Towards Early AI for PreK-2nd Grade

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Personal Robots Group

Demos:
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Stefania Druga, 3rd-6th
[Blakeley Hoffman, AI ethics]

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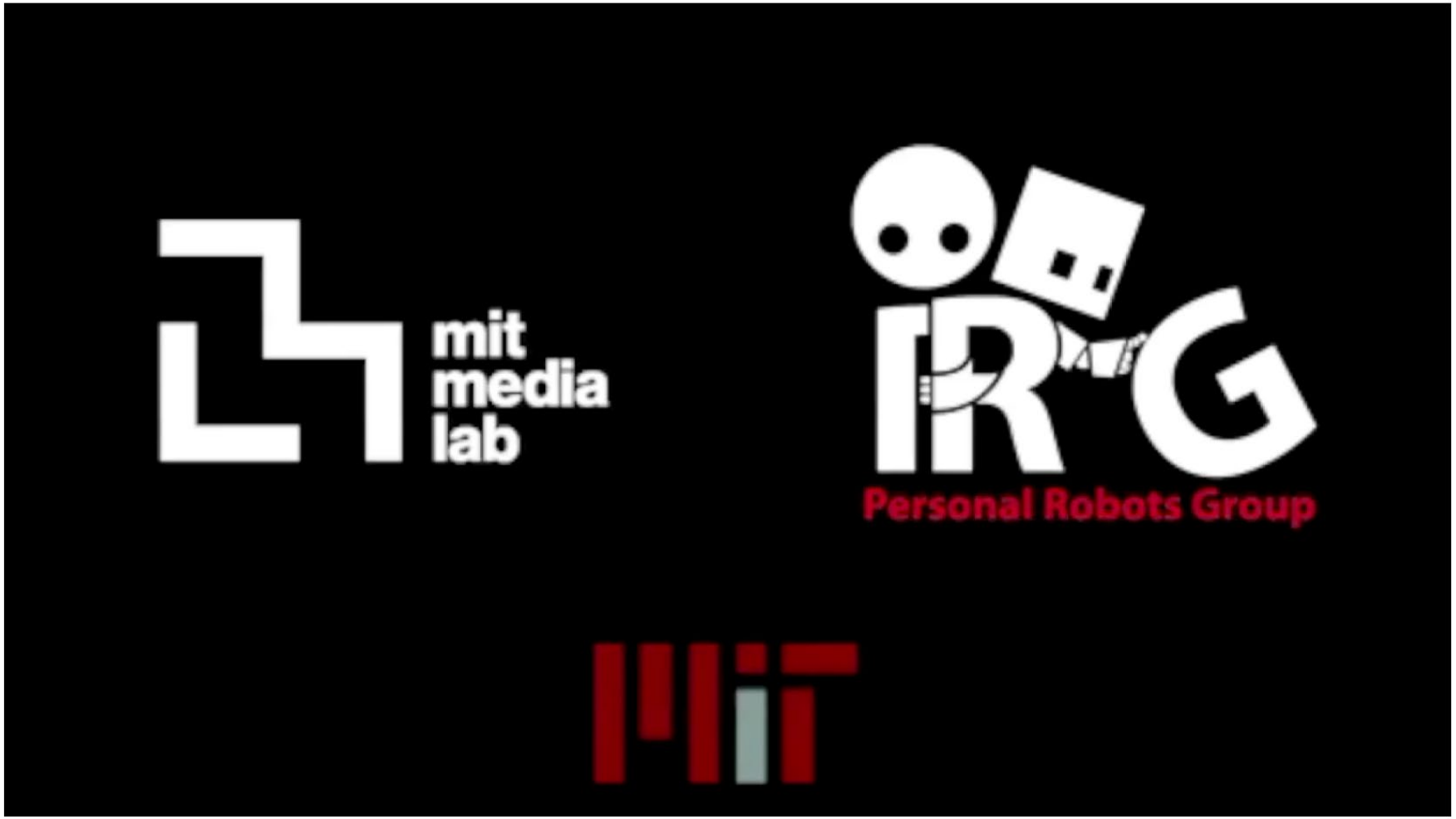
NSF Support
- NRI
- Cyberlearning
- Expeditions in Computing



Personalized Learning Companion Robots for Early Childhood

Children are growing up with AI-enabled systems that exhibit lifelike intelligence and social agency.

However, children do not have the tools to understand how this new technology works

"AI Natives"

"Alexa, what do sloths eat?"

"I'm sorry. I don't know how to help you with that."

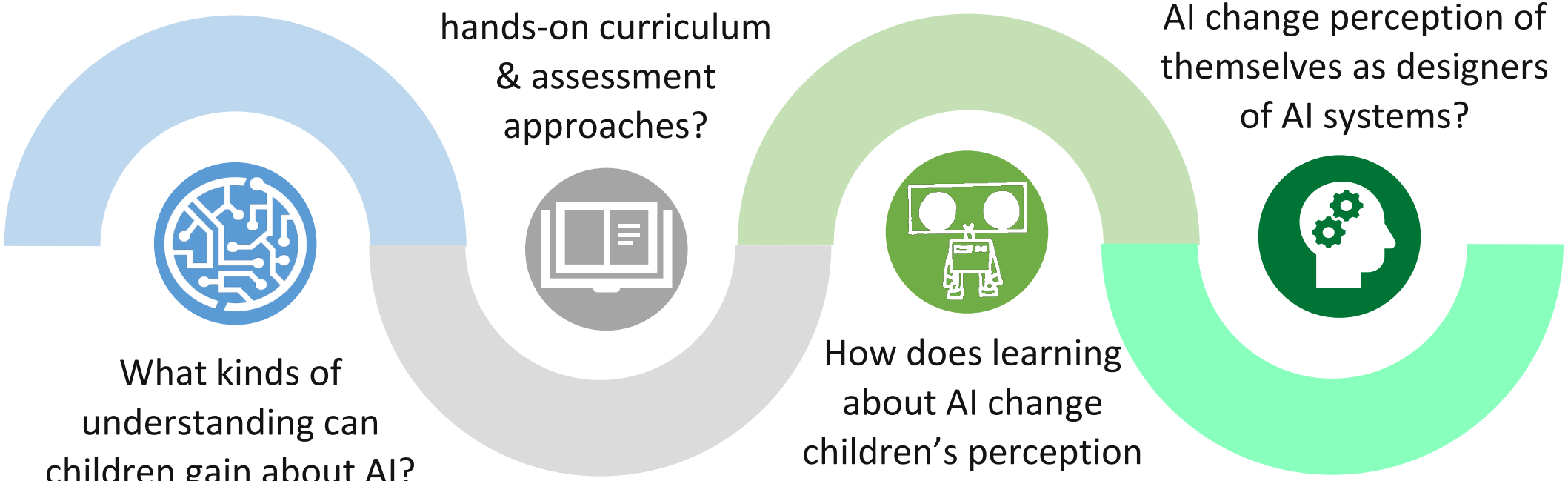
"That's okay," she exclaimed.

Picking up a second Amazon Echo,
"I'll see if the other Alexa knows."

Paraphrased from "Hey Google, Is It OK If I Eat You?"
Druga, Williams, Park & Breazeal (2017)

A Constructionist Approach

Children learn about AI through making, programming, teaching & interacting with robots!



https://www.youtube.com/watch?v=pYnIVuz0oXw&feature=youtu.be

Stefania Druga
MS Thesis, 2018

Randi Williams
MS Thesis, 2018

PopBots

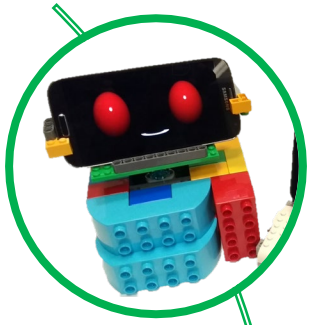
Using creative learning to teach artificial intelligence to young children

[Pre-K & Kindergarten]

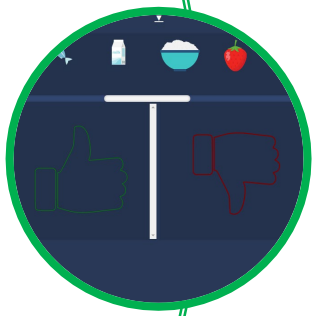
COMPONENTS

OVERVIEW OF POPBOT ELEMENTS

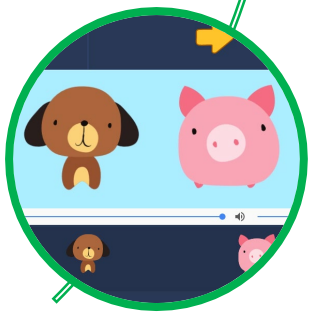
Uniquely designing for a low-cost AI curriculum for early learners



Toolkit: Intelligent, Programmable Robot



Curriculum: Interactive AI Activities



Assessments: Knowledge about AI and their Perception of AI systems

POPBOT TOOLKIT

A. PHONE

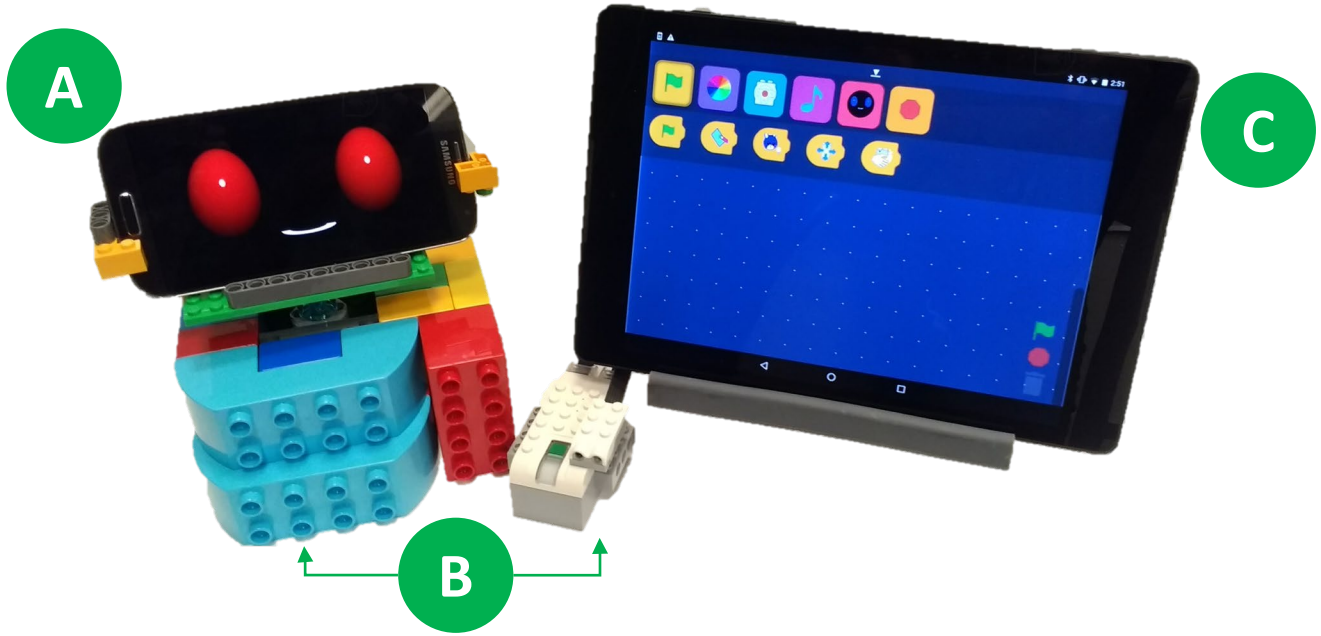
Android app with social robot software, AI tutor and activities, code compiler, and sensors

B. LEGO BODY

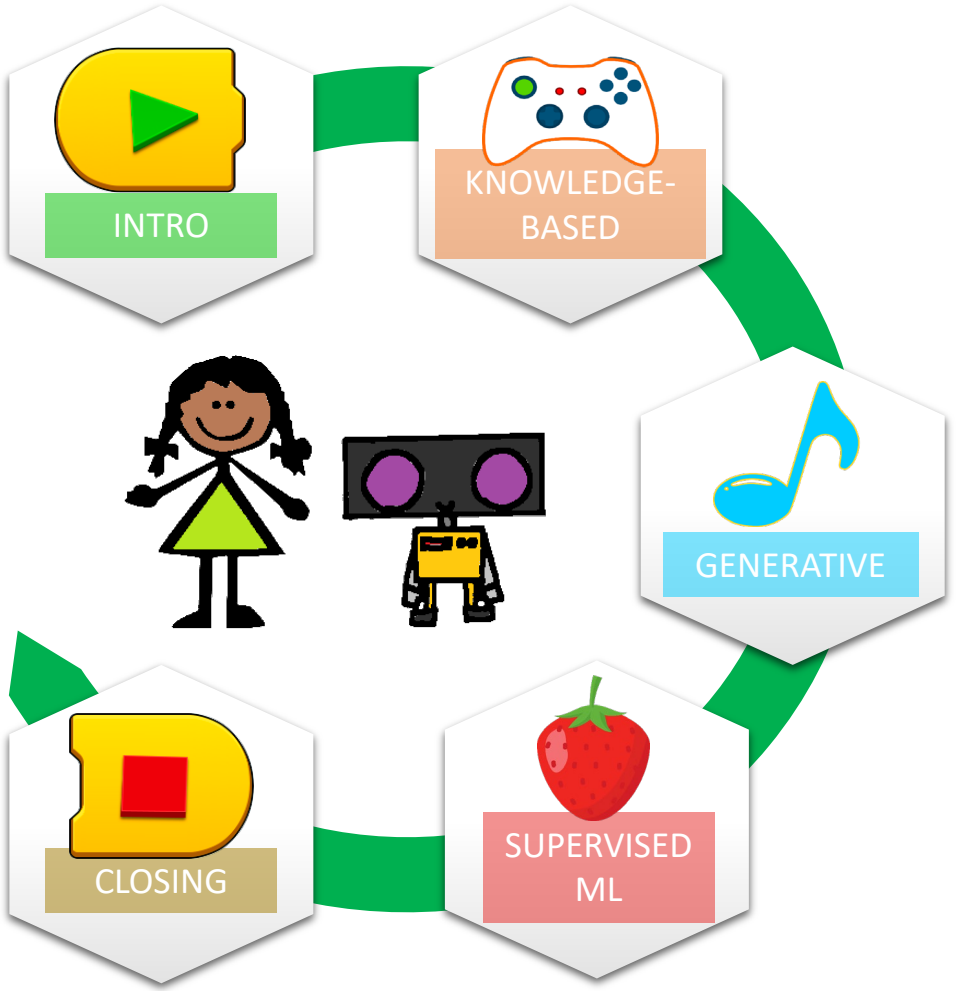
Robot body made of LEGO pieces, compatible with LEGO WeDo 2.0 and Arduino for motors and sensors

C. TABLET

Android or desktop app with icon-based programming blocks, AI activity interfaces, and assessments



POPBOT CURRICULUM



ACTIVITY	MAIN AI CONCEPT	AI CONCEPTS	LIFE SKILLS
ROCK PAPER SCISSORS	KNOWLEDGE BASED SYSTEMS	Reinforcement Learning, Training Set	Sportsmanship, Learning by Practice
ROBOT REMIX	GENERATIVE AI	Probability & Randomness, Modelling	Music Composition, Music and Emotion, Turn-Taking
FOOD SORT	SUPERVISED ML	Nearest Neighbors, Classification	Un/healthy Foods, Sorting

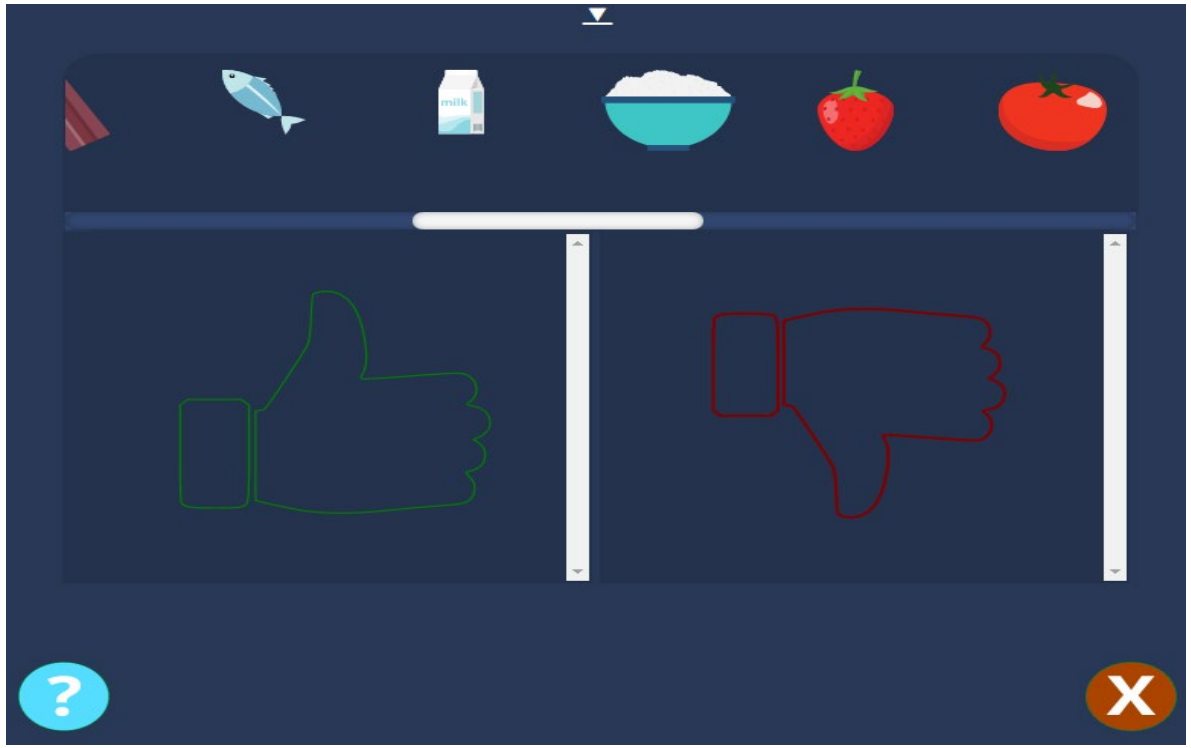
FOOD SORT
Supervised Machine Learning

Learning Goals

- Children learn about training vs. test sets
- Children learn K-Nearest Neighbors

Key Interactions

- Teaching robot about individual foods
- Hearing the robot explain its reasoning for grouping foods
- Seeing the robot make better guesses



Creating a Training Set

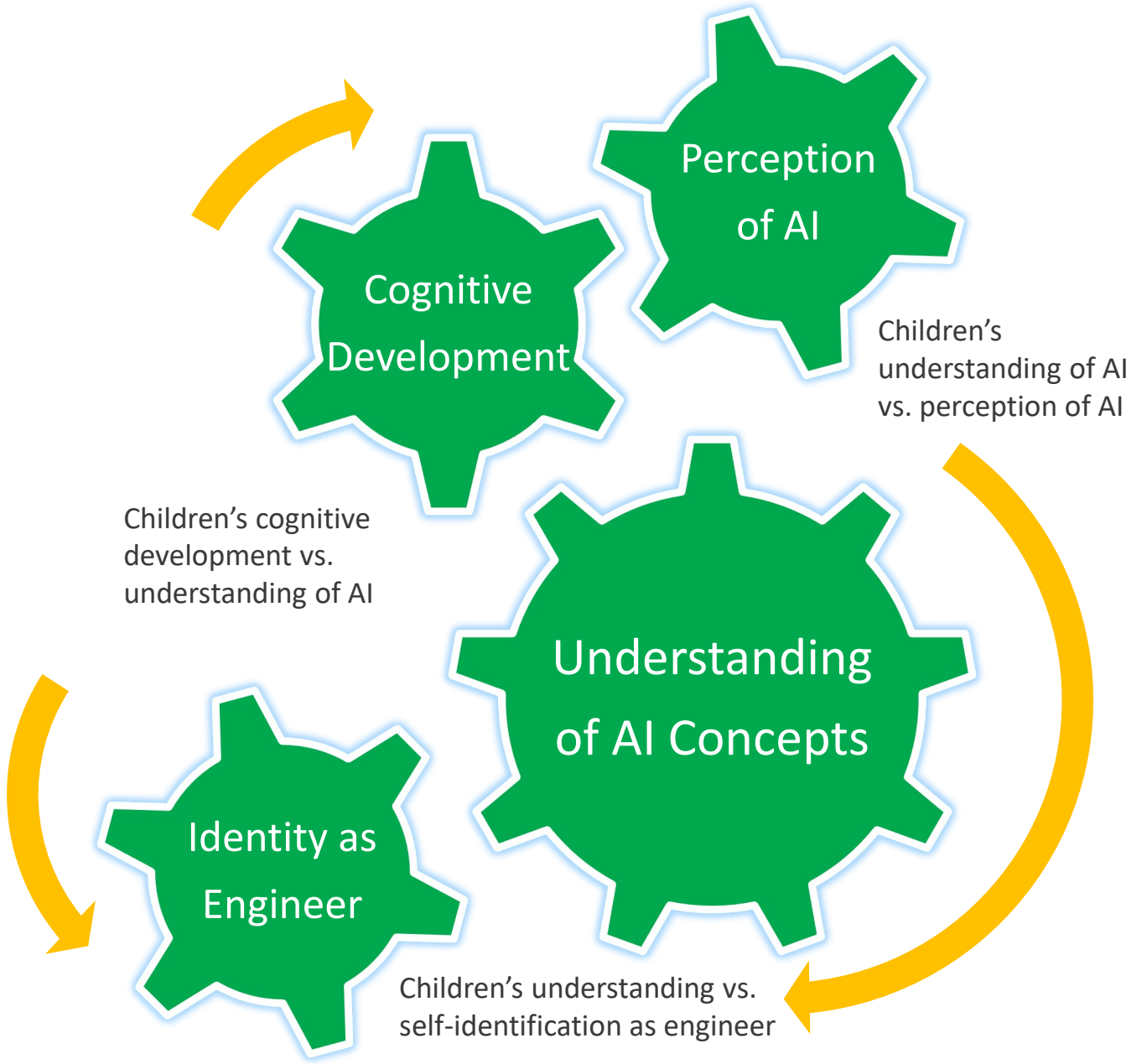
Evaluating Test Set

Programming Robot Behavior

POPBOT ASSESSMENTS

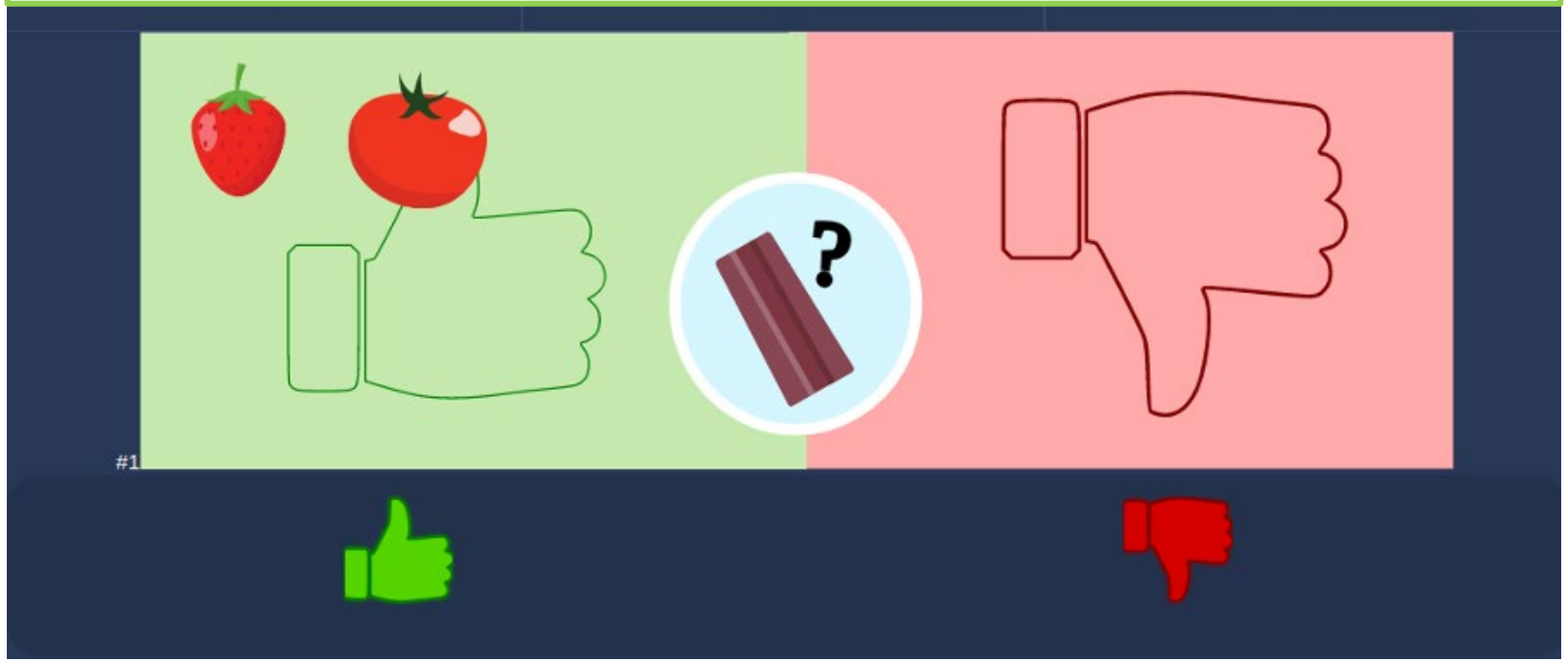
UNDERSTANDING CHILDREN'S MINDS

Developing age-appropriate assessments to measure children's learning and perceptions of AI



Assessments

So far, you tell the robot that strawberries and tomatoes go in the good group. Then you ask the robot where to put chocolate. What will the robot think?



The assessments are multiple choice and seek to evaluate children's basic understanding of the algorithm, its edge cases, and its pitfalls.

Some questions require social reasoning.

WORKSHOPS

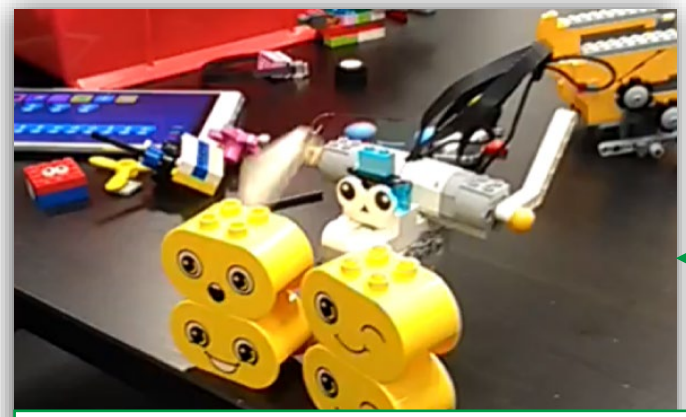
80 Children

3 Boston Public Schools & 1 Private School

Pre-K & K Classrooms | Ages 4-6

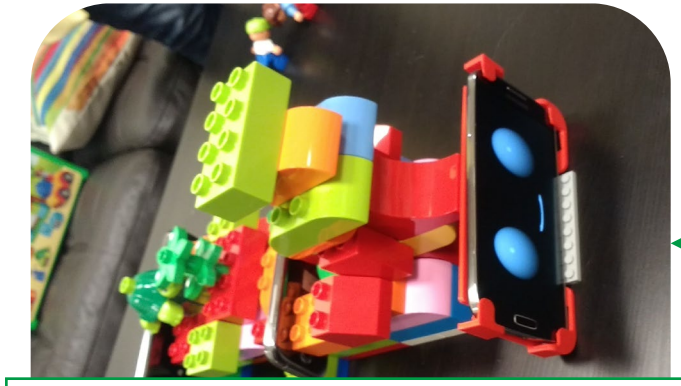
5 half-hour sessions for classrooms of 5-20 children with mentor. Each session facilitated learning through interaction with the toolkit then reflection + assessments

CHILDREN'S POPBOT CREATIONS

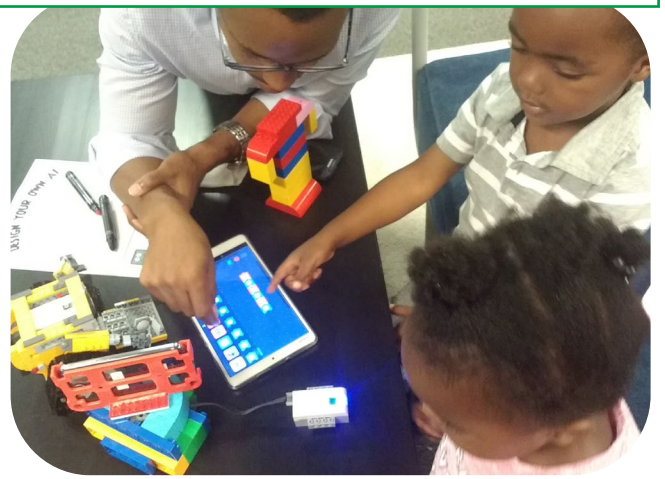


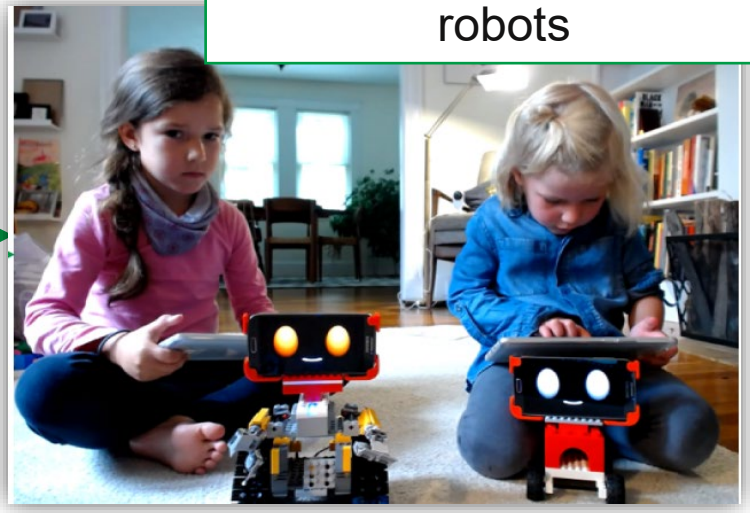
This robot and its creator both know karate

These girls (7 and 3) wanted mobile, dexterous robots



A 4 y/o boy taught robots to speak in multiple languages



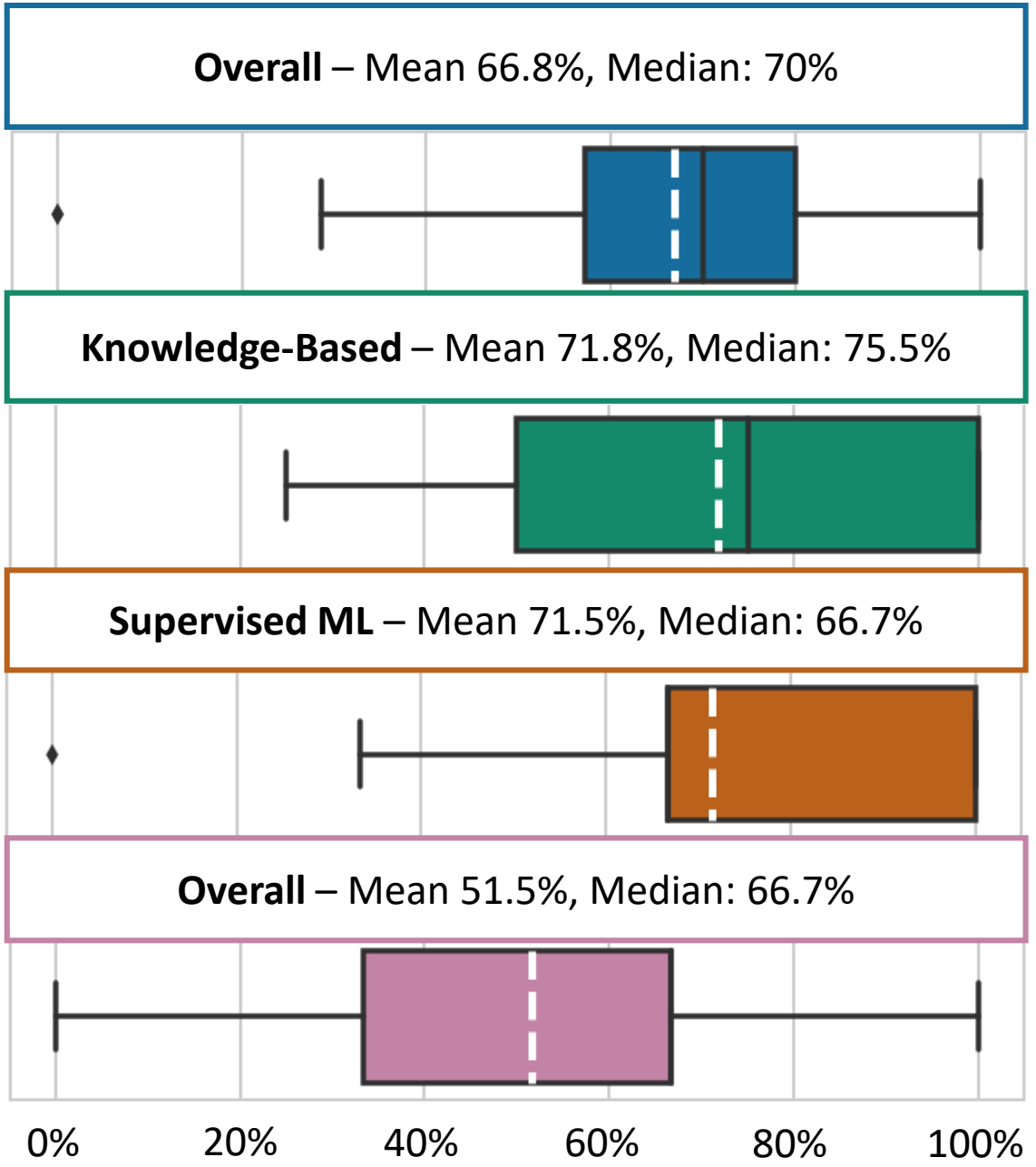


RESULTS

WHAT KINDS OF UNDERSTANDING CAN CHILDREN GAIN ABOUT AI?

PreK + K children understood the majority of the information presented in the toolkit, with large differences in understanding depending on the activity.

Differences were explained by their development and depth of toolkit use.



HOW DID CHILDREN'S THINKING EVOLVE AFTER MAKING MACHINES THINK

We saw that children could not only use AI in their robots, they could also express different concepts in their own words

TRAINING

Researcher: How did the robot work?

Lily (6-years-old): I taught the robot the rules of the game...[then] it would learn as I go.

ONLINE LEARNING

HOW DID CHILDREN'S THINKING EVOLVE AFTER MAKING MACHINES THINK

We saw that children's understanding of algorithms was anchored in their social interactions with the robot

Researcher: So who won more? You or the robot?

Lily: The robot.

Ivy (6-years-old): The robot. Well, at first [I won a lot], but then the robot kept saying 'I think you will put rock' and I had put rock so it won. The robot got smarter the more we played.

HOW DID CHILDREN'S THINKING EVOLVE AFTER MAKING MACHINES THINK

Afterwards, children used their new knowledge to grapple with the implications of artificial intelligence

Researcher: So who's smarter now? You or the robot?

Lily: Well...maybe the robot. But I taught it. So actually I'm still smarter for now but I think the robot can get a lot smarter.

Young children can learn about AI using constructionist methods

Early Math → Early AI

Co-Design, iteration + Research needed to expand & refine