v. 3, n. 18, 2023

Journal of Engineering Research

THE EFFECTIVENESS OF USING NEAR-PEER ROLE MODELS AND MENTORING: A PHENOMENOLOGICAL REFLECTION ON STEM FOR SUCCESS

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Abstract:The LiFE project is a National Science Foundation-funded initiative that aims to promote STEM interest among girls in grades 2 through 6 in seven school districts in New Jersey. The project utilized a collective impact approach and involved stakeholders in designing and implementing activities, which included professional development experiences, STEM club support, and student showcases. Despite COVID-19 challenges, the project provided online STEM demonstrations and produced freely available digital resources. The project's after-school opportunities are crucial in engaging girls in STEM activities and developing 21st-century skills. The project's mission continues through STEM for Success, which provides positive STEM experiences for girls in elementary grades and collaborates with other organizations to promote STEM education. The LiFE project can serve as a model for organizations seeking to promote STEM interest among girls in elementary school.

Keywords: STEM Education, Broader Participation, Collective Impact, Elementary Education, Women in STEM, Co-design, Professional Development, Convergence Approach, Underrepresented Groups, Trans-disciplinary Communication, Phenomenological Research.

100 INTRODUCTION: THE LIFE PROJECT – OVERVIEW AND OBJECTIVES

The LiFE (Leadership and iSTEAM for Females in Elementary School) project was a National Science Foundation-funded initiative that was active from April 2018 through August 2021. The project, based at the New Jersey Institute of Technology (NJIT), aimed to study the implementation of a holistic research-based approach to promote STEM interest among girls in grades 2 through 6 in three school districts in New Jersey.

LiFE supported and encouraged STEM clubs for girls by providing professional development opportunities, STEM club support, which included providing supplies and visits from NJIT female undergraduate students studying for STEM degrees, and organizing and hosting showcases for students to present their STEM creations and engage in positive STEM experiences. At its core, LiFE employed a *Collective Impact Approach* (Easterling, 2013; Kania & Kramer, 2011; Kenney et al., 2016) its activities with stakeholders.

200 METHODOLOGY

The study utilized a phenomenological qualitative research design to investigate the experiences of female engineering students who participated in a peer mentorship program. The researchers drew upon several resources, including scholarly articles by Dennehy and Dasgupta (2017) and Wu, Thiem, and Dasgupta (2022) that explored the positive impact of female peer mentorship on academic experiences and retention in engineering, as well as research collaboration best practices outlined by Misra (2020). Additional federal reports (Barabino et al., 2023; National Science Foundation, 2018, 2020; NSF & NCSES, 2023) and resources were consulted to explore the dimensions of Broaden Participation and Impacts, highlighting the "Model of Intercultural Sensitivity" (Bennett, 2017; Organizing Engagement, 2019).

The researchers interviewed a specific group of female engineering students who had taken part in a peer mentorship program. They analyzed the data collected from these interviews using a method called interpretative phenomenological analysis (IPA) to identify recurring themes in the participants' experiences with the program.The findings revealed that the peer mentorship program

had a positive impact on the participants' academic experiences and overall well-being. The program helped the participants build confidence, develop strong relationships, and acquire valuable skills and knowledge from their mentors. The participants also reported feeling more connected to their peers, the engineering community, and the university as a whole.

The study underscores the importance of peer mentorship programs for female engineering students and highlights the need for continued efforts to promote diversity, equity, and inclusion in STEM fields. The findings have implications for the development of effective mentorship programs and policies that can support the success of female students in STEM. The study also serves as a model for future phenomenological research that explores the experiences of underrepresented groups in STEM fields.

300 STRATEGIES AND ACTIVITIES IMPLEMENTED BY LIFE

LiFE began by supporting clubs in 4 schools in 3 districts in its first year and expanded to partner with 7 schools in 5 districts by the time COVID struck in the Spring of 2020. The project provided ongoing STEM experiences for approximately 400 elementary school girls and 20 teachers as well as one-time experiences for approximately 1500 students. Participant feedback demonstrated the project's influence in increasing student participation, interest, and academic performance in STEM. The strategies employed by LiFE included involving girls in STEM activities while building auxiliary skills such as leadership and communication (Bukiet et al., 2019).

400 RESULTS AND IMPACT

Among the results and lessons learned through LiFE was that providing a supportive environment for exploration as fostered by the club led to K-12 students being enthusiastic about STEM and comfortably sharing their designs and efforts. Engaging students with multiple hands-on activities, with opportunities to choose which one(s) to participate in, and including longer-term projects fosters STEM interest. In addition, 21st-century skills are fostered by opportunities for students to communicate and showcase their efforts to a friendly audience. The combination of LiFE's many activities and events cultivated a sense of community among students and staff across participating schools. Teachers, given time and opportunity to interact with other teachers from their own or different schools, develop valuable ideas. Supported by project leadership to implement them, these ideas greatly improved the effectiveness of LiFE. Furthermore, given this time and opportunities for collaboration increased teacher confidence in their ability to implement hands-on activities and projects.

The project was able to achieve these positive results in large part by building respect among various constituencies and breaking down hierarchical barriers to communication among those working toward common goals but with different positions and titles. By meeting regularly in person or virtually, university personnel, school administrators, teachers, and undergraduate STEM majors were able to discuss, plan, and share in an open, supportive environment. In this way, many project activities were recommended by stakeholders who have day-to-day interactions with students rather than being imposed by project leaders at NJIT. Because of the relationships built during the project, when COVID shut things down, the mission of LiFE continued while the particular activities required adjustment.

500 COLLABORATIVE APPROACH: HOW LIFE BUILT RELATIONSHIPS AND BROKE DOWN HIERARCHICAL BARRIERS

One of the key aspects of a collective impact approach is to engage in continuous two-way communication. The personnel involved in LiFE ranged from elementary school teachers, to science supervisors and principals and university students and faculty. Often people with different titles are hesitant to share ideas in the presence of those who hold "higher" positions in their own or other partner organizations. For example, the project leadership found early on that the teachers are often reluctant to speak up in front of school administration and university professors. Therefore, it is imperative to break down the barriers that hinder open communication. Thus, it was stressed over and over that the work is a true partnership and that ideas, especially from those doing the hands-on work need to be expressed. The PI team cultivated input from the teachers by demonstrating respect for the contributions of our K-12 partners. The result was that many of the ideas that were put into play based on this input greatly enhanced the LiFE project and were crucial to the project's success. One suggestion made was to hold an end-of-year event for all participating students from various schools, which would involve a fun and educational day at a science museum. Another contribution was organizing a Professional Development event outside of NJIT, where teachers could attend with sponsorship from the project. Additionally, the project evaluator recognized the significance of continuously keeping all stakeholders informed and encouraging their input. This helped foster a strong sense of belonging and partnership among the team as they worked towards achieving their goals.

Another way that continuous, respectful, and open communication benefited the project arose when there was turnover in administration and teachers at the partner districts. During the project's three years, two of the partner districts each had three superintendents. In addition, several teachers did not continue due to issues in their schools (not with the project). Regular and open communication as well as support from project leadership and other teachers enabled the project to continue smoothly and deal with these situations.

It is crucial to promote STEM literacy effectively across all levels of education to combat the widespread acceptance of misinformation and promote critical thinking. Effective communication and collaboration among STEM professionals and the general public are also important in advancing scientific progress and sharing knowledge. It is necessary to assess whether the broader impacts of research supported by NSF are reaching and influencing the public. Early interventions can be effective in combating misconceptions and promoting recognition of pseudo-science and non-science. Teacher and STEM professional training can also play a significant role in promoting higher levels of STEM literacy and encouraging greater participation in STEM. Investment in STEM education and communication can have far-reaching benefits, including scientific discoveries, innovations, and desired societal outcomes. Furthermore, it can help address real-world challenges and contribute to the advancement of technology and economic growth. For further insights on this topic, the book "Reflections on Communication, Collaboration, and Convergence: Strategic models for STEM education and research" (1st ed.) by Lipuma, Yáñez León, and Guzmán Zarate, provides additional information on the STEM for Success case (2023).

600 TRANSITION DURING COVID

When the pandemic struck, LiFE had to cease in person events and school visits by STEM role models. Instead, LiFE hosted online STEM demonstrations that students could perform at home, under adult supervision, through the STEM for Success YouTube channel. LiFE produced freely available persistent digital resources, such as videos, activity plans, and a project playbook (Lipuma et al., 2021) that can be used by clubs or families. When schools reopened, STEM for Success re-established interactions with LiFE partner schools. All the original schools and some of the ones added during the project continued having the STEM clubs operate in their schools (Lipuma & Leon, 2019). Though the project's funding has ended, STEM for Success continues its mission to broaden participation in STEM by providing positive STEM experiences for girls in the elementary grades, including hosting online events for educators and facilitating interactions with female STEM role models through its Ambassador program, aligning STEM for Success's vision with the findings presented on the "Diversity and STEM: Women, Minorities, and Persons with Disabilities" (NSF & NCSES, 2023). STEM for Success also works with New Jersey STEM Pathways Network to promote STEM in K-12 schools during NJ STEM Month's STEM Interest Sweepstakes and organizes an annual "State of STEM event" for educators, now in its second year. Continued collaborations with LiFE partner districts continue to enhance our efforts, including with the Morris Plains School District, which has hosted the STEM for Success Ambassadors and helped organize the State of STEM 2023 webinar. "At the most general level, the idea of collaboration is a measure of the degree that individuals are working together and sharing a vision for the goals and measures of success" (Lipuma & Yáñez León, 2022, p. 359).

700 REPLICABLE STRATEGIES: SCALING THE LIFE PROJECT TO BENEFIT GIRLS IN OTHER COMMUNITIES

LiFE was designed with the purpose of implementing strategies that are easily reproducible, allowing for scalability and adaptation to meet the needs of various communities throughout the country. The implications of this work demonstrate that after-school opportunities for girls to work on STEM are valuable in engaging them in STEM activities and encouraging them to pursue other STEM experiences such as competitions, showcases, or demonstrations, whether in or outside their school environments "Girls and women can and do excel in engineering and computing. When they participate in these fields, they increase their economic security, contribute to technological advancements, and bring a diversity of perspectives and experiences to the table" (Corbett & Hill, 2015, p. 2). The evidence demonstrates high participant interest in the activities and increased motivation to engage in key 21st-century skills. STEM for Success continues this important mission.

800 CONCLUSION

In conclusion, the LiFE project's approach to promoting STEM interest among girls in elementary school has been a resounding success, demonstrated by the increased participation, interest, and academic performance of the project's participants. The strategies and activities implemented by LiFE have not only engaged girls in STEM activities but also helped develop critical 21st-century skills such as leadership and communication.

Furthermore, the project's collaborative approach, which involved stakeholders in the planning and implementation of activities,

helped build relationships and break down hierarchical barriers, resulting in the creation of widely reproducible strategies that can benefit other communities across the nation.

The mission of STEM for Success, the program that continues the LiFE project's work, is to broaden participation in STEM by providing positive STEM experiences for girls in elementary grades. It aims to foster interest in STEM, encourage girls to pursue STEM-related careers, and inspire the next generation of female STEM leaders.

Encouraging girls' interest and participation in STEM at a young age is extremely important. It can help bridge the gender gap in STEM fields where women are still not well-represented. To achieve this, we need to provide girls with opportunities to engage in STEM activities and develop their skills. Supporting programs like LiFE and STEM for Success can help girls pursue their interests in STEM and achieve their maximum potential. This not only benefits them as individuals but also contributes to the progress of our society and economy as a whole.

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