The Impact of an Integrated Literacy and Design Activity on Student Attitudes Toward Coding

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BYU Technology & Engineering Studies
IRA A. FULTON COLLEGE OF ENGINEERING

Introductions

BYU Technology & Engineering Studies
IRA A. FULTON COLLEGE OF ENGINEERING

Service Missionary

BS & MS
Technology & Engineering

Middle School Teacher

PhD, Curriculum & Instruction

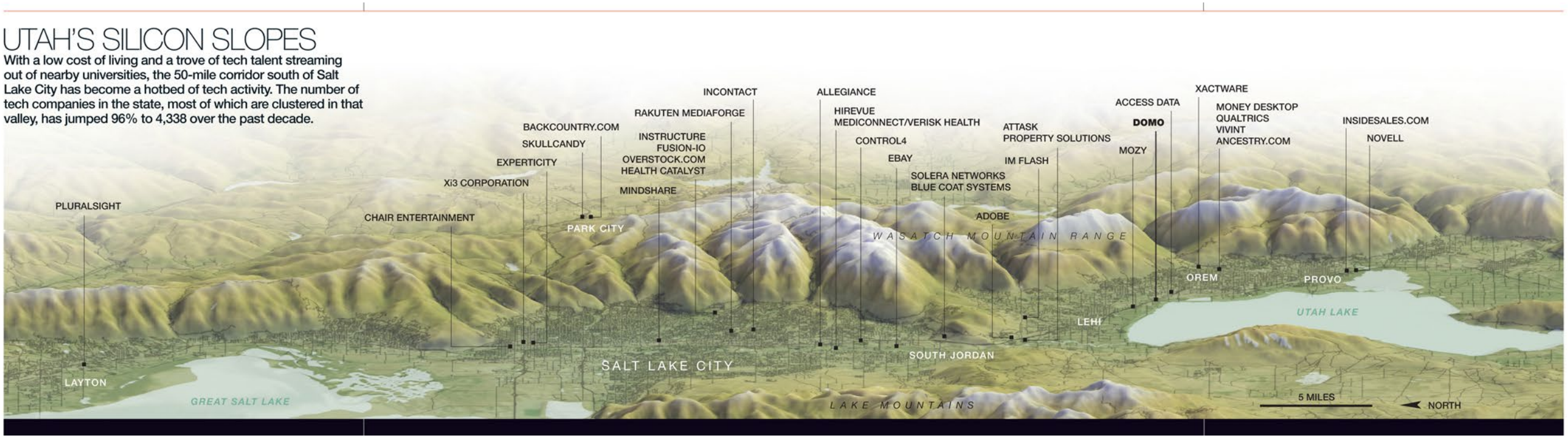
Asst. Professor
Engineering/Technology Education

Asst. Professor
Technology & Engineering Studies

Visiting Professor
UP-Diliman, College of Education
April 2023– August 2023

How it all started…

The 5-million-dollar challenge



2019

New sEEd & Literacy Standards

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Utah State Board of Education

Keyword Search

Students and Families | Community and Partners | Schools and Educators | Parent Portal

Welcome to Science

Welcome to the Science website for the Utah State Board of Education. On the home page, you will find links to some of the most recent news from our office, and in the subsequent pages, we've placed more details about state science standards, endorsement information, grant applications, and our ongoing projects. Peruse, enjoy, and if you have any questions, please contact us.

Core Standards | Core Guides | Educator Endorsements | Safety Certification | Professional Learning | OER Textbooks | SSECC | PAEMST

Core Standards

The Utah State Board of Education (USBE), in January of 1984, established policy requiring the identification of specific core standards to be met by all K-12 students in order to graduate from Utah's secondary schools. The USBE regularly updates the Utah Core Standards, while parents, teachers, and local school boards continue to control the curriculum choices that reflect local values.

Current Standards

- Utah Core Standards: Utah Science with Engineering Education (SEEd) Standards Utah K-12 Science
- Utah Core Standards: Utah Science with Engineering Education (SEEd) Standards Utah K-2 Science
- Utah Core Standards: Utah Science with Engineering Education (SEEd) Standards Utah 3-5 Science
- Utah Core Standards: Utah Science with Engineering Education (SEEd) Standards Utah 6-8 Science
- Utah Core Standards: Utah Science with Engineering Education (SEEd) Standards Utah 9-12 Science
- Utah High School Supplemental SEEd Standards Astronomy, Botany, Envireonmental Science, Wildlife Biology, and Zoology

Utah Core Literacy Standards

Utah State Board of Education Core Standards for English Language Arts (ELAs) and Literacy in History/Social Studies, Science, and Technical Subjects
Utah State Board of Education Elementary Language Arts

Included are standards for Science Literacy Instruction in both reading and writing:

- Reading Standards for Informational Text K-5 (Page 15)
- Writing Standards K-5 (Page 21)
- Reading Standards for Literacy in Science and Technical Subjects 6-12 (Page 74)
- Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12 (Page 78)

UTAH SCIENCE WITH ENGINEERING EDUCATION (SEEd) STANDARDS

Strand 4.1: ORGANISMS FUNCTIONING IN THEIR ENVIRONMENT

Through the study of organisms, inferences can be made about environments both past and present. Plants and animals have both internal and external structures that serve various functions for growth, survival, behavior, and reproduction. Animals use different sense receptors specialized for particular kinds of information to understand and respond to their environment. Some kinds of plants and animals that once lived on Earth can no longer be found. However, fossils from these organisms provide evidence about the types of organisms that lived long ago and the nature of their environments. Additionally, the presence and location of certain fossil types indicate changes that have occurred in environments over time.

- **Standard 4.1.1** **Construct an explanation** from evidence that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. Emphasize how structures support an organism's survival in its environment and how internal and external structures of plants and animals vary within the same and across multiple Utah environments. Examples of structures could include thorns on a stem to prevent predation or gills on a fish to allow it to breathe underwater. (LS1.A)
- **Standard 4.1.2** **Develop and use a model** of a system to describe how animals receive different types of information from their environment through their senses, process the information in their brain, and respond to the information. Emphasize how animals are able to use their perceptions and memories to guide their actions. Examples could include models that explain how animals sense and then respond to different aspects of their environment such as sounds, temperature, or smell. (LS1.D)
- **Standard 4.1.3** **Analyze and interpret data** from fossils to provide evidence of the stability and change in organisms and environments from long ago. Emphasize using the structures of fossils to make inferences about ancient organisms. Examples of fossils and environments could include comparing a trilobite with a horseshoe crab in an ocean environment or using a fossil footprint to determine the size of a dinosaur. (LS4.A)

2019

That's great….but….

- Many schools in Utah don't offer any sort of CS classes (and/or only introductory)

- *"Utah lacks enough teachers to teach additional computer science courses and elementary teachers need additional support to integrate the newly adopted computer science standards into their instruction."* -UCSMP, p.10

- Elementary teachers are generalists who know a little about a lot of things – computer science is not usually one of them

Digital Storyboards

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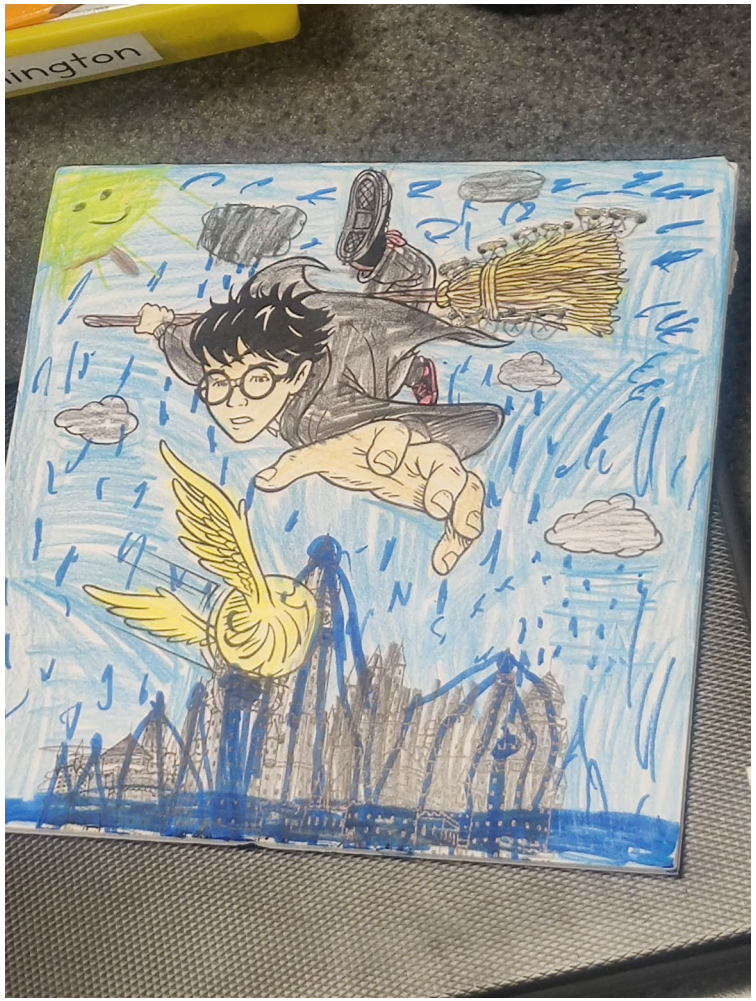

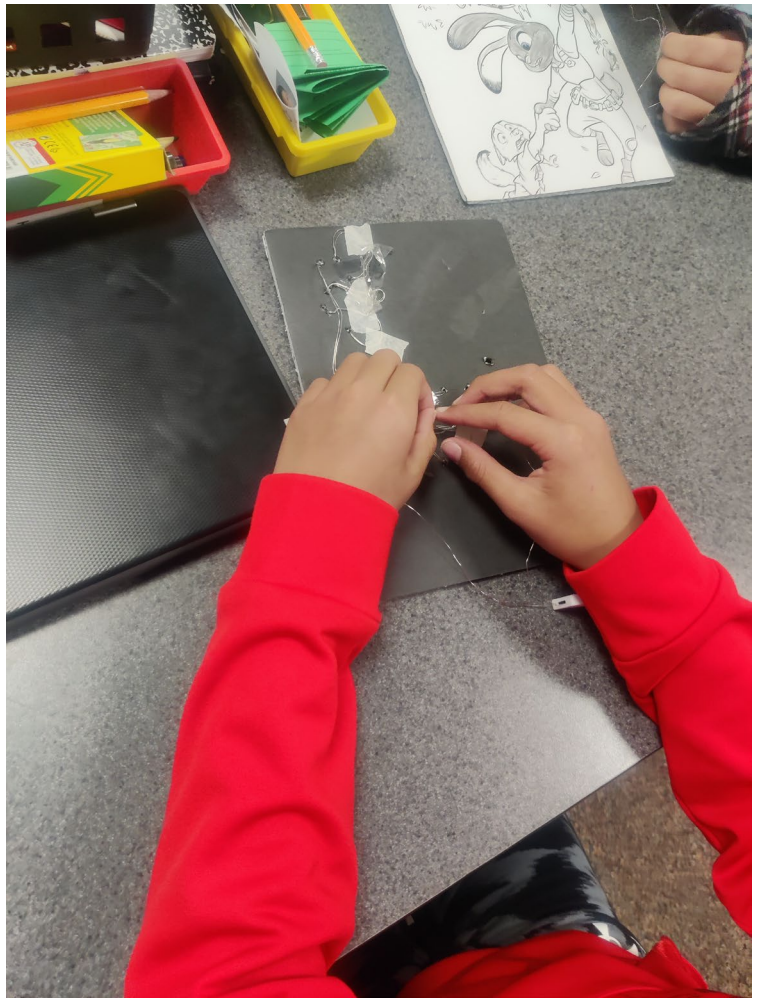

Digital Storyboards

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RQ: 1. What is the impact, if any, of participation in the digital storytelling project on elementary students' perceptions of, and interest in, coding?

Technology & Engineering Undergrads

Elementary Teachers (4th grade)

Standards (4th grade)

Engineering Design
Computational Thinking
Literacy

Elementary Students Attitudes Towards Coding Survey
-Mason & Rich, 2020
Semi-structured interviews

ESCAS Survey

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Factor	Item	Statement (Agree – Disagree)
Coding confidence	C1	I can learn to code.
	C2	I am good at coding.
	C3	I am good at problem solving.
	C4	I can write clear instructions for a robot or computer to follow.
	C5	If my code doesn't work, I can find my mistake and fix it.
	C6	I've been told I would be good at coding.
Coding interest	I1	I like coding, or I think I would like coding.
	I2	I would like to learn more about coding.
	I3	Solving coding problems seems fun.
	I4	Coding is interesting.
	I5	I would like to study coding in the future.
Utility	U2	I can use coding skills in other school subjects.
	U3	Knowing how to code will help me to create useful things.
	U4	Knowing how to code will help me solve problems.
	U5	I think I will need to understand coding for my future job.
Social value	S3	My friends think coding is cool.
	S4	My parents think coding is important.
	S7	I am friends with kids who code
Perceptions of Coders	ST2	Kids who code are smarter than average.
	ST5	Kids who code enjoy doing sports.
	ST7	Coders are good at math.
	ST8	Coders are good at science.
	ST9	Coders are good at language arts.

Digital Storyboards

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Day	Activity
Before	2 hours of teacher PD
1	Consent/Assent forms, What is a story, ESCAS
2	Basic circuits
3	Digital storyboards: choose a scene
4	Micro:bits – basic programming
5	Micro:bits – inputs/conditionals
6	Digital Storyboards – add lights
7	Digital Storyboards – add lights
8	Advanced challenges
9	Advanced challenges
10	ESCAS, Student celebrations
11	Semi-structured interviews

Findings & Key Takeaways

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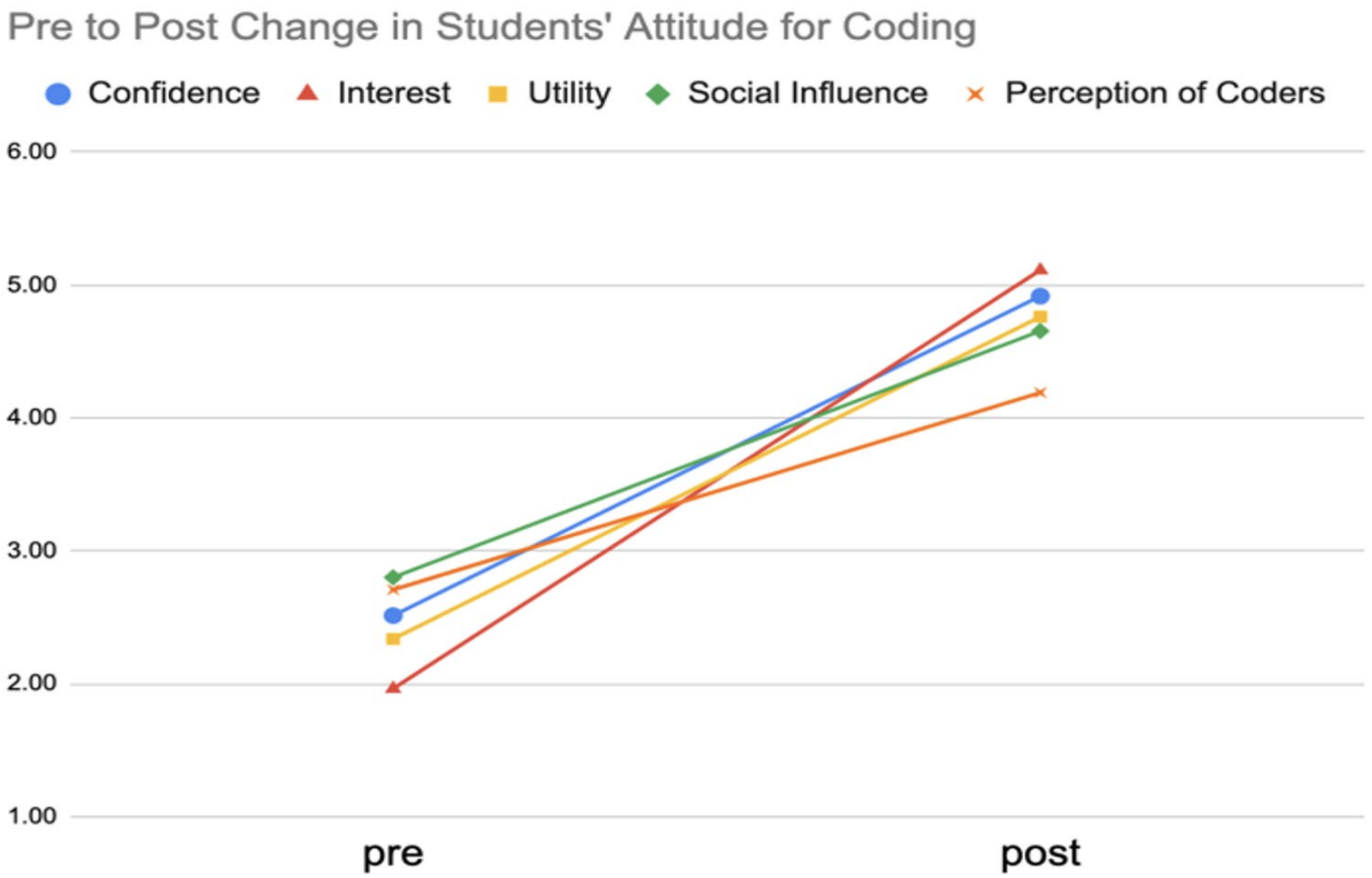

Findings & Key Takeaways

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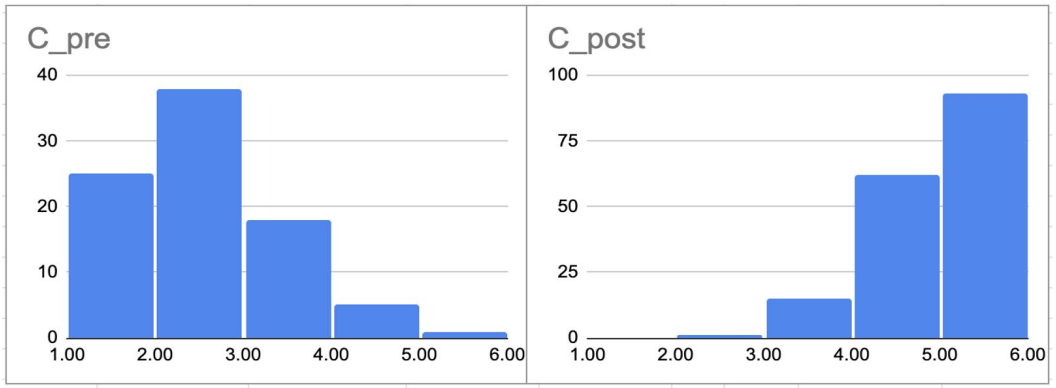
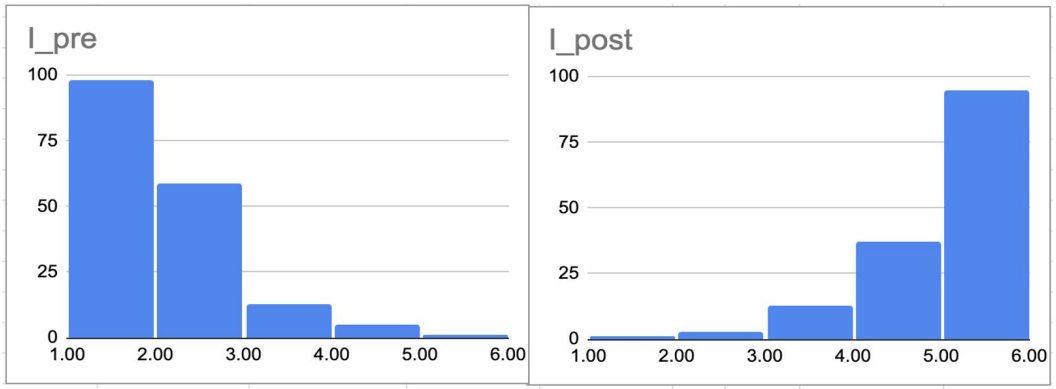
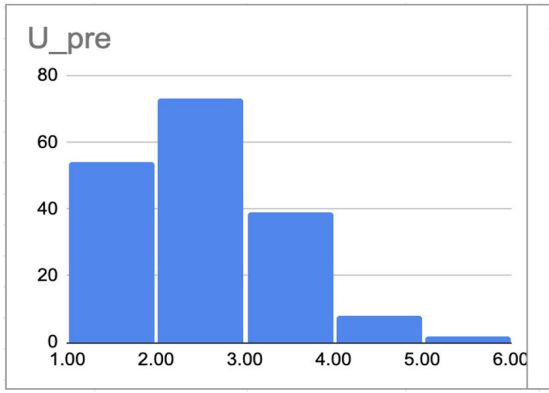
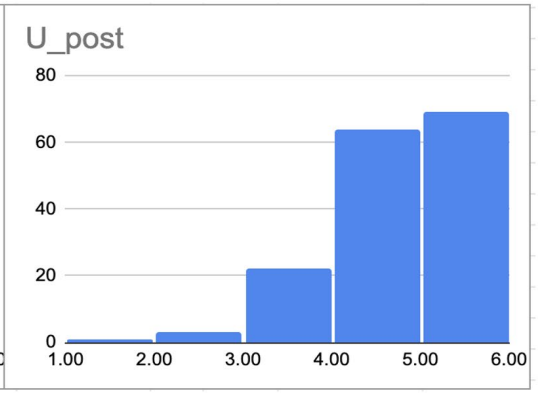


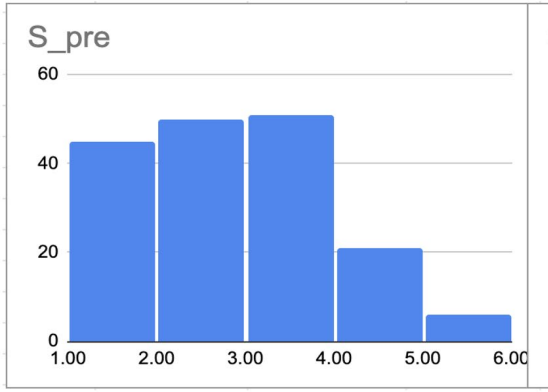


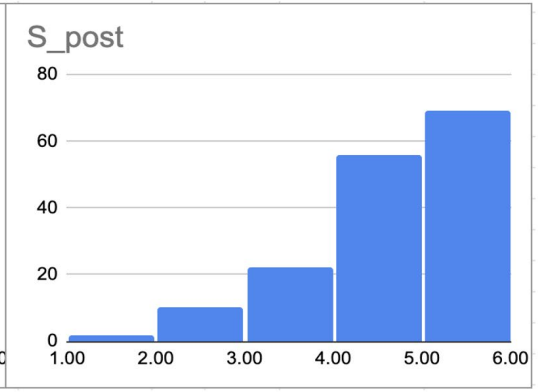
Confidence

Interest





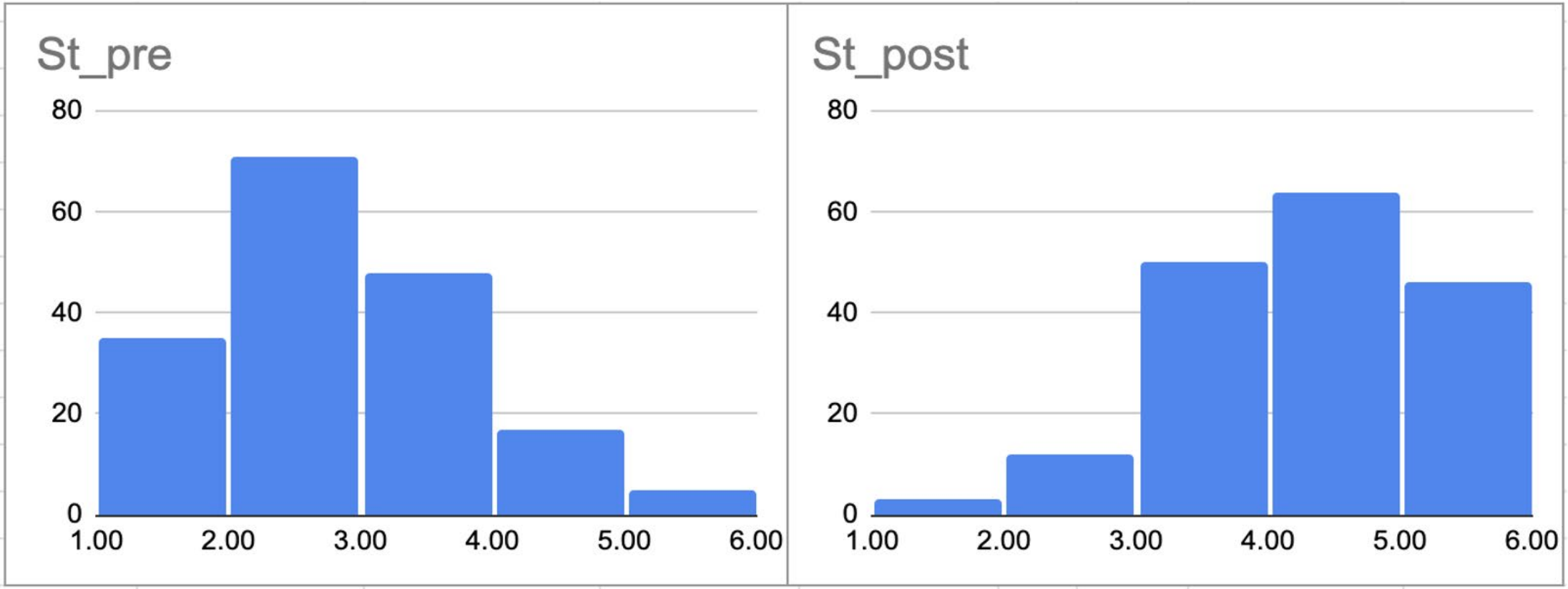




Utility

Social Influence

Findings & Key Takeaways



Perceptions of Coders

Student Interview Themes

	Theme	Count	Percentage
	Specific reference to a task/challenge	92	37%
1	Grit	26	10%
2	Following Explicit instructions vs Problem Solving	26	10%
3	Physical components versus digital components	26	10%
4	Reference to computational thinking characters	22	9%
5	Teamwork	21	8%
6	Choice/Freedom	15	6%
7	Mentor/Adult influences	12	5%
8	Complexity of task/directions	7	3%
9	Coding Inputs and Outputs	2	1%

Interviews (GRIT)

"It was so hard. And then we're like, this is too hard. I can't do it. And then we keep trying and trying and trying. And and then it's like, oh, it's finally working."

"I liked how it was challenging because I had like no idea what I was doing, but it was fun when I was done because I thought I could maybe do that again."

"·It was difficult. But later the as soon as I got towards the end it came together to me really easy. So now I can solve coding projects."

"We got all the lights to turn on. I thought it was impossible. Because it was super hard for me, but I got over it. That's what was most exciting."

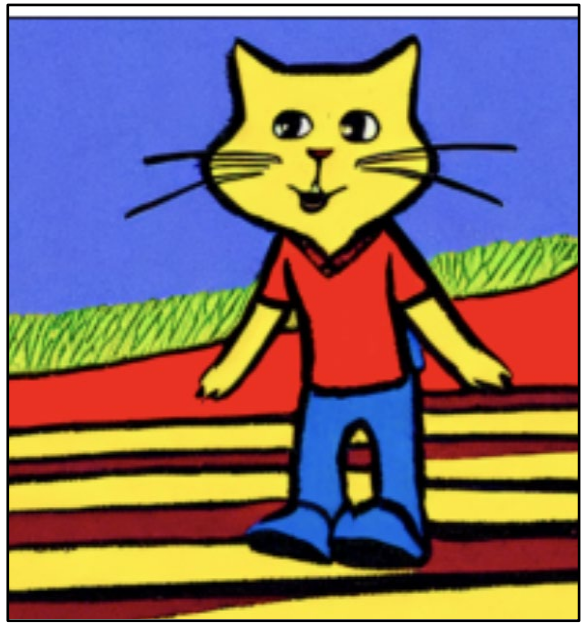
Surprising Finding (Characters)

Deco the Zombie

DECOMPOSITION

PATTERN RECOGNITION

Pat the Cat



Abs the Detective

ABSTRACTION

ALGORITHM DESIGN

Algordo the Chef

Current/Future Plans

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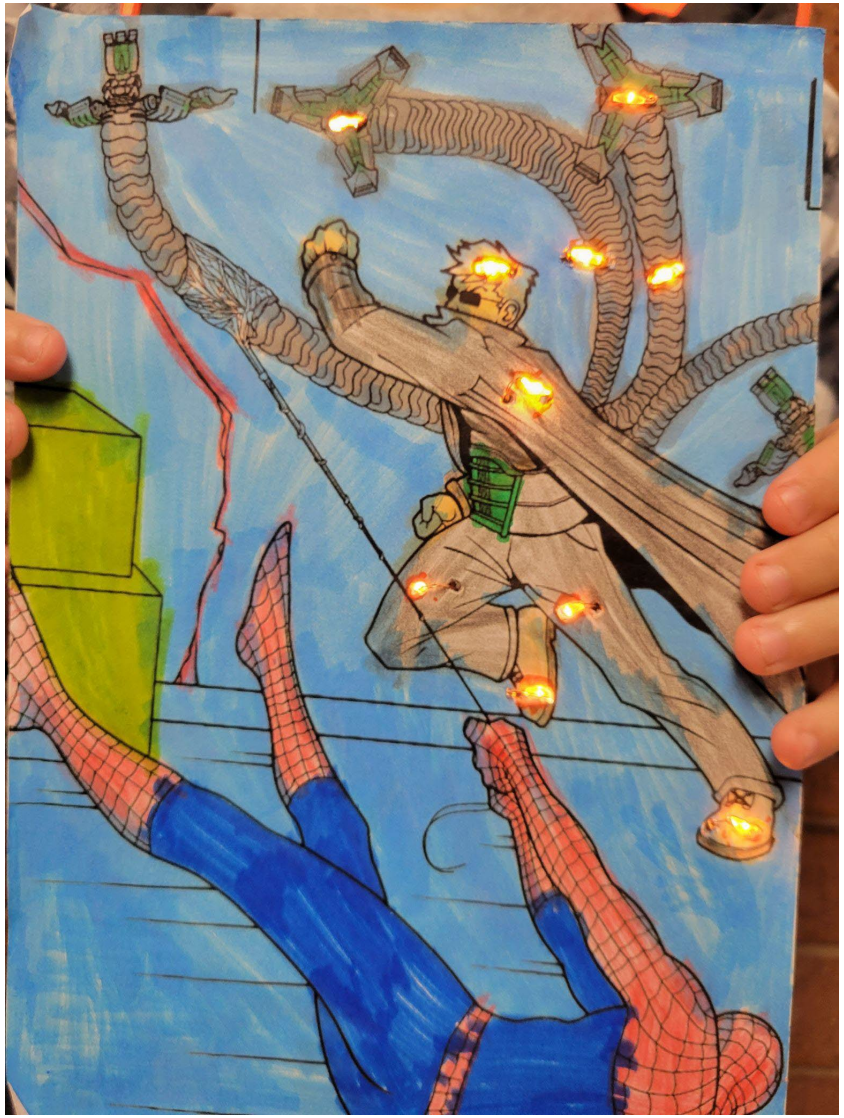
- 30K research practitioner partnership grant (‘23-’25)

- 24 classrooms (2023-2024)
  - 4th grade (24 teachers)
  - 3 school districts
  - ~700 students
  - 5 BYU TES Majors

- ESCAS & TBACCT surveys (pre/post)

- Semi-structured interviews
  - Five per class (2 upper, 2 lower, 1 mid)
  - Teachers

- Lesson plans, supply lists, teacher support



Thank you!

Questions?

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