

Family Makers: Online Engineering Program for Underserved Children and Caregivers at Rural Libraries

Summary: The research team from IUPUI and University of Cincinnati—with national library partners and the Association for Rural and Small Libraries (ARSL)—seeks \$496,574 to conduct a three-year applied research project that promotes lifelong learning by broadening engineering learning opportunities for rural underserved children from young age. Our goal is to develop, test, and disseminate an online engineering program entitled *Family Makers* for underserved children (5-10 years) and caregivers in rural communities to 1) explore visible and relevant entry points and pathways to rural engineering informed by digital contents representing lived experiences of rural engineers and technical professionals, 2) design for the rural community by utilizing engineering design thinking and prototyping tailored for children through open-ended maker activities, and 3) celebrate rural engineering solutions that *Family Makers’* children and caregivers designed. As a result of an implementation research through two iterations of *Family Makers* across multiple rural library settings, the primary outcome will be a nationally scalable *Family Makers* program that includes curricula for six online sessions and digital resources (i.e., design journal, facilitation and technology guides, a list of prototyping tools, craft materials, hotspots, and mobile devices). As a secondary outcome, the project will enhance rural librarians’ engineering understanding and online facilitation skills.

Project Justification: Diversifying who gets to participate and contribute to STEM, regardless of social positions, is a national imperative.¹ Given that children’s career aspirations towards—and away from—engineering start as early as 10,² engineering is increasingly being integrated into K-12 education.³ However, rural school districts often lack qualified teachers and resources to implement engineering curriculum.⁴ While informal science education can positively impact children’s engineering interest, underserved children in rural communities experience challenges accessing the informal science learning resources due to geographical location and social position. Considering many rural communities lack public institutions, besides the library, that provide free access to learning resources and facilitation, rural libraries are critical for underserved children to engage in engineering learning. One particularly accessible way to engage in engineering learning is through open-ended making, as making has shown potential to develop understanding of the engineering design process.⁵ Libraries actively implement making programs to support STEM learning⁶; however, the majority are situated on-site, neglecting patrons who lack resources and time to visit the library. While efforts exist to bring STEM resources to the learners (e.g., circulation kits), underserved families are often challenged to provide the “social envelop” that influence the quality of scaffolding and modeling from caregivers.⁷ Learning is a social activity, mediated by interactions with social, material, technological, and situational resources.⁸ Children who utilize circulation kits, without appropriate facilitation, may have limitations in developing high-order thinking skills (e.g., problem-solving skills). As such, future endeavors to bring engineering resources to the learners must provide social facilitation in addition to material and technological resources. Our conjecture is that the combination of online space and the librarians’ remote facilitation can help to address this need.

Goals and Research Questions: The goal is to develop, test, and disseminate how library-based online engineering program, *Family Makers*, can serve underserved children and caregivers in rural communities. To disseminate *Family Makers*, the following research questions guide this study: **RQ1)** How do assets, practices, and challenges present in the rural environment influence the perceptions of children, caregivers, and rural librarians toward engineering and online learning programs?; **RQ2)** How does *Family Makers* support underserved children’s development of engineering interest and practices, and how does it enhance rural librarians’ understanding of engineering and online facilitation?; **RQ3)** To what extent does *Family Makers* generalize to different rural libraries and underserved families?

Prior Work: Given the limited literature around supporting underserved families’ STEM learning through rural libraries, this research conducted a preliminary study, *Empowering Rural Libraries as Sites for Youth Informal Learning through Making*, funded by Indiana University. The study informed the project team to consider an alternative way to engage patrons in STEM learning and the need to train rural librarians to develop understanding in STEM.⁹ To develop *Family Makers* online program, we will also adopt our work on transforming maker programs into online settings.¹⁰

Project Work Plan: Project activities will occur in four phases explained below.

Phase	Activities	Outcomes
Understand (Year 1)	Contextual inquiry: interviews/ focus groups with children, caregivers, rural librarians, rural engineers, and education stakeholders directly working with underserved families (e.g., youth pastors, afterschool coordinators); Literature review	Enhanced understanding of how underserved children and rural librarians’ assets, practices and challenges influence their perception of engineering and online learning; resources and considerations for designing <i>Family Makers</i>
Develop (Year 2)	Research-Practice Partnership (RPP): iterative design cycle 1 to develop program structure and	<i>Family Makers</i> program (iteration 1) that includes six curricula and digital resources, digital

	contents, digital contents creation with rural engineers, pilot test <i>Family Makers</i> , librarian training	contents representing lived experiences of rural engineers and technical professionals
Test & revise (Year 2)	At 3 libraries: Implement iteration 1 of <i>Family Makers</i> (six sessions); pre-and post-survey at the initial and final session; short family interview after each session; exit interviews; iterative design cycle 2 to design iteration 2 of <i>Family Makers</i> ; video-records of online sessions and iterative design cycles	<i>Family Makers</i> program (iteration 2); case studies of family participation and librarian facilitation; underserved children's development of engineering interest and practices; rural librarians' development of understanding in engineering and online facilitation
Replicate & disseminate (Year 3)	At 3 libraries (same activities as above, 3 different libraries from Year 2): Iteration 2 of <i>Family Makers</i> ARSL: generate webinars and training workshops; interviews and surveys with ARSL members to investigate the level of scalability Disseminate across different channels	Same as above, but final <i>Family Makers</i> program; resources for librarians to facilitate <i>Family Makers</i> (facilitation and technology guides); rural librarian training materials; rural librarians' increased interest in implementing <i>Family Makers</i> into their own libraries

We will bring in partner rural libraries' expertise in family literacy and community engagement in the development of *Family Makers*. The study will also build on existing frameworks (e.g., [Family Engagement Toolkit](#), [ConnectedLib](#), [Making+Learning](#)), resources (e.g., [Starting a mobile hotspot](#)), and infrastructures (e.g., [Infrastructure bill](#), [Emergency Broadband Benefit](#)). An implementation research through two cycles across multiple settings will ensure replicability and scalability. Findings and a scalable *Family Makers* program will be published on our project website, partner library websites, popular social media sites (e.g., Programming Librarian Interest Group), and ARSL website. Study findings and outcomes will be distributed through academic and non-academic channels.

Project Team: Key Personnel- *Soo Hyeon Kim* (PI, IUPUI) is an assistant professor whose research explores family STEM learning and rural library makerspaces. Kim also brings expertise in engineering design and design thinking from her prior academic and professional experience. This research builds on the successes of Kim's ongoing collaborative research, [DRL1759259](#), that supports families' at-home engineering participation and prior study, [MG-77-16-0137-16](#), in which Kim worked as part of the team to provide STEM workshops for families in rural communities. *Andrea Copeland* (Co-PI, IUPUI) is an associate professor with expertise on co-creation of community repository. *Gi Woong Choi* (Co-PI, U of Cincinnati) is an assistant professor whose research explores educational affordances of online technologies and tablet-mediated collaboration. **External Evaluator-** *James Diamond*, an assistant professor at Johns Hopkins University, will evaluate and provide feedback on curricula. **Advisory Board-** AB will support the evaluation of the program design, data analysis, and findings. AB members are: *Kathy Zappitello*, President of ARSL, *Amy Koester*, the Vice President/ President-elect for the Association for Library Services to Children (ALSC) and the Learning Experiences Manager at Stoke PL, *Adam Maltese, PhD*, a professor at IU with expertise in family STEM learning, *Kyungwon Koh, PhD*, an associate professor at UIUC with expertise in digital children and makerspaces in libraries. **Partner Libraries-** 1) Plumas CL, CA, 2) Page PL, AZ, 3) Stuttgart PL, AR, 4) Rushville PL, IN, 5) Kingsville PL, OH, 6) Tyrone Snyder PL, PA. **ARSL** will promote the findings and help build capacity of other rural librarians by collaboratively providing webinars and training sessions. **Rural engineering organizations-** 1) Turner Construction, 2) Lift Academy, 3) US Green Building Council. We will continue to create more partnerships in the industries that are most represented in rural America (e.g., healthcare, agriculture, manufacturing).¹¹

Diversity Plan: Community members served by our rural library partners represent racial and ethnic diversity. We will also attend to diversity as it relates to social economic class, ability, mobility, and sexual orientation in our recruitment of participants and rural engineers to include a diversity of perspectives¹². Also, the research team will coordinate with [Indiana University' Center for Rural Engagement](#) to learn the specific challenges in rural communities.

Project Results & National Impact: The study will contribute to a research-based program for how to engage underserved rural children and caregivers in culturally-relevant and accessible online engineering learning through rural libraries, and how to support rural librarians to facilitate online engineering learning experiences. *Family Makers* online engineering program will extend beyond the scope of this grant, by empowering rural librarians to provide engineering learning to patrons who experience issues with time, transportation, and scheduling to visit the library.

Budget Summary: Total \$496,574: Project personal \$296,742 (IUPUI \$117,062- one PI, one co-PI, two GAs; U of Cincinnati \$179,680- one co-PI, one PhD student); Data collection materials and supplies (including mobile devices, hotspots) \$17,532; Stipend for participants, AB, partner libraries, and ARSL \$27,060; Travel, transcription, and others \$44,750; indirect costs at 58.5% of MTDC \$110,490.

References can be found [here](#).