How to Train Your Robot: A Middle School AI and Ethics Curriculum

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1 Introduction

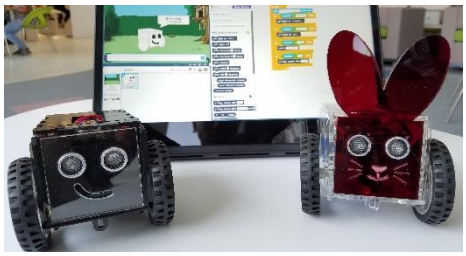

Fig. 1 Two Arduino robots and the Scratch interface used in the curriculum.

Artificial Intelligence (AI) education implemented in K-12 public schools is best positioned to prepare students from diverse backgrounds to thrive in our increasingly automated society. We developed the How to Train Your Robot curriculum to take on two pressing issues in making high-quality AI education available to all students: inability to scale and to train in-practice teachers. Last year, in collaboration with I2 Learning, we implemented our weeklong AI curriculum in seven 5-8th grade classrooms.

We designed the curriculum to be powerful yet accessible to non-experts, cost-effective and scalable, and constructionist. We emphasized two of the Five Big Ideas of AI, that AI can learn (Big Idea #2) and that it has good and bad impacts society (Big Idea #5) [1]. Building off previous work, we used both plugged and unplugged activities [2], taught ethical concepts in situ with technical ones [2], enabled students to train their own machine learning algorithms [3], and integrated physical artifacts to engage students in learning. To support teachers in implementing this course themselves in their classrooms, we conducted teacher training that prioritized developing their technical and pedagogical content knowledge of AI [4].

2 Curriculum Design

Everyday, students completed real-world connection modules, ethics modules, and technical modules. In the ethics modules, they learned about decision trade offs, stakeholders and their values, and the positive and negative impacts of AI. In the technical modules, students learned about and utilized text and image classification to

program AI-enabled robots. At the end of the week, students completed a final project where they used the robots to solve personally-relevant problems.

We used ScratchX as our programming platform; it allowed us to integrate custom machine learning and Arduino robot blocks. With this Chromebook compatible platform, students could train their own machine learning models for free and use them to control $50 motorized, Bluetooth-enabled robots (see **Fig. 1**).

Over the course of two full-day sessions, we trained teachers to prepare them for five full days of lessons. We focused on preparing teachers to work with hardware in the classroom and to address trickier concepts, like how to tell if something is AI or not and how to navigate ethical design decisions. During training, we relied heavily on guided practice strategies to help students grasp these new ideas.

3 Results

After they completed the curriculum, we interviewed three teachers at two of the participating schools. One school was a Title 1 (majority of students are economically-disadvantaged) school in Boston with a "tech-savvy" math teacher. The other school was a small (<100 students), rural school with two teachers, one with a technical background and one who was teaching science and math for the first time.

In teachers' interviews, we observed the following themes. First, that students were engaged with the curriculum. All teachers stated that the topic and hands-on activities led to every student being "more engaged than usual." Second, that teacher training should focus on key concepts and unfamiliar ideas. All teachers identified students understanding *What is AI or Not* as a key to students' understanding. Other topics had mixed results: some teachers embraced the ethics modules while others found them too unusual and confusing. Third, we saw that the use of hardware caused the most difficulty for teachers, but might be worth it. All teachers said that students were engaged "because there were robots" and that using robots helped students learn important skills like resilience. Still, teachers spent a lot of energy troubleshooting and managing frustration when things did not work.

References

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