table 1. *Constructs Ranked by Participants*

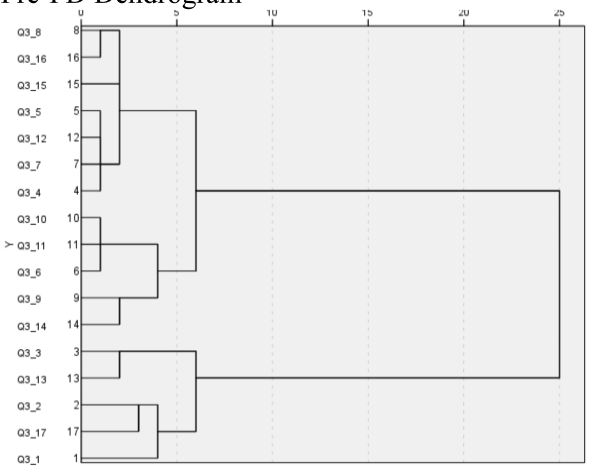
Label	Construct
Q3_1	Acquire knowledge through experience in the form of past data
Q3_2	Are biased
Q3_3	Can adapt and learn just like a human can
Q3_4	Can be integrated into science and mathematics
Q3_5	Can be used to enrich the lives of students
Q3_6	Can be used to personalize a student's learning experience
Q3_7	Connect to real world issues
Q3_8	Emphasize problem solving
Q3_9	Empower students to learn via experiments
Q3_10	Encourage collaboration among schools and others
Q3_11	Encourage students to develop their creative and intellectual potential
Q3_12	Engage students
Q3_13	Identify errors that are analyzed and corrected
Q3_14	Include gray areas with lots of subjective opinions
Q3_15	Incorporate computer use/computer programming
Q3_16	Involve critical thinking
Q3_17	Will only do what a programmer

Results

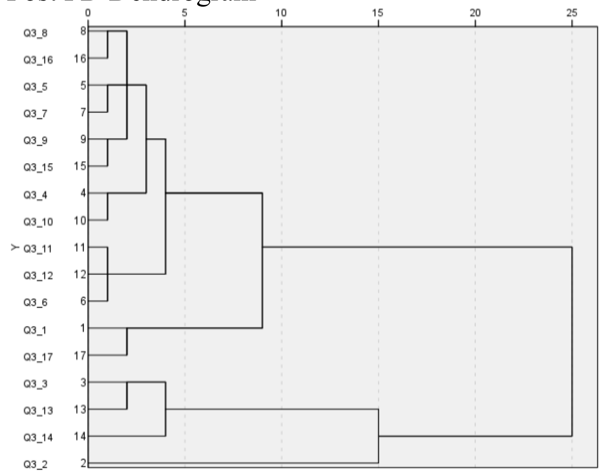
The results showed that the in-service teachers showed some changes in thinking in relation to their perceptions of artificial intelligence. More importantly, the dendrograms showed shifts in constructs across the clusters. There were four clusters in both the pre- and post-professional development dendrograms. However, there were construct shifts within those clusters. **Figure 1** is an overview of the dendrograms and the corresponding descriptive statistic for each of the 17 constructs.

Figure 1. *Pre- and Post-PD Dendrograms and Descriptive Statistics*

Pre-PD Dendrogram



Post PD Dendrogram



Descriptive Statistics, Pre-PD

	n	Min.	Max.	Mean	Std. Dev.
Q3_1	8	2	5	3.87	.835
Q3_2	8	2	4	3.00	.756
Q3_3	8	2	4	3.50	.756
Q3_4	8	4	5	4.38	.518
Q3_5	8	4	5	4.50	.535
Q3_6	8	4	5	4.25	.463
Q3_7	8	4	5	4.62	.518
Q3_8	8	4	5	4.62	.518
Q3_9	8	3	5	4.25	.707
Q3_10	8	4	5	4.38	.518
Q3_11	8	4	5	4.25	.463
Q3_12	8	4	5	4.62	.518
Q3_13	8	3	4	3.75	.463
Q3_14	8	3	5	4.00	.756
Q3_15	8	4	5	4.63	.518
Q3_16	8	4	5	4.62	.518
Q3_17	8	2	4	3.13	.641

Descriptive Statistics, Post-PD

	n	Min.	Max.	Mean	Std. Dev.
Q3_1	8	3	5	4.38	.744
Q3_2	8	2	4	3.13	.835
Q3_3	8	4	5	4.13	.354
Q3_4	8	4	5	4.50	.535
Q3_5	8	4	5	4.88	.354
Q3_6	8	4	5	4.62	.518
Q3_7	8	4	5	4.88	.354
Q3_8	8	4	5	4.75	.463
Q3_9	8	4	5	4.63	.518
Q3_10	8	4	5	4.63	.518
Q3_11	8	4	5	4.63	.518
Q3_12	8	4	5	4.75	.463
Q3_13	8	3	5	4.13	.641
Q3_14	8	2	5	4.00	1.069
Q3_15	8	4	5	4.75	.463
Q3_16	8	4	5	4.75	.463
Q3_17	8	3	5	4.25	.707

Conclusion

The broader implications of this research can positively benefit both the ImageSTEAM program as well as future teacher professional development in the field of artificial intelligence. It is clear that teachers experienced a positive shift in their attitudes and competencies surrounding AI. More technology-based workshops can potentially lower the barrier for middle school teachers to incorporate the material into their classrooms. However, there are still challenges including alignment with state-standards and how AI instruction can be made equitable particularly for schools and populations that are underprivileged and do not have adequate resources. Yet it is crucial for the United States of America in the 21st century to prioritize AI education in primary and secondary schools to maintain our technological edge in the global world in the future.

Acknowledgements

We would like to thank all the teacher and student participants of the ImageSTEAM program. We also thank Wendy Barnard and Megan O'Donnell for program evaluation. This research was supported by the National Science Foundation Innovative Technology Experiences for Students and Teachers (ITEST) program under award numbers DRL-1949384 and DRL-1949493. 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 National Science Foundation.

References

AI4K12. (n.d.). *Ai4k12.* AI for K12 Initiative. Retrieved from https://ai4k12.org

Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial Intelligence trends in education: a narrative overview. *Procedia Computer Science*, *136*, 16-24.

Holmes, W., Bialik, M., & Fadel, C. (2020). Artificial Intelligence in Education.

Kelly, G. (1955). *The psychology of personal constructs*. New York: Norton.

Wong, G. K., Ma, X., Dillenbourg, P., & Huan, J. (2020). Broadening artificial intelligence education in K-12: Where to start?. *ACM Inroads*, *11*(1), 20-29.

Zimmerman, M. (2018). *Teaching AI: Exploring new frontiers for learning*. International Society for Technology in Education.