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“Teacher Perspectives on HTTYR”
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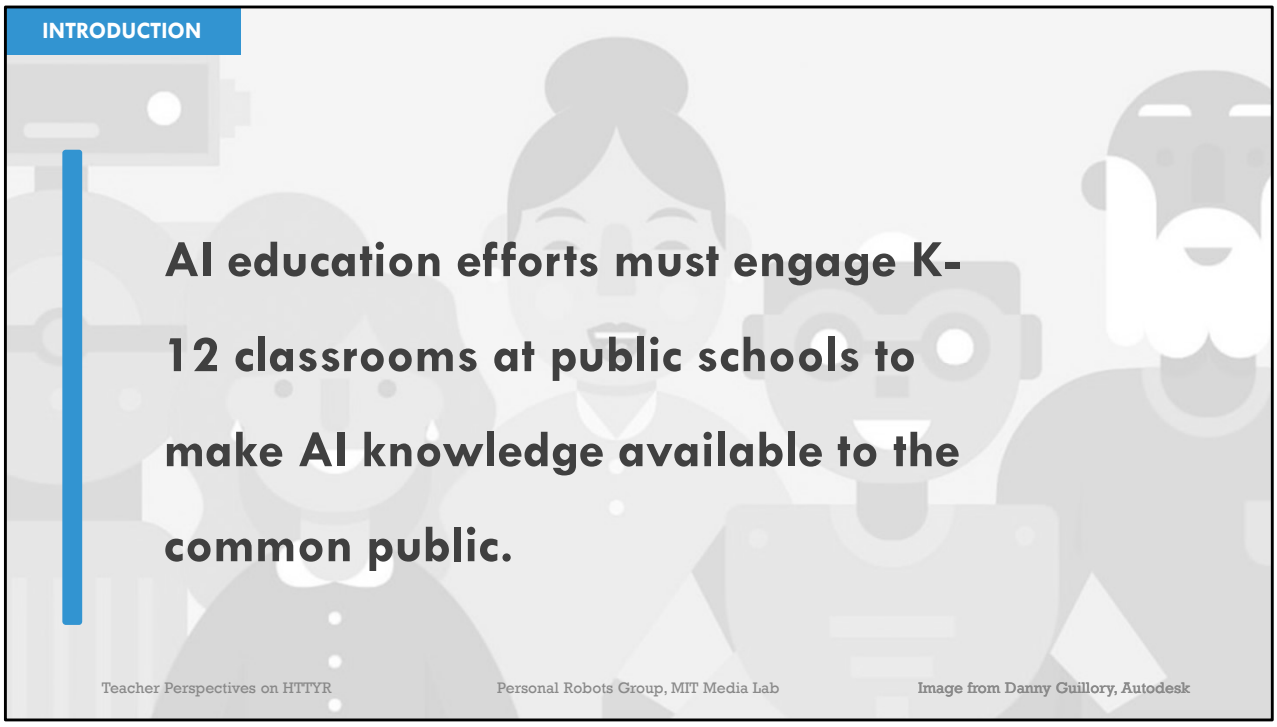


Children are growing up surrounded by AI – toys and other devices, chatbots and voice personal assistants, web services and social media
AI will continue to play a large role in their future

A lack of skills in emerging technologies could limit a person's ability to actively participate as a citizen and compete for the highest paying jobs.
AI skills gap exists and is widening

Important that AI skills are democratized. Today we're going to talk about how we scaled

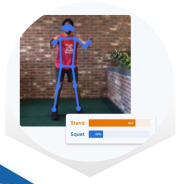
an AI curriculum by training teachers to deploy a middle school curriculum. The big question we explore is: how do we make AI approachable and engaging to non-experts

BACKGROUND

Prior Work in K-12 AI Education

WHAT IS AI?

Middle School AI + Ethics, Blakeley H. Payne, 2020



MACHINE LEARNING

Teachable Machine, Carney et. al, 2020
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Machine Learning for Kids, Dale Lane, n.d.

Mindstorms, Papert, 1980
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Robots in Undergraduate AI, Kumar 2004

AUTONOMOUS ROBOTICS

Teacher Perspectives on HTTYR

Personal Robots Group, MIT Media Lab

ETHICS & SOCIAL IMPACT

Decoding Design Agendas, DiPaola et al., 2020

Published studies on AI curricula in K-12 classrooms date back to at least 2010
The past 3 years have exploded

Prior work:

1. How to define and recognize AI
2. Computers learn from data
3. AI algorithms embodied in autonomous robots
4. AI impacts society in both positive and negative ways

HTTYR

Curriculum Overview

httyr.media.mit.edu

Hands-on, technical and ethical activities

Low-cost, low-floor hardware and software platforms

Middle school teacher training and materials

Five Days / 30 Hours of Project-Based Curriculum

Designed for students ages 11-15

In designing the curriculum, we prioritized hands-on activities, accommodating novice teachers and students, real-world relevance, and cost-effectiveness.

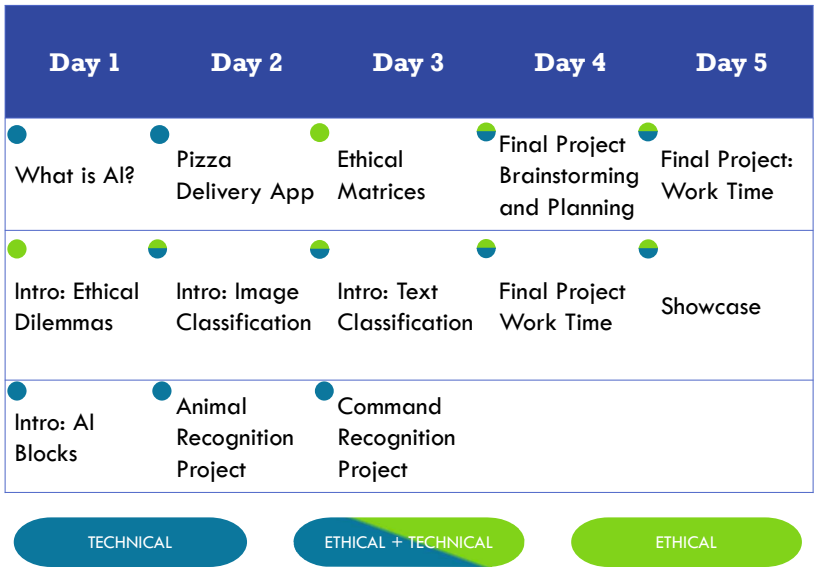
•We did not require or expect students or teachers to have any prior programming or computer science experience

•Balancing unplugged and plugged activities allowed students to exercise and develop their critical thinking as well as computational thinking skills

HTTYR

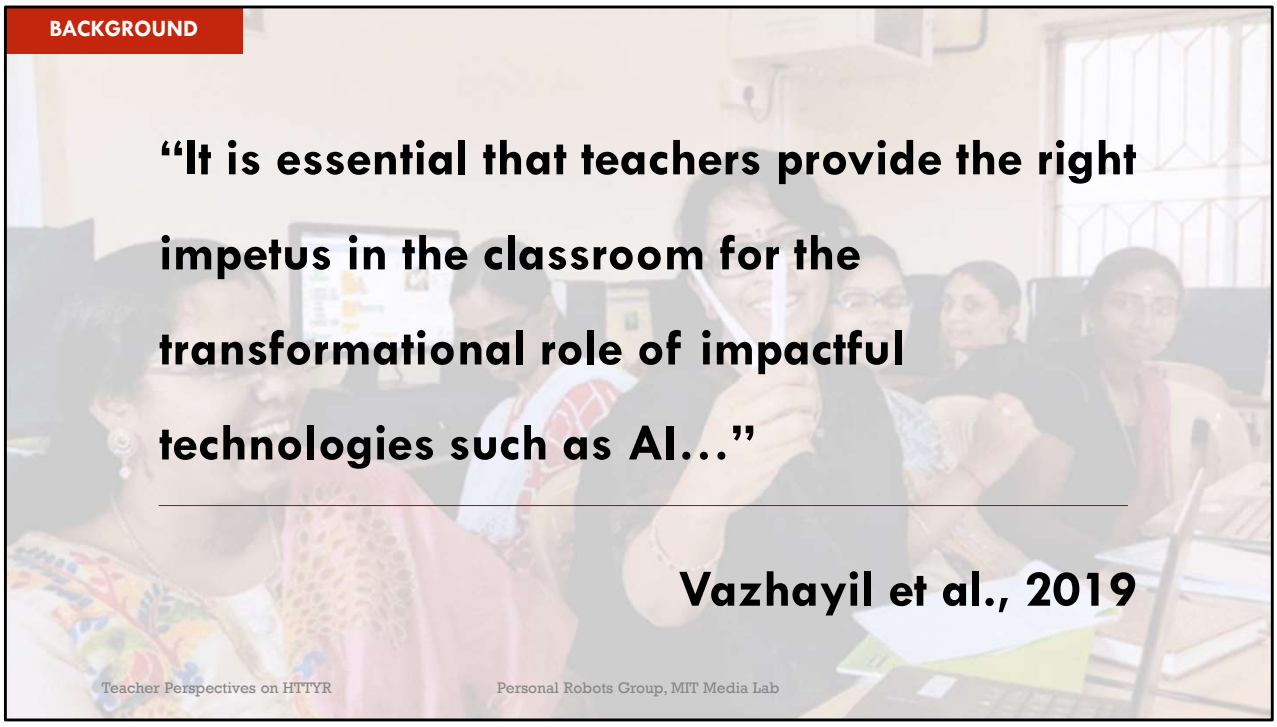
Key Activity Overview

Students dive into technical and ethical ideas then apply their knowledge to a problem of social import.



These are some of the key activities of the curriculum

- The key technical ideas were identifying AI, robotics (sensors and actuators), neural networks (image classification), K Nearest Neighbors (text classification), and the creation of AI projects
- Ethical concepts were embedded and they included stakeholder identification and analysis as well as biases present in neural networks and K Nearest Neighbors
- The majority of the final days was dedicated to the projects, students had freedom to choose how to apply their knowledge



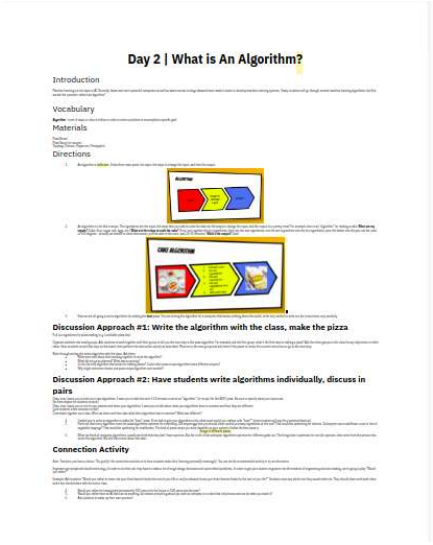
AI education efforts must target K-12 classrooms at public schools, this means learning about how to work with in-service teachers.

Teachers

•Vazhayil ran a study where they trained 34 secondary school teachers in India
•Used ML4Kids and focused on project-based teaching
•Found that teachers were eager to begin using the tools
•Found that teachers were concerned about knowing enough to run a plugged, exploratory, project-based course

HTTYR

Teacher Training



Educator Guide. Lessons support different learning paths connect concepts to real-world

Teacher Training. Professional development prepares teachers for discussions and AI programming activities.

We provided teachers with curriculum materials (educator guide, slide deck, student worksheet materials, programming guides)

- Written by AI experts and a middle school teacher
- Employed the universal design for learning framework, variations of activities connect the subject matter to their students' strengths and interests

Provided teachers with synchronous training sessions

- PD sessions were ~8 hours long for a weeklong session
- And PBL support: modelling the classroom and having teachers complete a short iteration of the programming activities

•Focused on content knowledge: trickier material (What is AI?) and hardware troubleshooting

METHODS

2019 Workshop:

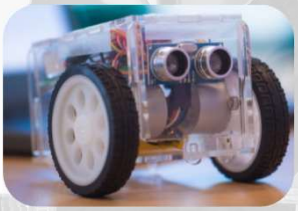
25 Hours in-person

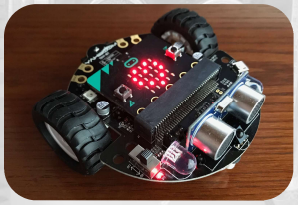
7 Teachers, 90 Students

2020 Workshop:

10 Hours online

7 Teachers, 42 Students





Teacher Perspectives on HTTYR | Personal Robots Group, MIT Media Lab | Image from Danny Guillory, Autodesk

We ran this workshop twice. Once in 2019 with 7 teachers (3 participants) and 90 students in classrooms for a week.

Then we revised the materials and ran it again in 2020 with 7 teachers and 42 students, this was online for a week during the summer.

RESULTS

Curriculum Iterations

1 **Aligning with Standards and Students**

We redesigned activities to suit students with different strengths and interested. We adjusted activities to better align with national reading, writing, and CS standards.

2 **Simplified Technology**

Made technology simpler to setup and maintain. Removed software downloads, API accounts, and changed robots

3 **Accelerated ML Creation**

Changed to machine learning platforms to make it quicker to create and iterate on models

•Made the curriculum more clearly align with middle school reading, writing, and CS standards
•Gave teachers more options to approach activities for students with different interests and strengths.
•Faster to train unlimited ML models (ML4Kids -> TM)
•No software downloads and further simplified the setup procedure (esp. for robot), Replaced the hand-built Arduino robots with more reliable, commercial robots

RESULTS

Effectiveness and Engagingness of Activities

1	**Overall Engagement**	Students deeply engaged with the ideas in AI and were excited by the activities
2	**Projects & Programming**	Teachers observed that the programming activities were particularly engaging for students. Projects allowed them to connect their personal values to AI knowledge
3	**Embedding Ethics**	Teachers were excited about the way ethical content was embedded in the lessons; it was a great model for future lessons

- Students were engaged, even went above and beyond
- Programming was particularly engaging, students had the opportunity to engage in all parts of the AI development process "wheels to their ideas"
- Projects gave students a meaningful way to connect their knowledge to their values
- The "perfect mix" of ethical and technical content was a model teachers hoped to further use and explore in other subjects

RESULTS

Technology Use and Integration

1	**Robots: The Good, The Bad**	Robots were both the object of students' engagement and frustration.
2	**Extending Block-Based Programming**	Teachers enjoyed using block-based programming to extend AI platforms and enjoyed being able to explore AI with Scratch, a familiar programming tool

•The robots were a huge point of engagement, they also caused the most frustration and confusion for both students and teachers.
•The AI extensions to Scratch were seen as a huge benefit. Teachers who had used TM said this gave them the next step, a way to continue using the tools. For teachers who had used Scratch before, they were excited about the new kinds of technologies their students could explore with this very familiar, accessible programming platform
•Using tools that some students were familiar with made it easy to pick up the new material. In the online class in particular, we had to leverage more tools. We used

slides (ethical matrices), spreadsheets (decision trees), and accessible math (2d graphs for word vectors)

RESULTS

Supporting Students

1	**Supporting Learners Online**	A wide-range of strategies, like dedicated breakout rooms and asynchronous forums, helped students get unstuck
2	**Experts Adjusting to Teachers Adjusting to Students**	AI experts and teachers constantly conversed about class content. Teachers supported students' understanding in diverse ways
3	**Conversations About Inclusion**	Teachers supported students in developing skills and a STEM identity as they progressed through the course

•Finding ways to support students when they get stuck, especially in a virtual classroom
•There continues to be a tension with working with students with a wide range of needs
•Teachers adjusted the curriculum to what they knew about their students strengths and interests - ongoing partnership between AI experts and teachers
•Supporting students from underrepresented backgrounds by intentionally supporting the development of a STEM identity

CONCLUSIONS

Key Takeaways

Hands-on technical and ethical activities effectively explained and hooked students in AI

Technology is an important tool for this work, but it does come with its limitations and difficulties

AI experts partnering with classroom experts in the development and delivery of courses will facilitate broader adoption of curricula

•Implications not just for future K-12 AI curricula, but for non-expert retraining courses. Teachers were excited to take the course into their classrooms. Currently running that study!

•Thinking about the cost of robots, Further technology changes like creating an offline, mobile version

•Biggest takeaway: think carefully about how we partner with others to design AI curricula that reaches "all". Connecting ideas to art and future careers

Thank You!

I2 Learning

Our student and teacher participants from Georgia, Massachusetts, New Jersey, New York, Ohio, and Texas

MIT Personal Robots Group Graduate Students and Undergraduate Researchers

Pablo Alejo and Tejal Reddy

LEGO Foundation

NSF Graduate Research Fellowship

Amazon Future Engineer

Schools
MIT PRG and undergrads
Sponsors
All of you!

Teacher Perspectives on How to Train Your Robot

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MIT Media Lab

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