Middle School Teachers Lesson Modules on AI topics from Summer Workshop

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Abstract

Through a NSF funded ITEST program, labeled *ImageSTEAM,* a summer workshop was conducted at UGA by the team to empower middle school teachers to Artificial Intelligence (AI) topics. For the summer workshop, teachers were introduced to AI topics including computer vision, machine learning and computational cameras as part of their professional development. After the introduction, lesson modules were co-created with teachers to introduce them to middle school students in their classroom. The lesson modules were related to math/science/art topics and align with state and national standards of learning in middle school curriculum. After developing the lesson module, each teacher presented the lesson to workshop students to gauge their understanding and interest in AI topics. This paper discusses the variety of lesson modules developed by the teachers and how the lesson modules were adopted into middle school curriculum. The results and experiences of teachers/students (some specifics needs to be included??) will be shared and presented at the conference.

Keywords

K-12, AI, Teachers, Lesson Modules

Introduction

Artificial intelligence (AI) and its applications have transformed our modern society through technologies such as Alexa, Facebook, and Twitter. To prepare citizens for the future, there is a renewed interest in AI education, permeating K-12 and higher education, so that students have a strong understanding of the implications of this technology on their lives. Recently, the AI for K12 organization (AI4K12) has created a set of guidelines for teaching AI in public schools, and Zimmerman outlines lesson ideas for AI and design thinking and project-based learning for STEM (Zimmerman 2018). Introductory AI books have been introduced at the middle and high school level (Enz 2019a,b; Klepeis 2019b,a). In addition, there has been focus on teacher professional development through workshops incorporating AI concepts into STEM classes for high school students (Lee and Perret, 2022).

The primary challenge of introducing AI into K-12 levels is that few teachers have professional training and experience to deliver such a curriculum. Most teachers will not have taken AI course in their undergraduate/graduate training. Further, while there may be opportunities to introduce AI into computer science education, integrating into core science, math, and English/Language Arts (ELA) classes takes more careful design and creativity. Yet this integration is critical to reach a broad, diverse group of students (not just students who take computer science/technology electives) for whom AI will impact their future lives the most.

A two-week summer workshop was conducted at UGA by the project team to empower middle school teachers to AI topics, through a NSF funded ITEST program, labeled *ImageSTEAM*. The AI topics (computer vision, machine learning and computational cameras) were introduced to teachers during the workshop. Middle school teachers along with the ImageSTEAM team co-created the lesson modules and then tested with students during the workshop. The lesson modules related to AI with science/math topics integrating the standards was the focus for the workshop. The workshop details including teacher recruitment, development of lesson modules and evaluation with students are briefly described below.

Recruitment of Teachers

A flier was developed and distributed to attract and recruit teachers from Title I schools in coordination with the respective school administration (more details). At the end, we recruited a total of 6 teachers, 4 were female and 2 were males who teach in a designated Title I school. The ethnicity of teachers include two Spanish, Hispanic, or Latino, two White or Caucasian, one Black/African American, and one Asian. Teachers' experience ranged from 1 to 18 years of experience, with an average of 9 years in the classroom.

Lesson Module Development

The developed teaching lesson modules introduce AI technologies and tools, and provides several examples of how AI algorithms, data and predictions are used. Students learn about various AI techniques and tools as well as how the AI knowledge can be adopted for STEM subjects and ELA courses. Each teacher (a total of 6) developed a single lesson that integrates AI topics along with their topics they teach in the middle school curriculum and delivered at the end of the workshop. ImageSTEAM project team briefly introduced the AI concepts including data, AI, algorithms, neural networks through hands-on-technology experiences. These include Google's Teachable Machine, image editing software and image generation software (GauGAN) from Nvidia, and Tinker cad. After the familiarization of AI topics and tools, teachers led the development of a lesson module that incorporates these new AI into their own existing lessons they teach in the middle school curriculum. All teachers attended the next week workshop, in the morning and taught the new lesson to students. Each teacher received the feedback from everyone, and also observing peer lesson modules. More details about the lesson modules are briefly presented below.

The lessons modules developed by teachers at the UGA workshop include convex/concave concepts; rocks and geology; transparent, translucent and opaque; universal systems model; Spanish art; and geometry and CAD models. These lessons were organized with the following pedagogical materials: Lesson outline including objectives, standards alignment, and short overview of the lesson; video lectures and resources to be displayed in the classroom; lecture slides for teachers; teacher guide consisting of detailed lesson plan, scripts, and other helpful resources to teach the lesson. The lesson modules address the need for student training in AI technologies to be aware and be prepared for the disruptive applications to meet the complex challenges in future.

Teachers presented the lesson to students to get experience as well as feedback to further improve the lesson plan and implementation. To provide the details, a sample lesson module is presented below to further illustrate the AI concepts to middle school students.
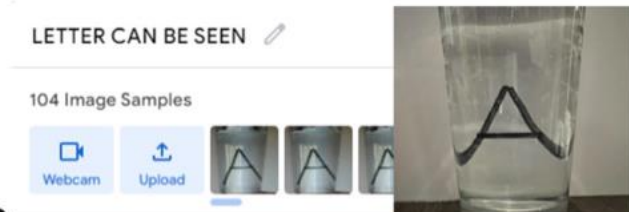
Sample Lesson Module: Translucent, Transparent, and Opaque

This lesson addresses translucent, transparent, and opaque materials, and how light flows through each, and is aligned with Georgia's standard S8P4.D – "Develop and use a model to compare/contrast how light and sound waves are transmitted through various materials." In the lesson, students participated in a lab where they decrease the transparency of water using milk and compare the computer's ability to see through materials of different transparency using Google's Teachable Machine. The lesson features a "gamification" strategy where interactive games are hidden in links in the lecture slides. Students click on these hidden links to connect to games such as Blooklet to test conceptual knowledge. This was an example where a teacher's pedagogical style helped inform the co-creation of this lesson and promoted inquiry-driven learning.

Fig.1 Student worksheet for Translucent, Transparent, and Opaque lesson

Evaluation and Results

An independent evaluation was conducted using multi-methods approach, which included Likert-scale quantitative survey questions as well as open-ended survey questions for the teachers. In addition, focus groups were conducted with the teachers. The following briefly describe the results.

Teacher Feedback

Teacher feedback was largely positive on the structure of the professional development: "The facilitators/instructors provided a general overview of AI. They introduced me to software applications that used AI in one way or another. The sequence in which they presented the material worked really well for me." Other teachers complimented the design and use of the website in the workshop, stating "The structure of this PD was efficient. One week of training and the other was practical. This program was practical in the AI field. It was something that is doable and user friendly for kids.". The teachers' experiences were not without challenges. One teacher noted "The only thing that might need improvement is allowing the teachers to really learn the material by following a specific set of curriculum or instructions, so when they have to create their lessons they are fully knowledgeable to an extent of the lessons and what is expected.", and another mentioned "Finding other programs to connect with the content, or developing programs to

connect with the content (standards). Converting this into an elective class at schools instead of in the content area if possible." This illustrates the challenge of adopting this curriculum into school districts more generally.

We are currently in the middle of evaluation, but the full evaluation will be completed which will then be reviewed by the leadership team for adjustment for the coming year workshop.

Conclusions and Future Work

The *ImageSTEAM* workshop in-person at UGA was successful and preliminary data analysis suggests that teachers were exposed to the AI and computer vision topics. With the knowledge abs topics gained, teachers were able to create lesson modules that were relevant to the science/math topics they usually teach in middle school curriculum. The teachers were able to present their lesson module to the students during the workshop to get feedback to further improve the lesson module along with *ImageSTEAM* project team. The finalized lesson modules will be presented to the students in Fall/Spring in the middle schools and these are also available at *ImageSTEAM* website (imagesteam.org). Finally, we will continue offering the workshop in the next summer and more lesson modules will be developed and the content will be available on the project website.

Acknowledgements

References

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