UF Herbert Wertheim College of Engineering
UNIVERSITY of FLORIDA

ENGAGED QUALITY INSTRUCTION THROUGH PROFESSIONAL DEVELOPMENT
EQuIPD

Development of K-12 STEM Teacher Self-Efficacy through Participation in Goldberg Gator Engineering Explorers Summer Programs (RTP)

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POWERING THE NEW ENGINEER TO TRANSFORM THE FUTURE

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2. Goldberg Gator Engineering Explorers
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4. Methodology
5. Results and Discussion
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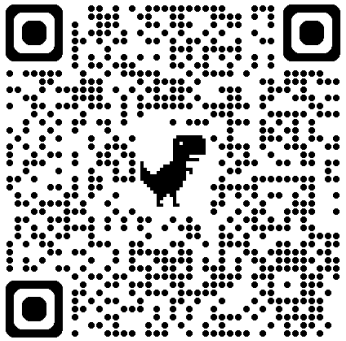


1. Introduction

- Informal learning outside of the traditional classroom engages scientific curiosity, motivation, and excitement.

- Informal learning programs provide learning opportunities for students outside of the classroom. These experiences can also serve as professional development for teachers.

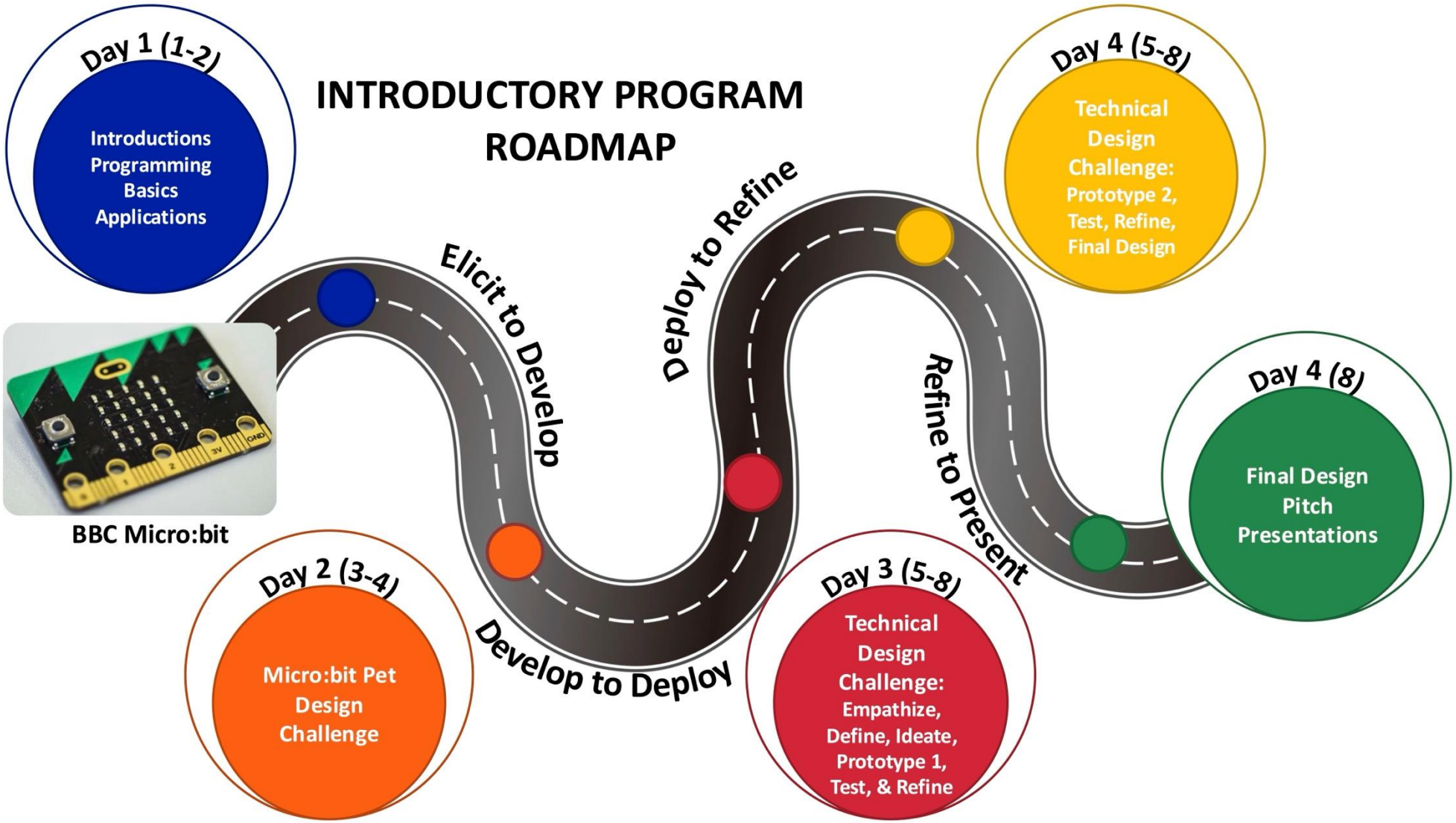
1. Introduction

- Self-efficacy is defined as a person's belief in their ability to succeed in a particular task in a particular situation; in this case, teachers teaching STEM concepts [3].
  - Teachers' self-efficacy can be tied to their pedagogical beliefs, choices, and practice [4].
  - As teachers develop more self-efficacy in the topics they teach, student learning increases [5], [6], [7].

1. Introduction

- The GGEE program supports teachers in:
  - Learning new STEM concepts
  - Upskilling them in programming
  - Empowering them to continue or expand their STEM teaching

2. Goldberg Gator Engineering Explorers



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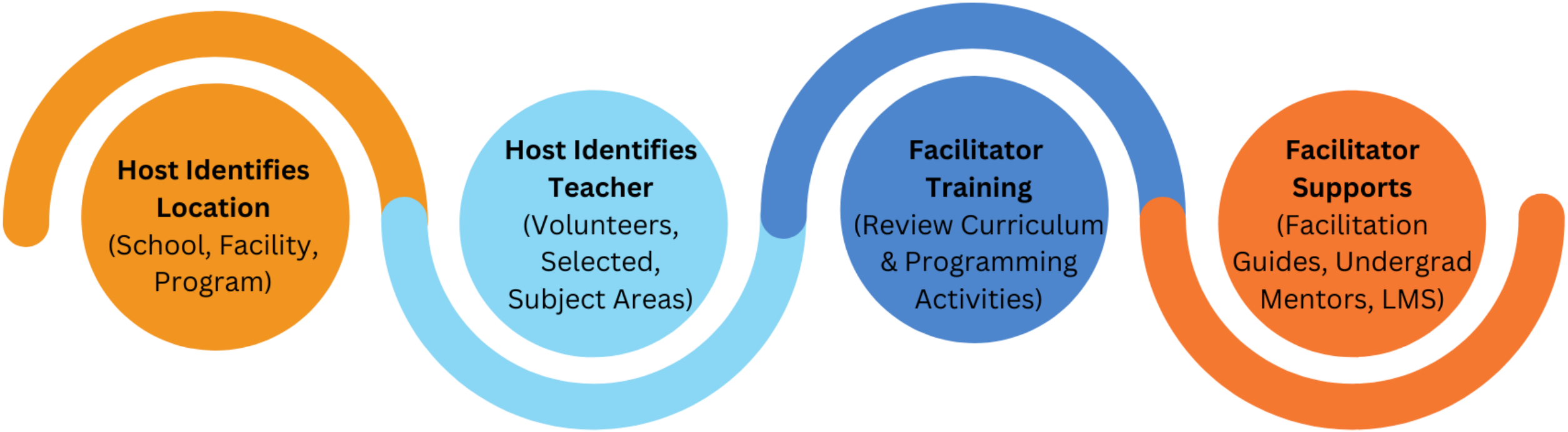
2. Goldberg Gator Engineering Explorers



2. Program Design

Structure

- Funding from multiple donors and a city
- Cost sharing
- Train local teachers and undergrads

Locations

- 26 Camp Sessions
- 13 school districts

Format Options

- 4 Full Days
  - 7-8 Hours
- 8 Half Days
  - 4 Hours

People

- 23 Teachers
- 22 Undergrad Mentors
- 322 Student Participants Grades 6-9

3. Research Aims

1. *How does participating in an informal STEM summer program impact teachers' perception of their coding and programming skills?*
2. *How does teacher STEM self-efficacy develop after participating in STEM summer programs?*

4. Methodology

- Data Collection
  - Pre- and Post-Surveys (via Qualtrics)
    - Coding Skills; STEM Self-Efficacy
  - Semi-Structured Exit Interviews (Confidential via Zoom)
    - Classroom applications

4. Methodology

Coding Skills and Prior Experience

“How would you rate your coding skills?”

None, Basic, Medium, High

4. Methodology

Teacher Efficacy and Attitudes Toward STEM (T-STEM) [19]:

A. I am continually improving my STEM teaching practice.

B. I am confident that I can teach STEM effectively.

C. I understand STEM concepts well enough to be effective in teaching STEM.

D. I am confident that I can answer students' questions about STEM.

E. When a student has difficulty understanding a STEM concept, I am confident that I know how to help the student understand it better.

F. I know what to do to increase student interest in STEM.

Strongly Disagree, Disagree, Agree, and Strongly Agree

4. Methodology

Interview Questions

- How has your participation impacted the way you think about teaching?
- How do you plan to incorporate computational thinking, engineering design use of technology, and system thinking in your future classrooms?

5. Results and Discussion

- 23 Teacher Facilitators
- 20 Participated in Research
- 17 Complete Pre- and Post Surveys

5. Results and Discussion

Table 1. Teacher gender, racial, and ethnic demographics

Category	Participants
Gender (n=20)	
Female	30%
Male	65%
Prefer Not To Say/Not Listed	5%
Race (n=20)	
Black or African American	10%
White	85%
No Race Selected	5%
Ethnicity (n=20)	
Hispanic or Latin(x)	20%

5. Results and Discussion

Table 2. Teacher grade level, subject area, and teaching experience demographics.

Category	Participants
Grade Level (n=20)	
9-12	45%
6-12	15%
6-8	30%
K-5	5%
None Listed	5%
Teaching Experience (n=20)	
30+ years	10%
20 – 29 years	20%
15 – 19 years	15%
10 – 14 years	10%
4 – 9 years	30%
0 –3 years	15%

5. Results and Discussion

Table 2. Teacher grade level, subject area, and teaching experience demographics.

Category	Participants
Subject Area (n=20)	
STEM Elective	50%
STEM Subject Area and STEM Elective	25%
STEM Subject Area	5%
STEM Subject Area, STEM Elective, and Other	5%
STEM Subject Area and Other	5%
Social Science	5%
Other (Non-Teacher)	5%

5. Results and Discussion

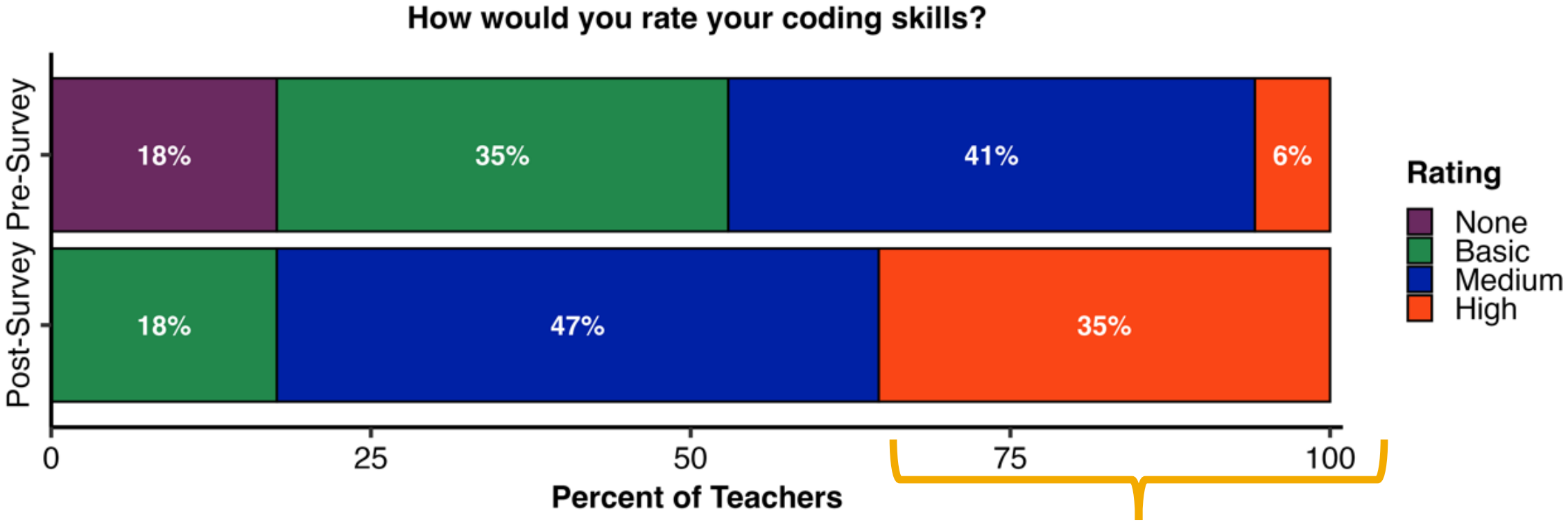
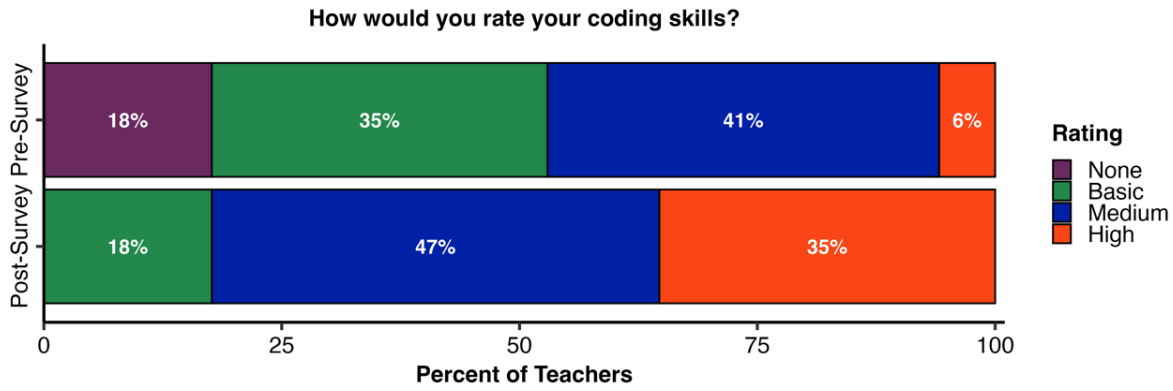
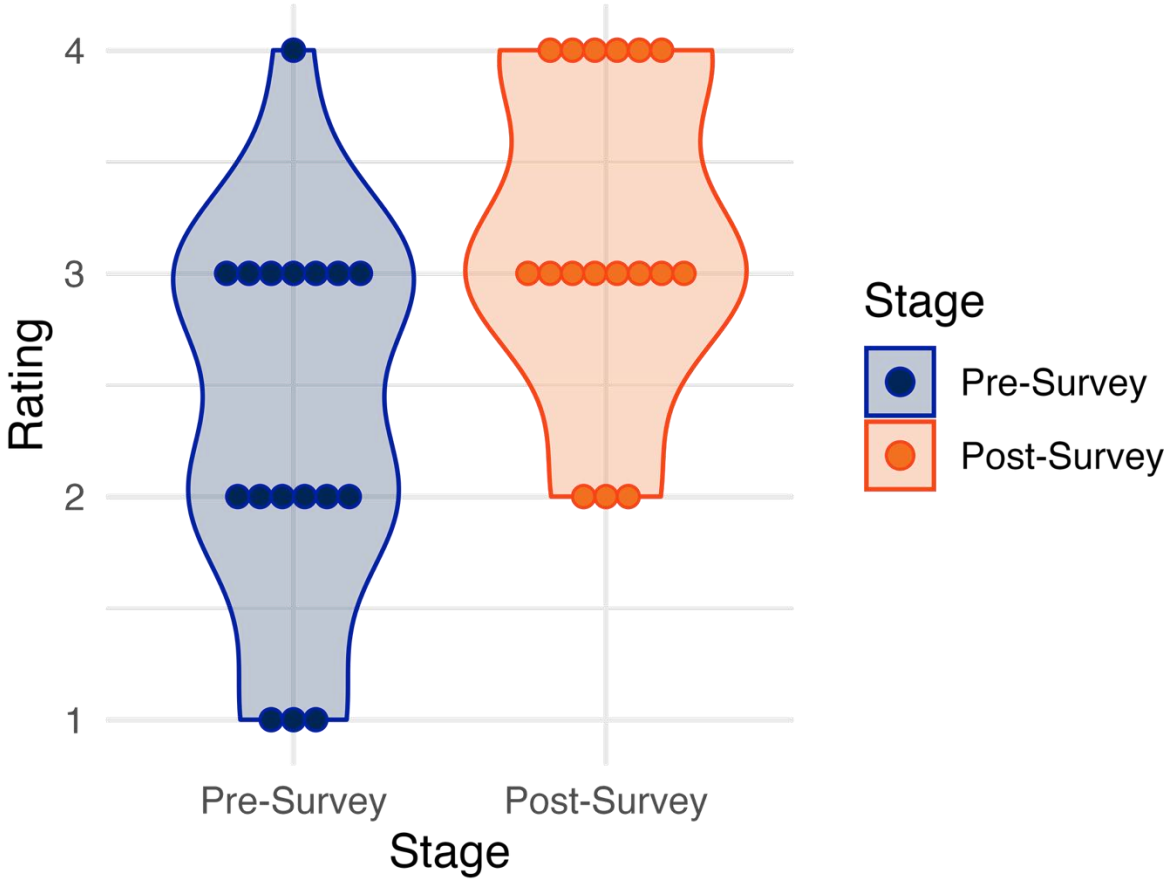


Figure 4: A comparison of teachers' coding skills ratings before and after the camps (n=17). Significant increase in average rating from pre- to post.

5. Results and Discussion



Group 1 Pre-Survey	Group 2 Post-Survey	p	p.signif
2.35 ± 0.86	3.18 ± 0.73	2.01e-07	****



5. Results and Discussion

Table 3. Pre- and Post-survey STEM teaching efficacy and beliefs. (n=17)

Question	Mean (SD) Pre	Mean (SD) Post	p (<0.05)
A. I am continually improving my STEM teaching practice.	3.71 (0.47)	3.65 (0.49)	0.332
B. I am confident that I can teach STEM effectively.	3.65 (0.49)	3.65 (0.49)	-
C. I understand STEM concepts well enough to be effective in teaching STEM.	3.41 (0.62)	3.65 (0.61)	*0.0413
D. I am confident that I can answer students' questions about STEM.	3.29 (0.59)	3.47 (0.62)	0.0826
E. When a student has difficulty understanding a STEM concept, I am confident that I know how to help the student understand it better.	3.24 (0.56)	3.53 (0.62)	*0.0201
F. I know what to do to increase student interest in STEM.	3.24 (0.66)	3.41 (0.62)	0.0826
Overall Scores	3.42 (0.59)	3.56 (0.57)	*** 0.0003

5. Results and Discussion

Implications for Practice

- Teachers who are both competent and confident in their conceptual understanding of STEM topics and coding skills increase student success in the classroom [10-12].
- Evidence suggests that participation in the GGEE summer program improved teachers' programming skills and increased their self-efficacy in teaching students difficult STEM concepts.
- Participation in this program may therefore serve as a passive professional development for teachers

5. Results and Discussion

How has your participation impacted the way you think about teaching?

- *"It helped me at learning how to teach open-ended project assignments in the computer science field. It kind of just helped me with teaching open-ended projects with the micro:bit in computer science, and that is what I like to do."*

5. Results and Discussion

How do you plan to incorporate computational thinking, engineering design, use of technology and system thinking in your future classrooms?

- *"...If I write a common story for the course I am teaching, system thinking is going to help me narrate that course better. I am teaching Environmental Science. It is all about relationships. From the beginning, I am teaching kids to make maps and that is making a common map we will use throughout the course. Computational thinking is the logic and step-by-step. The activities we did in the camp were common. They were part of my teaching before and will continue to be. Engineering design and technology the same thing as computational thinking. The one that is most impacted is system thinking.'*

6. Conclusions

- This study aimed to investigate the impacts of teachers' participation in a summer program on coding skills and self-efficacy in STEM.
- There was a significant 35% increase in teachers who rated their coding skills as Medium or High from pre- to post-survey.
- Overall, teachers experienced a strongly significant increase in STEM self-efficacy after training and facilitating a GGEE summer program.

6. Future Work

- Future work for this portion of the research study includes creating more refined interview questions to better understand the impacts of camp participation on teacher STEM self-efficacy.

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- The opinions expressed in this paper reflect those of the authors and do not represent the views or opinions of other individuals within the University of Florida. All work from this program is original.
- University of Florida Institutional Review Board (IRB202102451)

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THANK YOU!

ANY QUESTIONS?

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