# Everyday AI (EdAI) for Youth

## Investigating Middle School Teacher Education, Classroom Implementation, and the Student Learning Outcomes of an Innovative AI Curriculum

Presentation for the
**2022 PI ITEST Annual Meeting**


**Katherine Moore**
Research Scientist
MIT STEP Lab
ksmoore@mit.edu

**Helen Zhang**, co-PI
Senior Research Associate
Boston College
zhangzm@bc.edu

**Irene Lee**, PI
Research Scientist
MIT STEP Lab
ialee@mit.edu



Thanks to the generous support of NSF ITEST 2048746


stelar
STEM LEARNING AND RESEARCH CENTER

# Brief Introduction to the Project

# Brief Introduction to the Project

**Research Questions**

**RQ1:** How can we best prepare a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

**RQ2:** How and to what extent do teacher-led implementations of the DAILy curriculum impact student knowledge and interest in AI and AI-related careers?

**RQ3:** What teaching practices positively affect students' learning with these innovative materials?

**RQ4:** What was the impact of variation in implementation setting on student gains/losses?

# Brief Introduction to the Project

## Research Questions

**RQ1:** How can we best prepare a **wide variety of teachers** to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

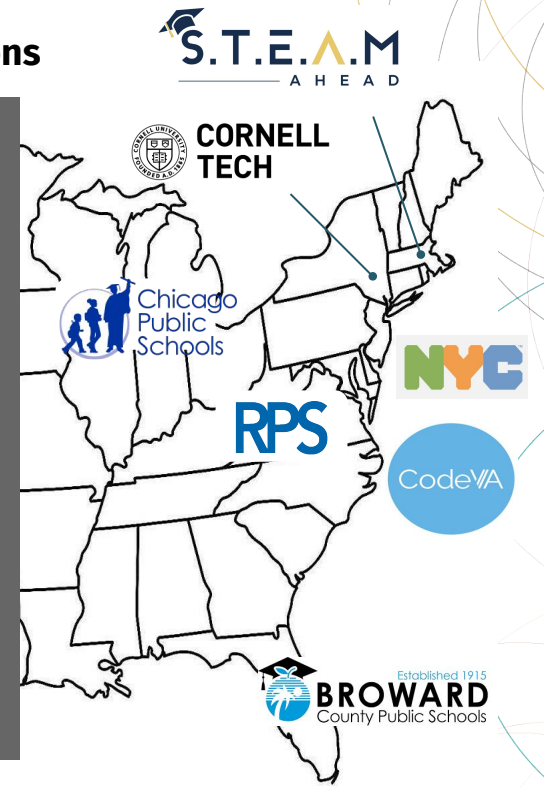
## Partner Programs and Locations

**Aim to recruit diverse populations** including:

- Teachers of color
- Students of color

**Why?**

- Most impacted by negative aspects of AI
- Sensitive discussions on ethics, race, bias
- Seeking to address inequities in AI educationo

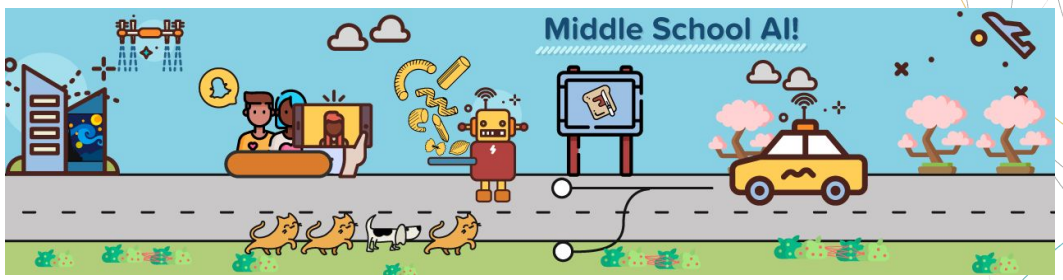


# Brief Introduction to the Project

## Research Questions

**RQ1:** How can we best prepare a wide variety of teachers to **use the DAILy curriculum** to help their students learn AI concepts and gain awareness of careers of the future with AI?

## The Developing AI Literacy (DAILy) curriculum




### Ethics and AI

- 0.1 What is AI?
- 0.2 Algorithms as Opinions
- 0.3 Ethical Matrix
- 0.5 Investigating Bias
- 2.3 Unanticipated Consequences
- 3.1 Environmental Impact of AI
- 3.2 Youtube Redesign

### AI Core Concepts

- 0.4 Decision Trees
- 1.1 Supervised Machine Learning
- 1.2 Neural Networks
- 1.3 Classifying vs. Generating AI

### Creativity in AI

- 2.1 What are GANs?
- 2.2 How do GANs Work?
- 2.4 AI Generated Art
- 2.5 What are Deep Fakes?
- 2.6 Spread of Misinformation
- 2.7 Generate a Story

### AI Career futures

- 0.6 Career Daydream
- 1.4 Inventory of Me
- 1.5 Planting My STEM Job
- 2.8 AI's Impact on my Future Job(s)
- 3.3 Roadmap to my Future Job

# Brief Introduction to the Project

## Research Questions

**RQ1:** How can we best **prepare** a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

## Everyday AI (EdAI) Professional Development Sequence

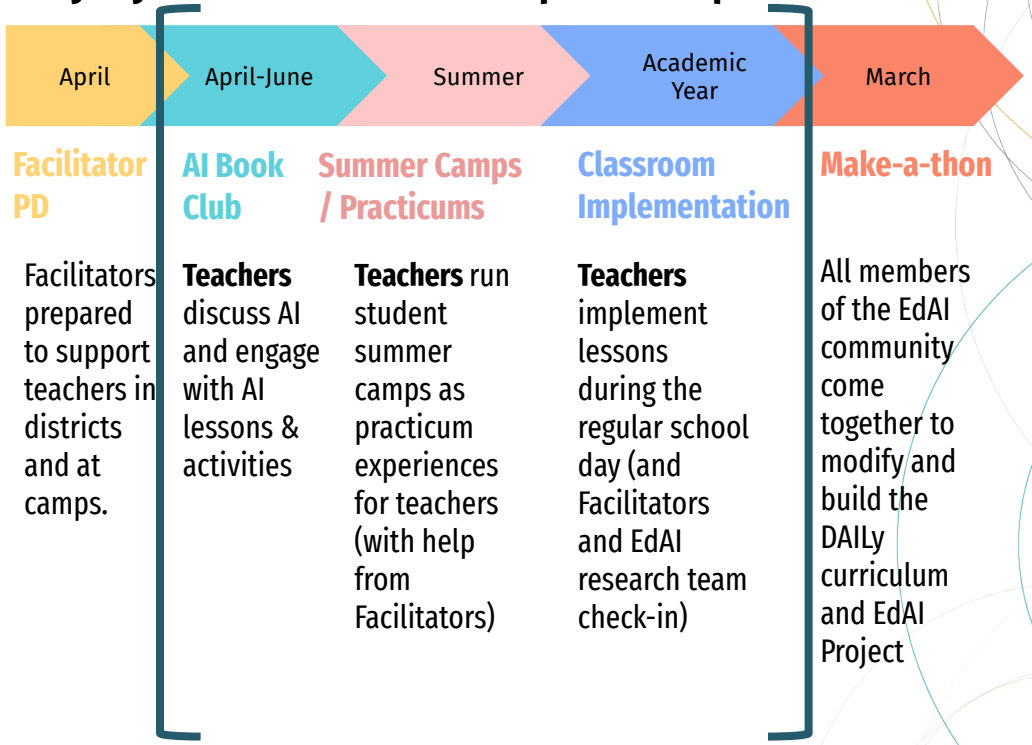

| Facilitator PD | AI Book Club | Summer Camps / Practicums | Classroom Implementation | Make-a-thon |
|---|---|---|---|---|
| Facilitators prepared to support teachers in districts and at camps. | **Teachers** discuss AI and engage with AI lessons & activities | **Teachers** run student summer camps as practicum experiences for teachers (with help from Facilitators) | **Teachers** implement lessons during the regular school day (and Facilitators and EdAI research team check-in) | All members of the EdAI community come together to modify and build the DAILy curriculum and EdAI Project |

# Brief Introduction to the Project

## Research Questions

**RQ1:** How can we best **prepare** a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

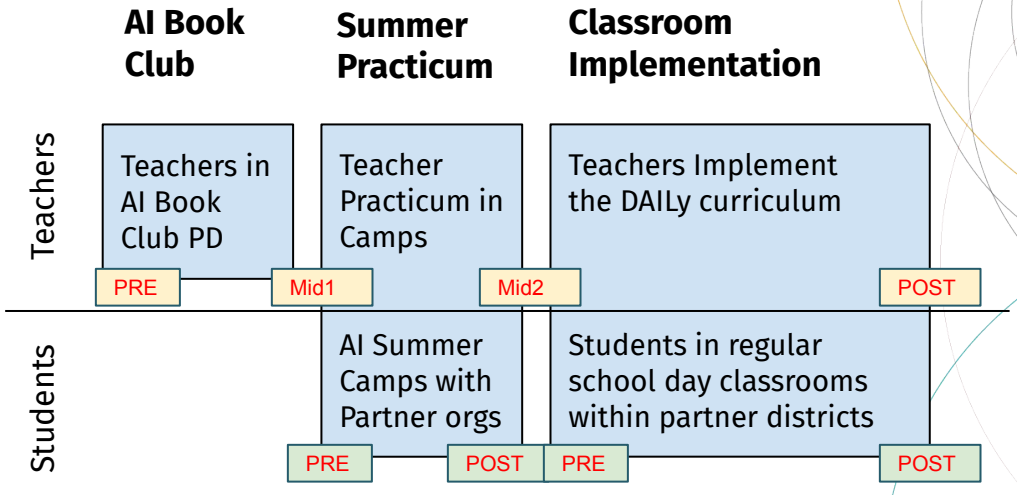
## Everyday AI Professional Development Sequence



# Brief Introduction to the Project

**Research Questions**

**RQ1:** How can we best prepare a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

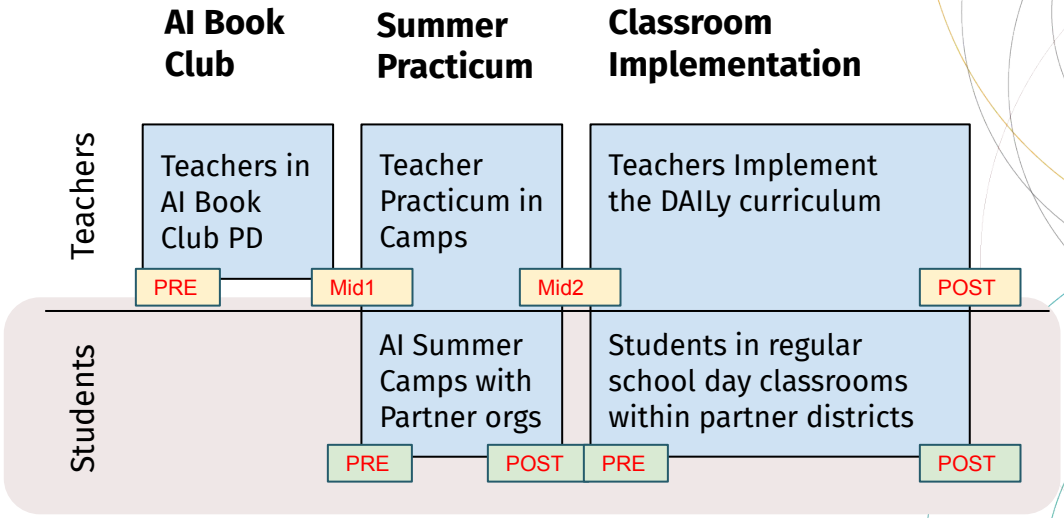


# Brief Introduction to the Project

## Research Questions

**RQ1:** How can we best prepare a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

**RQ2:** How and to what extent do teacher-led implementations of the DAILy curriculum impact **student knowledge and interest in AI and AI-related careers**?



# Brief Introduction to the Project

## Research Questions

**RQ1:** How can we best prepare a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

**RQ2:** How and to what extent do teacher-led implementations of the DAILy curriculum impact **student knowledge and interest in AI and AI-related careers**?

## Findings from Year 1

Student interest in AI grew after teacher implementation during the academic year.

**Table 1.** Change in Student Attitudes Towards AI from Academic Year, 2021-2022

| | | pre | | post | | | | |
|---|---|---|---|---|---|---|---|---|
| Constructs | n | mean | SD | mean | SD | t | *p* | *d* |
| Interest | 240 | 3.05 | 0.87 | 3.36 | 0.77 | 6.26 | <.001 | 0.86 |
| relevance | 207 | 3.27 | 0.52 | 3.32 | 0.47 | 1.38 | 0.17 | 0.77 |
| anxiety | 237 | 2.56 | 0.73 | 2.5 | 0.8 | -1.04 | 0.3 | 0.85 |
| career awareness | 205 | 3.1 | 0.84 | 3.16 | 0.73 | 1.03 | 0.3 | 0.74 |
| career adaptability | 182 | 3.59 | 0.87 | 3.66 | 0.74 | 1.09 | 0.28 | 0.89 |

# Brief Introduction to the Project

## Research Questions

**RQ1:** How can we best prepare a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

**RQ2:** How and to what extent do teacher-led implementations of the DAILy curriculum impact **student knowledge and interest in AI and AI-related careers**?

## Findings from Year 1

Students learned about AI from teacher implementation.

**Table 2.** Student Learning Gains from Academic Year, 2021-2022

| From teachers who taught... | | pre | | post | | | | |
|---|---|---|---|---|---|---|---|---|
| | n | mean | SD | mean | SD | t | *p* | *d* |
| All items | 58 | 0.55 | 0.09 | 0.59 | 0.12 | 3.03 | <.01 | 0.44 |
| AI general | 222 | 0.62 | 0.13 | 0.66 | 0.14 | 4.08 | <.001 | 0.32 |
| Logic system | 236 | 0.63 | 0.25 | 0.6 | 0.26 | 1.28 | 0.2 | 0.1 |
| Supervised Learning | 202 | 0.43 | 0.17 | 0.47 | 0.19 | 2.66 | <.01 | 0.22 |
| Machine Learning | 192 | 0.66 | 0.23 | 0.68 | 0.23 | 1.18 | 0.24 | 0.11 |
| Neural Networks | 196 | 0.34 | 0.28 | 0.35 | 0.28 | .31 | 0.76 | |
| Generative Adversarial Networks (GANs) | 73 | 0.5 | 0.17 | 0.57 | 0.21 | 2.45 | <.05 | 0.39 |

# Brief Introduction to the Project

## Research Questions

**RQ1:** How can we best prepare a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

**RQ2:** How and to what extent do teacher-led implementations of the DAILy curriculum impact student knowledge and interest in AI and AI-related careers?

**RQ3:** What **teaching practices** positively affect students' learning with these innovative materials?

## Findings from Year 1

Students learned about AI from teacher implementation.

**Table 2.** Student Learning Gains from Academic Year, 2021-2022

| From teachers who taught... | n | pre mean | pre SD | post mean | post SD | t | *p* | *d* |
|---|---|---|---|---|---|---|---|---|
| All items | 58 | 0.55 | 0.09 | 0.59 | 0.12 | 3.03 | <.01 | 0.44 |
| AI general | 222 | 0.62 | 0.13 | 0.66 | 0.14 | 4.08 | <.001 | 0.32 |
| Logic system | 236 | 0.63 | 0.25 | 0.6 | 0.26 | 1.28 | 0.2 | 0.1 |
| Supervised Learning | 202 | 0.43 | 0.17 | 0.47 | 0.19 | 2.66 | <.01 | 0.22 |
| Machine Learning | 192 | 0.66 | 0.23 | 0.68 | 0.23 | 1.18 | 0.24 | 0.11 |
| Neural Networks | 196 | 0.34 | 0.28 | 0.35 | 0.28 | .31 | 0.76 | |
| Generative Adversarial Networks (GANs) | 73 | 0.5 | 0.17 | 0.57 | 0.21 | 2.45 | <.05 | 0.39 |

# Brief Introduction to the Project

## Research Questions

**RQ1:** How can we best prepare a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

**RQ2:** How and to what extent do teacher-led implementations of the DAILy curriculum impact student knowledge and interest in AI and AI-related careers?

**RQ3:** What teaching practices positively affect students' learning with these innovative materials?

**RQ4:** What was the **impact of variation in implementation setting** on student gains/losses?

## Findings from Year 1

Students learned about AI from teacher implementation.

**Table 2.** Student Learning Gains from Academic Year, 2021-2022

| From teachers who taught... | n | pre mean | pre SD | post mean | post SD | t | *p* | *d* |
|---|---|---|---|---|---|---|---|---|
| All items | 58 | 0.55 | 0.09 | 0.59 | 0.12 | 3.03 | <.01 | 0.44 |
| AI general | 222 | 0.62 | 0.13 | 0.66 | 0.14 | 4.08 | <.001 | 0.32 |
| Logic system | 236 | 0.63 | 0.25 | 0.6 | 0.26 | 1.28 | 0.2 | 0.1 |
| Supervised Learning | 202 | 0.43 | 0.17 | 0.47 | 0.19 | 2.66 | <.01 | 0.22 |
| Machine Learning | 192 | 0.66 | 0.23 | 0.68 | 0.23 | 1.18 | 0.24 | 0.11 |
| Neural Networks | 196 | 0.34 | 0.28 | 0.35 | 0.28 | .31 | 0.76 | |
| Generative Adversarial Networks (GANs) | 73 | 0.5 | 0.17 | 0.57 | 0.21 | 2.45 | <.05 | 0.39 |

# How did the PD Impact Teachers?

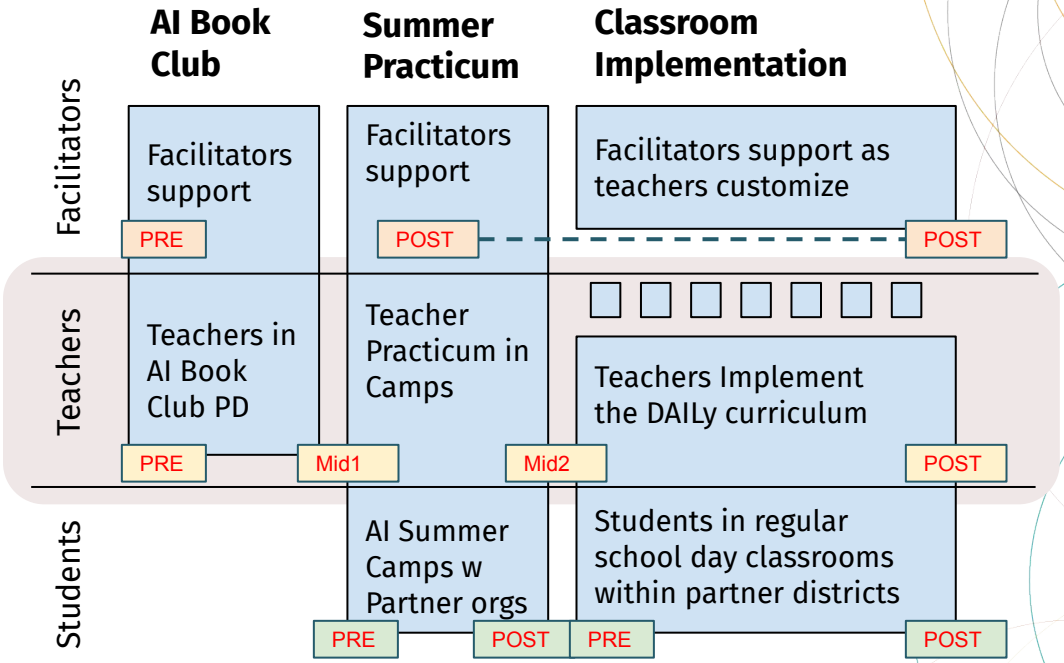
## Research Questions

**RQ1:** How can we best prepare a wide variety of teachers to use the DAILy curriculum to help their students learn AI concepts and gain awareness of careers of the future with AI?

**RQ2:** How and to what extent do teacher-led implementations of the DAILy curriculum impact student knowledge and interest in AI and AI-related careers?

**RQ3:** What teaching practices positively affect students' learning with these innovative materials?

**RQ4:** What was the impact of variation in implementation setting on student gains/losses?



# How did the PD Impact Teachers?


| | Wave 1 | Wave 2 | Wave 3 | |
|---|---|---|---|---|
| Concept Inventory | X | X | | |
| Personal beliefs and values | X | X | | X |
| Qualitative data | | observation, Slack posts | daily debrief meetings | focus group interview |

# How did the PD Impact Teachers?

- **Positive impact on AI Content Knowledge**, significant gains after the AI Book Club
  Measured with the teacher concept inventory.

**Table 3.** Teacher Learning Gains from AI Book Club, 2021

| | | pre | | post | | | | |
|---|---|---|---|---|---|---|---|---|
| Content | n | mean | SD | mean | SD | t | *p* | *d* |
| All items (20 items) | 26 | 12.58 | 2.37 | 14.38 | 2.06 | 2.94 | <.01 | .81 |
| AI general concepts (10 items) | 26 | 5.96 | 1.48 | 6.92 | 1.47 | 2.35 | <.05 | .65 |
| Logic system (3 items) | 26 | 2.34 | 0.75 | 2.46 | 0.71 | .57 | 0.57 | |
| Machine Learning (7 items) | 26 | 4.27 | 1.22 | 5 | 0.98 | 2.38 | <.05 | .66 |

# How did the PD Impact Teachers?

- **Positive impact on AI Content Knowledge**, significant gains after the AI Book Club
  Measured with the teacher concept inventory.
- **Positive impact on attitudes towards AI:** significant gains after the PD
  Measured with survey of teacher personal beliefs and values.

**Table 4.** Teacher Learning Gains from EdAI PD (AI Book Club + Practicum), 2021

| | | pre | | mid | | post | | |
|---|---|---|---|---|---|---|---|---|
| Construct | n | mean | SD | mean | SD | mean | SD | repeated ANOVA |
| Relevance | 29 | 4.34 | .62 | 4.56 | .35 | 4.52 | .58 | F(2,28)=1.51, p=.23 |
| Interest | 29 | 4.72 | .42 | 4.84 | .36 | 4.8 | .36 | F(2,28)=1.28, p=.29 |
| Anxiety | 29 | 2.70 | .52 | 2.63 | .66 | 2.44 | .33 | F(2,28)=1.80, p=.18 |
| Beliefs in Students | 29 | 4.14 | .64 | 4.27 | .58 | 4.31 | .58 | F(2,28)=.78, p=.47 |
| Career awareness | 29 | 3.73 | .61 | 4.15 | .45 | 4.29 | .50 | F(2,28)=6.39, p<.01 |

# How did the PD Impact Teachers?

- **Positive impact on AI Content Knowledge**, significant gains after the AI Book Club
  Measured with the teacher concept inventory.
- **Positive impact on attitudes towards AI:** significant gains after the PD
  Measured with survey of teacher personal beliefs and values.

  Personal values and motivations for teaching AI, $F(2, 28)=4.52$, $p<.05$
  - **Interest in AI** - e.g., “I am interested in learning about AI”
  - **Relevance** - e.g., “I will use my knowledge about AI to help my community”
  - **Career awareness** - e.g., “I know about jobs that use AI.”

# Key Constructs & Instruments

- **Positive impact on AI Content Knowledge**, significant gains after the AI Book Club
  Measured with the teacher concept inventory.
- **Positive impact on attitudes towards AI:** significant gains after the PD
  Measured with survey of teacher personal beliefs and values.

  Personal values and motivations for teaching AI, $F(2, 28)=4.52$, $p<.05$
  - **Interest in AI** - e.g., “I am interested in learning about AI”
  - **Relevance** - e.g., “I will use my knowledge about AI to help my community”
  - **Career awareness** - e.g., “I know about jobs that use AI.”

# Key Constructs & Instruments

- **Positive impact on AI Content Knowledge**, significant gains after the AI Book Club
  Measured with the teacher concept inventory.
- **Positive impact on personal values and motivations for teaching AI:** significant gains after the PD
  Measured with survey of teacher personal beliefs and values.

  Personal values and motivations for teaching AI, $F(2, 28)=4.52$, $p<.05$
  - **Interest in AI** - e.g., “I am interested in learning about AI”
  - **Relevance** - e.g., “I will use my knowledge about AI to help my community”
  - **Career awareness** - e.g., “I know about jobs that use AI.”

These are modified versions of validated instruments...
- Science Motivation Questionnaire (Glynn et al., 2011)
- Attitudes Towards Science Inventory (Weinburgh & Steele, 2000)
- Career Futures Inventory (Rottinghaus et al., 2012)

# Challenges in Instrument Adaptation

**Challenge** **Item Sensitivity**

Maintain item sensitivity to the constructs - AI concepts and attitudes - while simultaneously designing items that are accessible and meaningful for middle school age audiences.

**Resolution** **How we are working through this challenges:**

1. **Trimming**

   We are currently working on trimming the number of items to stay within the limitations of middle student attention span, and classroom constraints.

2. **Scenarios**

   Middle school student responses show more meaningful variation to answers that are written as scenarios.

3. **Complexity Reduction**

   Simplifying language removes barriers for low-level readers. Getting the right balance of language is tricky.

4. **Representing Abstraction**

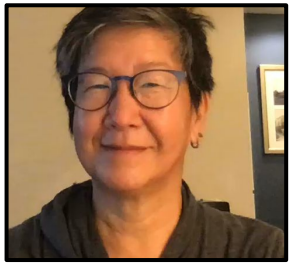
   We are studying how to best design items with representations of abstract concepts and processes.

# Everyday AI (EdAI) for Youth

## Investigating Middle School Teacher Education, Classroom Implementation, and the Student Learning Outcomes of an Innovative AI Curriculum


**Katherine Moore**
MIT STEP Lab
ksmoore@mit.edu

**Helen Zhang**, Co-PI
Boston College
zhangzm@bc.edu



**Irene Lee**, PI
MIT STEP Lab
ialee@mit.edu



Thanks to the generous support of NSF ITEST 2048746


SCHELLER TEACHER EDUCATION PROGRAM
education arcade

BOSTON COLLEGE