Board 166: Experiences from ImageSTEAM Workshop for the Middle School (Work In Progress)

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Experiences from the ImageSTEAM Workshop for Middle School AI Curriculum (Work In Progress)

Abstract

The rise of computing and artificial intelligence (AI) will transform our society and it is clear that students will be forced to engage with AI in their careers. Currently, the United States lacks adequate infrastructure or capacity to support the teaching of AI in the K-12 curriculum. To address these challenges, we introduce the use of visual media as a key bridge technology to engage students in grades 6-8 with AI topics, through a recent NSF funded ITEST program, labeled *ImageSTEAM.* Specifically, we focus on the idea of a *computational camera,* which rethinks the sensing interface between the physical world and intelligent machines and enables students to ponder how sensors and perception fundamentally will augment science and technology in the future. Two workshops have been conducted, the first in summer 2021, and the second in summer 2022. The first workshop was delivered virtually due to the persistent COVID-19 environment at the time. The second workshop had one week conducted in-person and the second week was conducted virtually. Teachers and students participated in the workshops and their experiences will be shared and discussed at the conference. In addition, teacher use of the skills and knowledge learned from the workshops will be shared.

Introduction

This is a work in progress paper. To many teachers and students at the secondary education level, AI is an abstract phenomenon, a mystery that is hard to grasp. Further, AI's base knowledge derived from various disciplines such as computer science, engineering, cognitive science, and psychology are foreign in the realm of the secondary education. In addition to the aforementioned challenges, only a few opportunities exist for teachers and students to engage in as AI continues to grow [1]. This paper provides an effort to improve AI experiences for teachers and students at the middle school level.

The effort to roll out the AI experience to middle school teachers and students was named ImageSTEAM. The name is coined from the use of computer vision as the main theme for learning modules that were developed. The modules were a collaboration between middle school teachers and college faculty in engineering and education. The goals of the project to consider and use local environments and resources to develop knowledge in ImageSTEAM material surrounding computer vision and visual media, integrate machine learning and AI with core mathematics/science content necessary to understand these concepts, and to adopt educational theory based on STEM and the arts integration (STEAM) for far reaching interdisciplinary collaborations.

Literature

It is certain that AI will continue to impact human interaction with technology and society [2, 3]. The impact will be experienced in many aspects of life such as in healthcare [4, 5], and business

and marketing [6, 7]. Part of the preparation to offer AI knowledge and its use will be administered in schools, therefore, an examination to learn of the extent to which curriculums have adopted such content is necessary [8, 9]. The curriculums show integration of AI in various fields such as computer science, English, Social Studies, problem-solving learning, etc. [10, 11, 12]. Teacher preparation is advocated as a vital avenue to provide a sustainable professional experience that will, in turn, reach many at the school level [13]. Part of the role of education is to improve skills in decision-making, critical thinking, and problem solving. Lecture and theory based teaching methods deny success to those who learn through experience. Therefore, opportunities that provides a learner a chance to make mistakes and receive immediate feedback that AI brings affords is a welcome to education [8,15].

Method

A three-year plan to study the impact of the AI computer vision workshops for teachers is underway. The first two years have been completed and are being reported in this paper. Year three will be conducted during the summer of 2023, and at the end of the project a comprehensive assessment of the experience will be made. In essence, the ImageSTEAM program is a set of professional development workshops for middle school teachers to prepare them to introduce topics surrounding vision and AI into their classrooms. During the two-to-three-week workshop sessions, teachers co-create curriculum with research experts, and test them with middle school students in online classroom settings during the workshops. Initially, all workshops were to be conducted in-person setting however, complications from the COVID-19 caused students workshops be offered online. Notable technological experiences for both teachers and students included tools such as Teachable Machine, NVIDIA's GauGAN software, Google Colaboratory, and Pixlr.

Faculty engagement

The workshops conducted in both Arizona and Georgia a were designed and conducted by faculty researchers from Arizona State University (ASU) and the University of Georgia (UGA). The coordination of workshop roll out was done by both teams. The expertise of the faculty included Engineering, Media Arts, and Education. The Arizona team conducted their workshops first and then Georgia's team followed. All four faculty and graduate students participated in various aspects of the workshops. The first year, all workshops were conducted virtually. The second year ushered in-person workshops for teachers as students continued with the virtual participation.

Recruitment

In Arizona, teachers were recruited from local Arizona schools which are considered Title I schools where a large population of students served come from low-income families. Teachers filled out an application and then were subsequently interviewed by the research team before selected. Student participants were selected from applications to the Digital Culture Summer Institute at ASU, a summer camp for media arts conducted every year in June.

In Georgia, teacher recruitment was made by reaching out to three counties with different "economies" yet close enough to our workshop site to ease their teachers and student to travel during the sessions for in-person activities. Even though unexpectedly COVID-19 hit, the decision to have the three counties was upheld, with the expectation of future workshops post the pandemic. The three counties represented were somewhat different with the first county having a 52-75% reduced lunch; 80% white; 1% black; 9% other; the second county had 100% reduced lunch; 53% white; 45% black, 2% other; and third county had 70% reduced lunch; 36% white; 29% black, 22% Latino; 12% Asian; 1% other. Notification about the application for the workshops were sent to school districts. We asked the school districts to help recruit math and science teachers considering minority and underrepresented as priority. Two teachers from each county were recommended. Each teacher had to show interest and was to participate in the entire workshop and develop an AI lesson that they would adapt and use in their class.

Table 1: 2021 workshop participants

Participants	Arizona	Georgia
Teachers	4	6 +(1 from Arizona)
Students	27	20

Table 2: 2022 workshop participants

Participants	Arizona	Georgia
Teachers	6	6
Students	52	17

Workshops

In 2021, both Arizona and Georgia used a three-week model workshop to provide similar experiences to teachers and students. Below is a short description of the model.

In the first week of the three-week model, teachers were introduced to the AI concepts, that included data, AI, algorithms, neural networks, and deep learning. Technology experiences were made using tools such as Teachable Machine, Google Colab notebooks, NVIDIA GauGAN, Pixlr, and more. During the second week, both teachers and students were grouped together to observe and learn AI topics and technology/tools taught by the research team. In the third week, teachers in consultation with the project team, each developed a lesson module that was delivered to students along with some specific topics/examples provided by the project team. All students were involved in experiential learning activities in using the AI tools/techniques. Some students participated in a single week while others attend additional weeks. Based on initial feedback, students are eager to learn and experiment AI topics and activities [14].

In 2022, the three-week model was used again in Arizona, however, Georgia used a two week model. In the first week of the Georgia two-week model, teachers were introduced to the same AI concepts conducted in Arizona in the first three days. The next two days was used to develop courses they would engage students during the second week.

Results

In a pre-test/post-test design, students completed a computer-based survey during the first week of the workshop, prior to instruction (Time 1); and in the final week of the workshop, after receiving some instruction (Time 2). The student survey contained several measures related to student science identity, perceptions of science concepts, and intention to pursue STEM education and employment in the future. Twenty-nine students participated at Time 1 and seventeen of these same students participated at Time 2. Results of two-tailed T-tests showed that students' perceptions of themselves became significantly ($p < .05$) more active at Time 2. Students also perceived that their teachers thought of them as more powerful or strong at time 2 in comparison to when they started the workshop. Students' perceptions of *Artists* became significantly ($p < .05$) more active, and their perceptions of *Coders* and *Engineers* became significantly ($p < .05$) more powerful and active. Other concepts saw marginal ($p < .10$) upward trends in evaluation, potency, and activity. Students saw no significant change in the salience, prominence, or centrality of their science identities. There was also no change in intent to pursue STEM education or careers. However, preliminary analyses show marginal decreases in the distance between students' self-identity ratings and some science identity ratings suggesting that students may be more likely to see themselves as similar to scientists after workshop participation.

Teachers were asked to what extent they agreed or disagreed with 1) I gained valuable skill in AI that will improve my teaching skills, and 2) The skills and knowledge I gained will be beneficial to my students. Results indicate that 67% of teachers that completed the survey 'strongly agreed' that they gained valuable skills and knowledge that will be beneficial to their students and to their overall teaching skills. The however, stated that they had not mastered the use of the software and programs as shown by two remarks below:

I thought through the experience I was able to get some fundamental basic knowledge of at least what AI is having a better understanding of all the different areas in our life that AI is already incorporated into. So, definitely, I knew nothing before.

At the beginning I knew a little bit about it, I didn't know how much it was incorporated into what we do today, what the different tools they showed us, how easy it is to access free tools online that can show you AI working, and all of that. I had really not a lot of knowledge on that. So when I took the workshop, I was a little lost in the beginning because it was really new to me.

An observation from the teachers indicates their concerns of how State standards would fit the scheme of AI use in the instruction. This statement for example:

I can see it incorporating them like telling the students about the tool, telling them how it applies to AI. But because we're so tied with the standards and how we are teaching things and the testing and all these different things that we have on our deadlines, I told them it would be better suited like for an enrichment class.

Conclusion and discussion

Teachers were generally satisfied with the introduction to AI but were not sure how to use it immediately. Examples of responses to interviews include, “It was a very, very exciting experience for me more than anything because I was able to see all the different things that you can do … and how just how AI is tied to everything, it was very, very exciting. …I really did appreciate being involved in a part of this, it's exciting and it's new.” In another interview, a teacher commented that the most beneficial aspect for them was seeing how AI could fit into standards. This is important because this interviewee along with another expressed concerns about their ability to implement AI lessons that meet state science standards. Finally, and related to state standards, the third interviewee said the most beneficial aspect of the program for them was finding AI tools that match the curriculum and developing a mini lesson.

Similarly, most students who took the survey were also satisfied with the program as indicated by the 77% of survey respondents who agreed or strongly agreed that they would apply to be in the ImageSTEAM program again. More than half of the students agreed or strongly agreed they would recommend someone like them to attend the ImageSTEAM program (62%).

AI workshops, in this paper, are viewed as problem-solving events using critical thinking to explore ways and methods to improve learning using available tools. A comprehensive paper will be made, when the third and final workshop is made in summer 2023. Lessons learned from the workshop experiences will be shared with the community.

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