



LUDDY

SCHOOL OF INFORMATICS,
COMPUTING, AND ENGINEERING
Indianapolis

Family Makers: Promoting Engineering Learning for Children and Caregivers Through Online Making Programs at Rural Libraries

Soo Hyeon Kim, Ph.D.
Indiana University Indianapolis

Makerspaces are “informal sites for creative production in art, science, and engineering where people of all ages blend digital and physical technologies to explore ideas, learn technical skills, and create new products.”

(Sheridan et al., 2014, p. 505)



Online space to expand library makerspace

OPENLY-NETWORKED



*Image from <https://lead.nwp.org/knowledgebase/what-is-connected-learning/>

Online making program

Tablets/ hotspots



Video conferencing

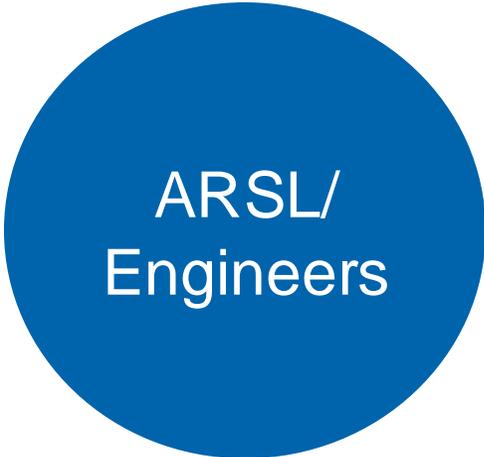


Take-home kits

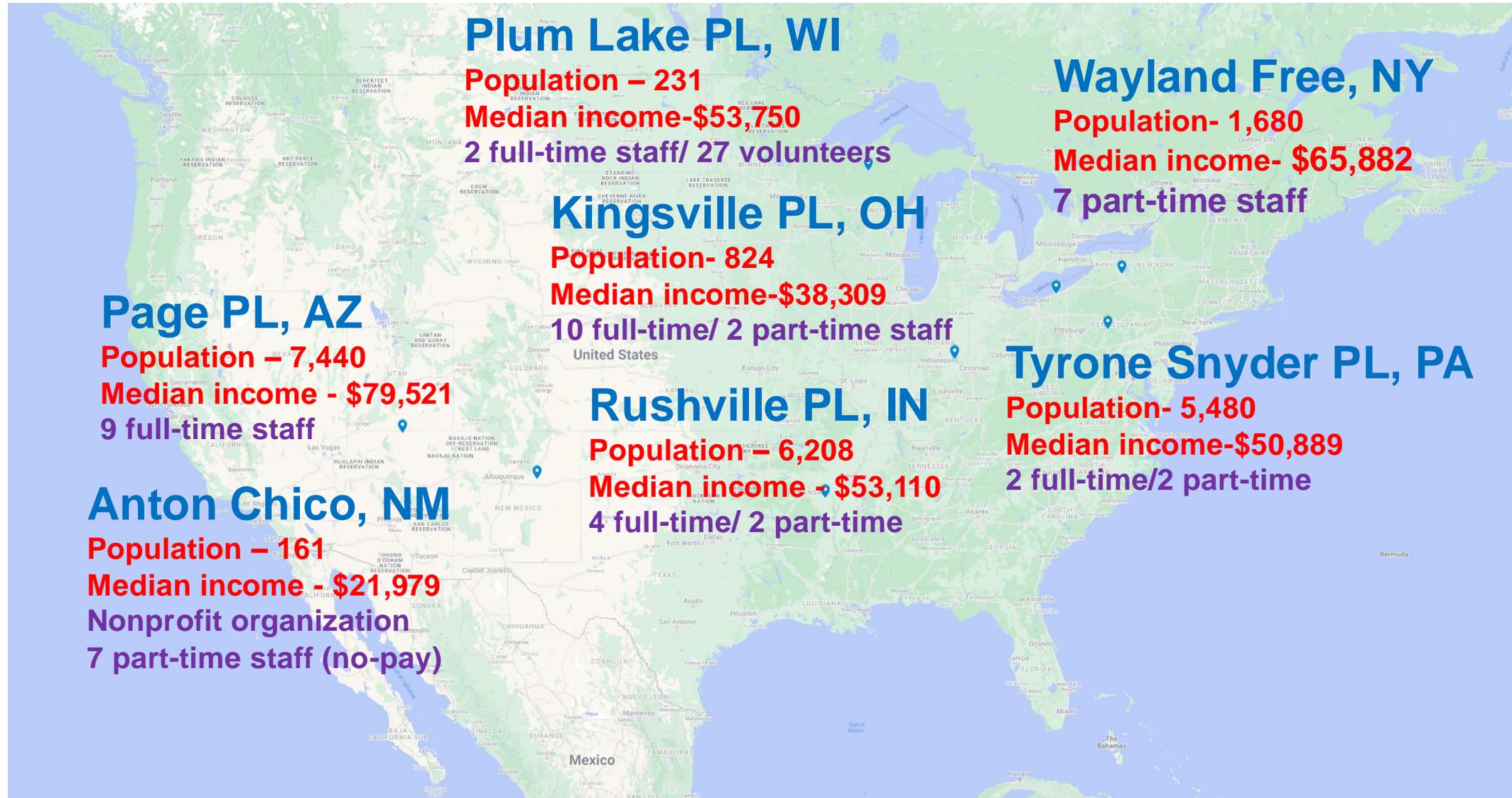




Online engineering program for children (ages 5-10) and parents/caregivers through rural libraries



Rural library partners



01



MATERIALS

Tablets, hotspots,
craft materials

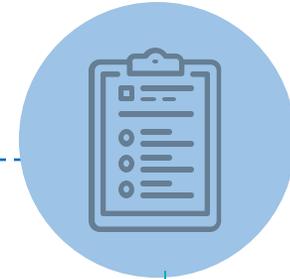
02



PARTICIPANTS

4-6 families per community
Children (5-10 years)
Caregivers
Library staff
Researchers

03

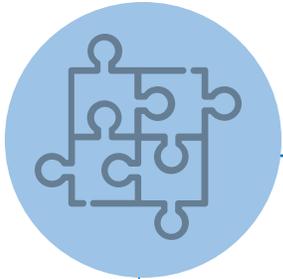


STRUCTURE

6 programs
1 hour/ once a week
Meet in Zoom

Goals & expected outcomes

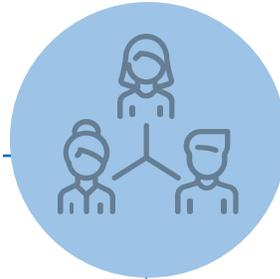
01



FAMILY MAKERS PROGRAM

Six curricula
Facilitation guide
Material list
Webinars

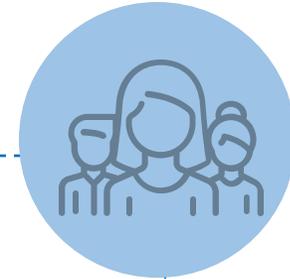
02



CHILDREN & PARENTS

Development of engineering interest and practices

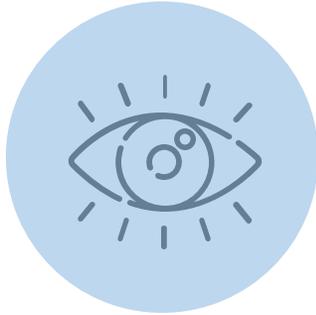
03



LIBRARY STAFF

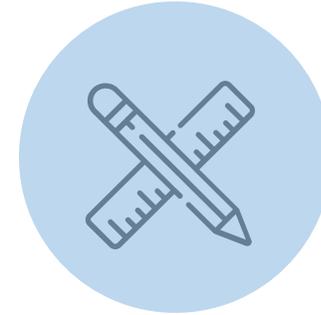
Development of understanding in engineering design thinking and online facilitation skills

Theoretical perspectives



Culturally relevant
pedagogy

(Ladson-Billing, 1995; 2014)



Constructionism

(Papert & Harel, 1991)

Making connections with rural engineers

10 Engineers



Video Shooting Instructions

Below you will find information on how to film your interview and action shots. Please read the instructions on the set-up, lighting, camera, and audio. Footage sharing instructions are also included once you are finished.

Camera

The GoPro already has the Media Mod on, which is the case like shell around it. To turn it on, hold the side power button. We will begin by adjusting the camera settings. The GoPro should be on its default settings which is what we want.

If so, the screen will look like this:



Then, adjust the settings by tapping the bottom middle quality button, and select Standard 4K|30|L.



If for some reason you get an alert that the SD card is missing, see p. 5.

When everything else is set up and you are ready to record, press the red recording button on the top of the camera.

If not, it will look something like this:



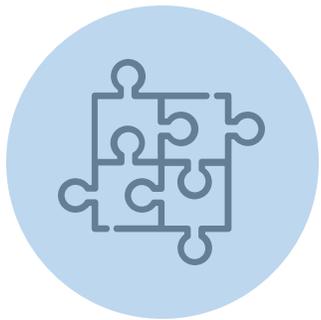
Adjust the frames per second by tapping the 2X (or any other setting) button and select 1X.



Three phases

Phase 1

Understand challenges rural library staff and underserved families experience and identify engineering-related funds of knowledge for engaging them in online engineering programs,



Funds of Knowledge (González et al., 2005; Hogg, 2011)

Challenges

Lack of confidence in engineering

Lack of resources

Insufficient internet and technology

Nurturing effective online engagement

Cultural and perceptual challenges

Funds of
knowledge
related to
engineering

DIY

Fixing

Repurposing

Upcycling

Farming

Gardening

Cooking

“Re-engineering”

Three phases

Phase 1

Understand challenges rural library staff and underserved families experience and identify engineering-related funds of knowledge for engaging them in online engineering programs,

Phase 2

Co-design *Family Makers* culturally relevant online engineering program with rural library staff that can be easily adopted and facilitated by rural library staff, and

Phase 3

Disseminate a research-based online engineering program by generating training materials for a pre-conference workshop and host online webinars.

How did children, parents, and rural library staff's perception and understanding of engineering change as a result of participating in Family Makers program?

Participants/ Data sources

- 7 librarians
- 14 caregivers/ 17 children

2023

Initial interview

Pre-survey

Spring 2024

Participation in
six Family Makers
programs

Spring - Summer 2024

Exit interview

Post-survey

Data sources

The screenshot shows a Google Jamboard session titled "Family Makers". The main content is a mind map with two central questions:

- Top Question:** "Families who may be perfect for this program are not signing up. Why?"
- Bottom Question:** "What strategies can we take to address these issues?"

Reasons for not signing up (Top Level):

- Primary target: general
- Cannot schedule that far in advance
- do not think they qualify
- Do not prefer online - Zoom fatigue?
- Lack of familiarity with engineering - fear issue?
- Their perception is that it is not run by the library - trust issue?

Additional reasons (Middle Level):

- They don't think programming opportunity applies to them.
- General overwhelm with work and family issues and time constraints.
- distrustful, not sure what this is
- contextualization needed

Strategies to address issues (Bottom Level):

- recording of an engineer
- introduced at a different way.: engineers do a program at the library
- Use summer events to promote Family Makers
- encourage in person group activities at the libraries
- provide dinner for busy families during program
- intro engineering program at the library
- Emphasize we introduce engineering by leveraging our everyday practices, such as making
- Emphasize that librarians will be there to facilitate
- Emphasize how this is open to the entire public limited only by age of participant.

The Jamboard interface includes a toolbar on the left with various drawing tools, a top navigation bar with "Share" and "4 / 18" slide indicators, and a vertical sidebar on the right showing video thumbnails of participants: Ju Hui Kang, Soo Hyeon Kim, Nicki Kirchoff, Jennifer Powell (she/her), Gi Woong Choi, and Hope Decker (she, her, hers).

Children's efficacy and attitudes toward STEM

(n=17)

	Pre-Program		Post-Program	
	M	SD	M	SD
Math	3.58	0.43	3.66	0.25
Science	3.66	0.70	3.98	0.48
Engineering/Technology	4.14	0.50	4.33	0.49
21st Century Skills	4.15	0.61	4.26	0.48

S-STEM survey: Unfried, A., Faber, M., Stanhope, D. S., & Wiebe, E. (2015). The development and validation of a measure of student attitudes toward science, technology, engineering, and math (S-STEM). *Journal of Psychoeducational Assessment*, 33(7), 622-639.

Parents' knowledge, attitude, and behavior in engineering

(n=14)

	Pre-Program		Post-Program	
	M	SD	M	SD
Knowledge	3.68	0.42	4.45	0.42
Attitude	3.87	0.28	4.14	0.28
Behavior	3.28	0.56	3.63	0.56

Survey adopted from: Yun, J., Cardella, M., Purzer, S., Hsu, M., & Chae, Y. (2010). Development of the Parents' Engineering Awareness Survey (PEAS) according to the knowledge, attitudes, and behavior framework. Paper presented at the 2010 ASEE (American Society for Engineering Education) Annual Conference. Louisville, KY.

Library staff's knowledge, attitude, and behavior in engineering

(n=7)

	Pre-Program		Post-Program	
	M	SD	M	SD
Knowledge	3.856	0.549	4.634	0.271
Attitude	4.057	0.305	4.271	0.411
Behavior	2.631	0.808	2.981	0.871

Survey adopted from: Yun, J., Cardella, M., Purzer, S., Hsu, M., & Chae, Y. (2010). Development of the Parents' Engineering Awareness Survey (PEAS) according to the knowledge, attitudes, and behavior framework. Paper presented at the 2010 ASEE (American Society for Engineering Education) Annual Conference. Louisville, KY.

Children initially lacked knowledge and experience in engineering

Pre-program

Lacking knowledge and experience in engineering

Initial thoughts had mechanical focus

- **Nadeem:** “I didn't really know anything... I never actually did one.”
- **Evelyn:** “Before, I didn't know that much.”

- **Aurora:** “I thought engineering was like **mechanical**.”
- **Larry:** “I just thought it was for **machines**.”
- **Stella:** “I just thought people that **build** stuff.”

Children's expanded understanding of engineering

Post-program

Engineering is about problem-solving

- **Nancy:** “I learned the whole process of engineering... **finding problems and creating solutions.**”
- **Lisa:** “Engineering is... facing a problem... **finding a way to solve it.**”

Different engineering disciplines

- **Norma:** “I didn't know there were **several different types of engineering.**”
- **Aurora:** “There are **different types of engineering.**”

Engineers make our lives better

- **Lisa:** “I thought it was just people that built stuff wearing protective hats... now I realize they **help our community.**”
- **Xavier:** “Engineering is about making stuff... **for people.**”

Shifts in parental attitudes and perception

Shift
towards
fostering
exploration
and
creativity

- **Betty:** “I recognized my frustration in creative tasks... now I need to engage more positively.”
- **Amber:** “I realized I can be more supportive of his ideas even if they seem messy at first...I’m more open to his messy ideas... it’s about exploring together rather than shutting him down.”

Perception of
STEM

- **Raven:** “Now I feel less intimidated by STEM projects... I’m excited to try this stuff at home...Now I feel like I would seek out more engineering opportunities for my kids.”
- **Perry:** “I learned it is beneficial to have more STEM projects... we’re incorporating them into our home school curriculum.”

Pre-program: Rural library staff's fear towards engineering

We are terrified. We are are like, oh, we don't know if we are qualified to do that.

Nervous.

Scared of introducing engineering while being the hub of the community.

Comfortable about the facilitating part. Just nervous about the (engineering) terminology.

Not an expert but can help and facilitate as a guide on the side.

Not sure.

If I understand the material and lesson, I'm confident.

Not confident

Very confident

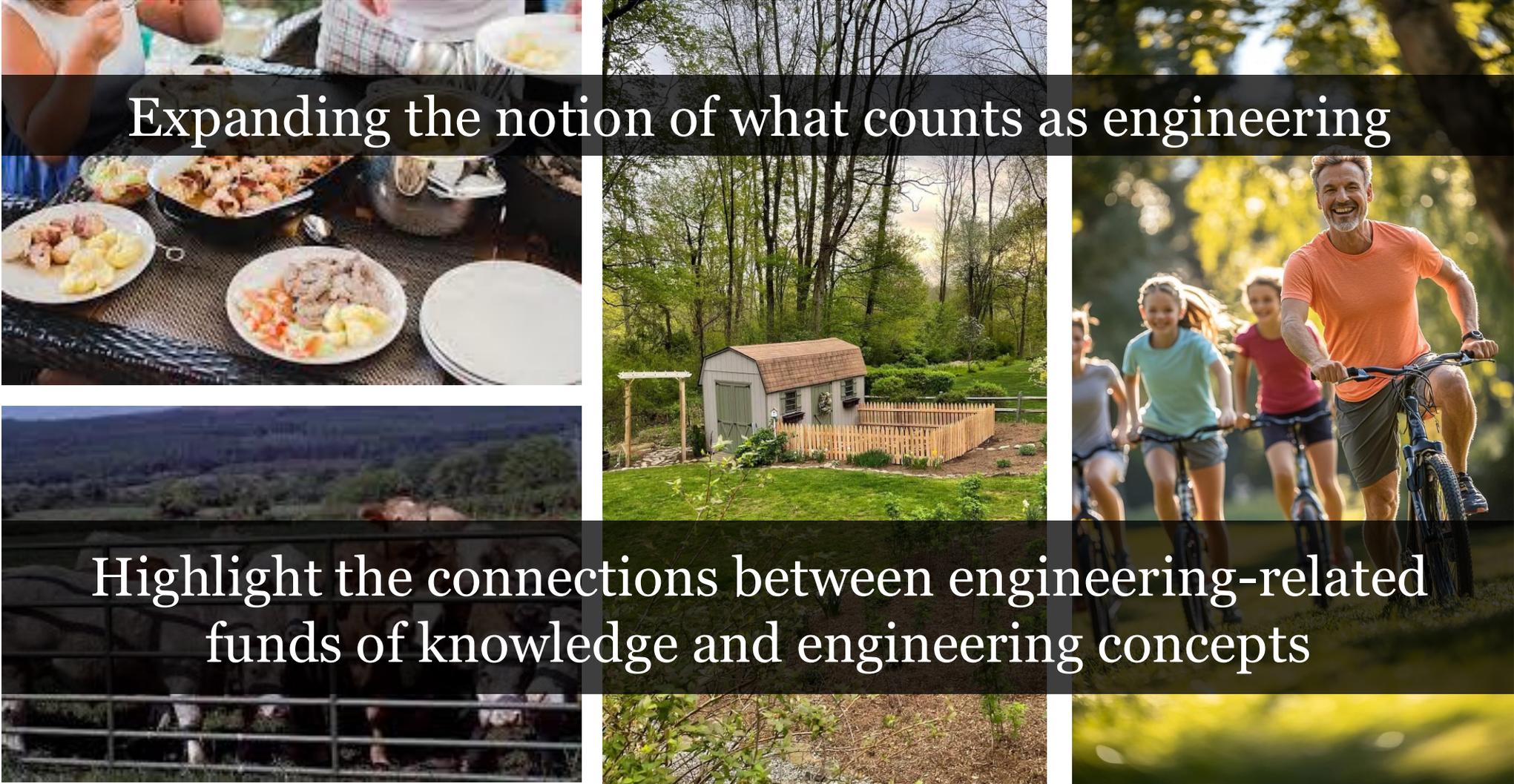
Post-program: Shifts in library staff's perspectives towards engineering

One of the lies, I tell myself, is, I'm not good at math, and I'm not a science person. But, doing these co-design activities and just seeing that it's so wider than this narrow view of it...Which made me go, okay, I could do this! And I'm not bad at math, that's what I tell myself. And **I am an engineering person because I engineer stuff all the time. I just don't call it that.**

(Krystal, pseudonym)

**Development of knowledge, attitude, and
understanding of engineering**
among children, parents, and library staff

Practical Implications



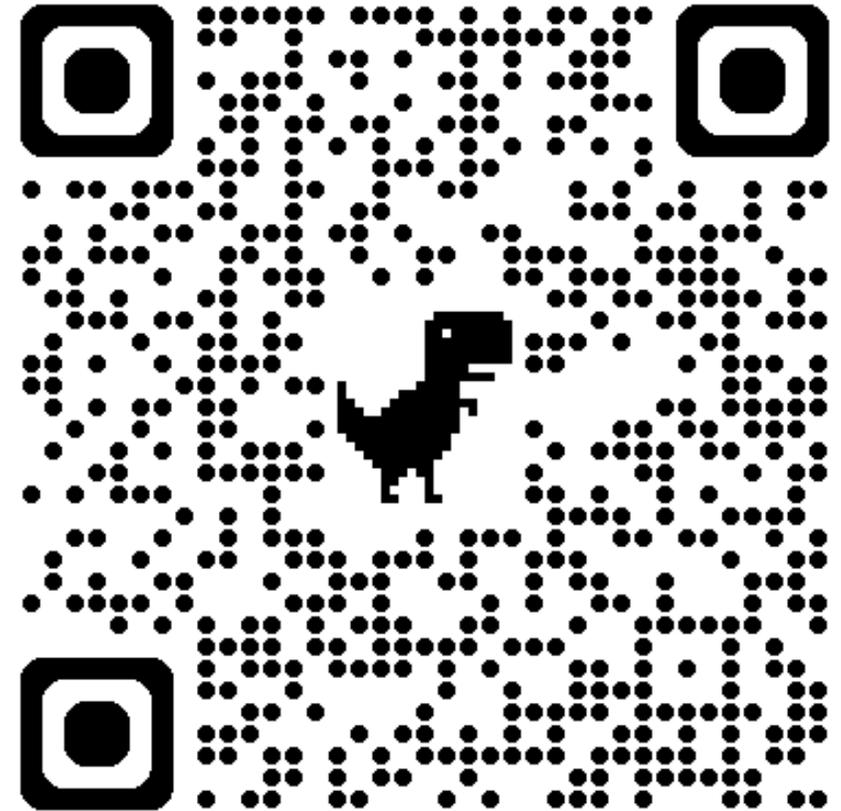
Expanding the notion of what counts as engineering

Highlight the connections between engineering-related funds of knowledge and engineering concepts

QUESTIONS?

Soo Hyeon Kim skim541@iu.edu

Scan QR code to access our website



Thank you!

Library Partners

Breezy Gutierrez
Danielle Weiser-Cline
Debbie Winlock
Emilie Braunel
Elisabeth Cowley
Hope Decker
Jennifer Powell
Jessica McGuinnes
Nicole Kirchoff
Rayauna Urban
Seairah Combest

Researchers

Ju Hui Kang
Deepak Giri
Gi Woong Choi
Lauren Harris
Mansi Kasar
Vaishnava Samudrala

*Acknowledgements: This project was made possible in part by the Institute of Museum and Library Services LG-252377-OLS-22.

