RCNET's Girls In STEM: Insights and Recommendations for Future Projects and Community College Programs

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Abstract: The labor market demand for individuals with STEM skills and degrees continues to grow in the United States and other countries. However, the gap between men and women in these fields persists, with fewer women participating in STEM education or pursuing STEM careers. For years, programs have been implemented nationwide in school and after school to engage girls, foster interest in STEM, and increase participation in STEM education. However, these programs are often grant-funded, time-limited, and lack long-term sustainability. In 2020, the Regional Center for Nuclear Education and Training (RCNET), housed at Indian River State College, launched a Girls in STEM program. This program initially engaged three high school girls to work collaboratively to research, create, and disseminate short videos interviewing women working in STEM. Now, as college students, they share their perspectives on the project, its impacts, and recommendations for the future of this work.

Keywords: girls in STEM, engagement, gender gaps, barriers, funding, sustainability, gender bias, community college, career development, advocacy

Introduction

Girls participating in Science, Technology, Engineering, and Mathematics (STEM) education play a crucial role in diversifying and enriching these career fields. Unfortunately, the historical gender gap in STEM persists, with fewer girls pursuing careers in these areas compared to boys [1-3]. However, efforts to encourage and support girls in STEM have been increasing, aiming to break down stereotypes and barriers that may discourage them from entering these fields. To better understand the barriers, this article centers on the experiences of three women who participated in the Girls in STEM Project through the Regional Center for Nuclear Education and Training (RCNET) (https://gonuke.org) from 2020-21. The Center, housed at Indian River State College in Fort Pierce, Florida, was established in 2011 with the support of NSF award #1104238 and re-supported in 2016 with award #160058 to address the critical nuclear workforce demands in a unified and systematic way [4].

In the Girls in STEM project, the girls interviewed women in STEM fields to create and disseminate videos via social media. They participated in multiple STEM education experiences to help raise awareness and build interest in STEM among girls their age. They also participated in panel discussions at several national conferences. This project builds on the success of STEM role model interventions described by González-Pérez et al. [5] but was led and implemented by the girls who participated in the program. This experience, in part, has motivated these girls, now college students, to become STEM champions and role models for other girls in STEM. In early 2024, these women shared their perspectives on STEM education during and after participating in the RCNET Girls in STEM Project. This article summarizes how these experiences shaped their decisions about education and careers, empowered them to teach others about the value of STEM, and strengthened their 21st-century skills. Building upon these experiences, recommendations are included for future projects and practical steps community colleges can take to expand opportunities for girls and women in STEM.

The work of programs such as Girls in STEM is critical in reducing and eliminating the gender gaps in STEM. This is important because, in the United States, the demand for employees in science, technology, engineering, and math continues to grow. According to the US Bureau of Labor Statistics, employment in STEM occupations is projected to rise by 10.8% between 2022 and 2032, creating a high demand for employees compared to the 2.8% growth in all occupations. Additionally, wages in these occupations are higher, with a median salary of $97,980 for STEM occupations compared to $44,670 for all occupations in 2022 [6]. Meeting this demand remains challenging, with only 32% of bachelor's degrees awarded in the United States being STEM majors [7] and a gender gap that has persisted for years [7, 8]. This gap is reported by the US Census Bureau [7] in STEM Bachelor's degrees, employment in STEM Fields, and earnings in STEM Fields, with women lower than men in every category (Table 1). Similarly, IPEDS [8] reports the bachelor's degree gap as it has persisted from 2012-2022 with little change (Figure 1). While overall degree attainment in STEM has increased, the gap between men and women persists [8].

Table 1. US Census Data Comparing Women and Men in STEM Fields[a]

US Census Bureau Category	Women	Men
STEM Bachelor's Degrees	24.7%	39.4%
Working in a STEM Field – Non-STEM Major	6.6%	20.5%
Working in a STEM Field – STEM Major	15.3%	37.1%
STEM Worker Earnings – Non-STEM Major	$76,230	$87,380
STEM Worker Earnings – STEM Major	$82,190	$98,870

[a]Adapted from US Census Bureau - From College to Jobs: Pathways in STEM (2021) [7]

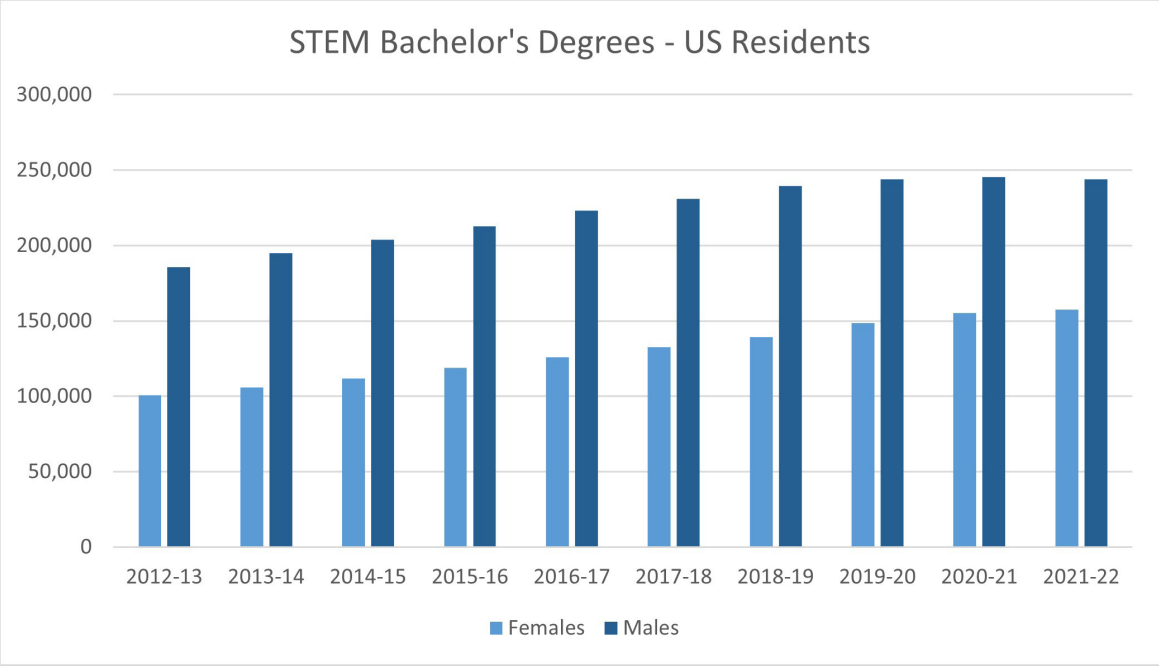

Fig. 1. IPEDS - Distribution of science, technology, engineering, and mathematics (STEM) degrees/certificates conferred by postsecondary institutions by sex of student: Academic years 2012-13 through 2021-22 [8].

Multiple factors can influence and support girls' participation in STEM, including external factors such as school culture, teachers, family, and peers [1, 2]. Internal factors can also motivate girls to engage in STEM education, including enjoyment, curiosity, self-regulation, and subject-embedded interest [1]. These factors, described as STEM self-efficacy by Falco and Summers, are improved by positive learning experiences [3]. Programs that create opportunities for exposure can enhance these factors by creating knowledge and opportunities for exploration. Many initiatives worldwide promote STEM education and careers for girls [1, 5]. These initiatives often involve outreach programs, mentorship opportunities, and highlighting the achievements of women in STEM fields to inspire and encourage young girls. Additionally, educational institutions and companies are working to create inclusive environments where girls feel welcome and supported in pursuing their interests in STEM.

The impact of RCNET's Girls in STEM project was deemed valuable with a small shadow, as noted in the Impact Allies RCNET 2022 Evaluation Report [4]. Additionally, the evaluation indicated that the project was valuable, but the time was limited to two years and was small-scale. Summarizing the biggest overall takeaway, RCNET PI Kevin Cooper noted that grants and other funding supporting this work must be restructured, recommending at least a 20-year funding cycle to move the needle in any given region. The initiative created opportunities for outreach to girls and tools for K-12 teachers to introduce STEM concepts, companies, and careers. Direct benefits to the participants were also identified, including professional development and skill building in creating videos and public speaking skills through sharing their experiences with others. Even though, as Cooper noted, conference audiences did not always believe the unfiltered/uncoached perspectives of the girls. With these results, the evaluation noted that efforts like this need continuous effort and funding to have an impact. It is not enough to create and post the content; engagement with girls must happen consistently with multiple communication points and engagement to create a high impact. Videos are one component that builds awareness, but that needs to be coupled with strategies such as direct outreach and in-person engagement to have a broader effect [4].

Methods

The RCNET's Girls in STEM initially engaged three high school girls in identifying and interviewing women working in STEM fields. These interviews were used to create video content shared on the YouTube platform RCNET's Girls in STEM channel [9] (https://bit.ly/4dlnHvv). Additional video content features interviews with the program participants and 2022 conference presentations at conferences, including the Advanced Technology Education Principal Investigators' (ATE PI) Conference and the High Impact Technology Exchange Conference (HI-TEC), providing an overview of the program and participant insights. The YouTube channel includes 15 videos that have nearly 400 views.

An interview in early 2024 with these initial RCNET Girls in STEM participants provided insights on the relatively low number of views, lessons learned about content distribution, and recommendations for future projects like this. Additionally, the qualitative interview analysis was coded using the ATLAS.ti (https://atlasti.com/) analysis software, identifying several themes about the successes, challenges, and lessons learned through this type of intervention and their direct impact on the three participants. ATLAS.ti is an online data analysis tool that utilizes OpenAI to customize data coding and insights. The results and discussion section summarizes those themes, recommendations for future programs, and strategies for community colleges.

Results and Discussion

The RCNET Girls in STEM participants (hereafter referred to as participants), now all in college, were interviewed in early 2024 and shared their perspectives on the project, success, challenges, lessons learned, and recommendations for the future of this work. These themes are summarized here and include observations directly related to the project and reflections on their broader experience as girls participating in STEM education.

Successes

Participants shared their experiences with adults and professionals in STEM fields through conference presentations at ATE PI and HI-TEC. They remarked that these experiences impacted adults by showing them the importance and impact of a young person's perspective in sharing the message about the importance of STEM versus the message from an adult. As the participants identified and connected with women in STEM occupations, they created and expanded their professional networks by building relationships with industry professionals, exploring careers, and managing projects. Even though the outreach and recruitment were challenging, the girls expressed that part of the positive impact of these videos was the in-person, on-site component that showed the women in their workplace, which made the work accessible and relatable.

As they learned more about STEM education and careers, the participants said they felt more empowered to share information with their peers, friends, and family. The experience helped them move from a basic understanding of STEM to a more confident stance that STEM is cool and interesting. They all continue to share information about STEM now that they are in college and consider that a positive outcome of the project. They are STEM champions, and in many ways, they have become lifelong STEM ambassadors and role models so critical to girls' success in STEM. While only one of the program participants is currently enrolled in a STEM major, all three expressed the value of this program in helping them understand their education and career path choices in and out of STEM. The research they did set them up to continue to ask questions, seek information, and make informed choices.

Challenges

Participants identified challenges specific to the project, including difficulties in cold-calling and recruiting STEM professionals to participate in the video interviews, researching and learning about different STEM fields, developing scripts with engaging content, and promoting the content. Noting that, while we are in the digital age, videos informing teenagers about education pathways are challenging to promote as this population utilizes platforms such as YouTube to destress and unwind. These challenges were also identified as learning opportunities, and they supported these participants in building confidence, fostering creativity, and expanding their knowledge. Additionally, as with many educational endeavors in 2020-2022, the COVID-19 pandemic had a limiting impact on this project. The participants noted that their inability to travel and access worksites hampered their ability to collaborate fully and produce the videos. While the three of them could collaborate virtually, they felt that creating the videos virtually would not have had the same impact.

Even though the participants feel empowered to share their knowledge about STEM with other girls and young women, they often find resistance or lack of interest, with some peers using words like "weird" or "nerdy" to describe STEM education. The participants attributed this to multiple factors, including the perception of math and science as challenging courses, resistance to asking for education support such as tutoring, the ongoing stigma of the difficulty of STEM courses, or gender imbalances in STEM courses. Teachers are essential in exposing young people to STEM education and careers. While most of their teachers supported their pursuit of STEM, participants noted that many teachers were busy with or focused on other things, including meeting students' basic needs, discipline issues, and the general day-to-day teaching work, making it challenging to provide meaningful support. The participants have also encountered gender bias in their STEM courses in high school and college, reflecting that they felt they had to work harder than the boys in their classes and do better on exams to be taken seriously. They felt this inhibits many women and girls from pursuing STEM education and careers. Participants noted that overall, schools struggle to emphasize STEM pathways enough, and opportunities like STEM clubs may be stigmatized, if they exist at all, discouraging participation.

Lessons Learned

Programs like this are intended to strengthen or deepen career exploration, leading to more informed choices about high school and college courses. The girls expressed that they did not even really understand what STEM was when they first started, having a vague idea going into the project but not a deep understanding of the different career paths. This project helped change that for them and gave them confidence as they entered college and made choices about their next steps. Two participants had previous exposure to STEM through their parents and understood what it meant, including a base knowledge of the equity gaps between men and women. Even so, they felt the project taught them more about the disparity between men and women in STEM fields and broadened their understanding of inequity in the workforce in general. In addition to the learning curve about STEM, there was a learning curve in building a professional network, outreach, and

creating video content. In projects like this, it takes persistence and effort to get the message out; even though the videos were posted on YouTube, the participants felt that more could have been done through other social media platforms to create a broader impact.

Recommendations for Future Projects

Based on their learning in this project, challenges, and experience in STEM education, the participants make the following recommendations for future projects.

- Engage students at a younger age through fun activities that expose them to STEM education and careers in an accessible way. Exposure in multiple ways breaks down barriers and supports participation in STEM education and careers. It is important to communicate this message in various ways, including print media representing girls and women engaged in STEM activities and sharing content across multiple social media platforms. While this project utilized YouTube, the girls recommended branching out into other platforms to broaden the reach of the content.
- Raise awareness by creating and distributing the message that not only is it okay but essential for girls to pursue STEM education and careers. This message has more value when peers deliver it and can reach students in ways that are different from the influence of the message delivered by teachers, parents, mentors, and other adults. While adults need to support this work, it has more power if it is led and delivered by girls. Their direct engagement in the research and outreach strengthened the authenticity of what these girls learned and gave them the credibility to share with their peers in a more powerful way than if the PI had done all the work. This representation and experience is critical for girls to see themselves in STEM.
- Organizational structures such as STEM Clubs can help educate students and normalize women in STEM by sharing examples that create exposure, providing mentoring, and connecting students with similar interests. These clubs can be an essential support structure if the message includes all interested, not just those with higher aptitudes. Schools must find a way to support these clubs and destigmatize participation in order to create the community needed to expand STEM participation.
- To build capacity and reach, programs like RCNET's Girls in STEM must be funded and sustained for a longer period. Exposure must start early (elementary and middle school) and be continuous. Doing this for a few years for a few classes is not good enough. Funding models and sustainability strategies must be built to sustain the work for much longer periods. If adequately funded, peer outreach, activities, and media can work together to support early and ongoing exposure, creating interest and participation.

Recommendations for Community Colleges

As Girls in STEM become women in STEM, community colleges play a vital role in recruiting and retaining students in two-year degree pathways that can lead to many next steps in STEM education and the workforce. If girls learn about STEM in elementary and middle school and participate in STEM activities in high school, there must be a seamless transition as they enter higher education. This transition can take many forms, including partnering with K-12 schools to create girls in STEM programs spanning K-14, intentionally creating pathways, and planning tools for a student's next step. Beyond these programs, there are specific things community colleges can do to support girls and women in STEM.

- Increasing the number of females participating in STEM education will require institutions to address academic sexism and harassment. Understanding the data is critical; institutions should analyze enrollment, persistence, and assessment data to identify equity gaps, including gender, and to help administrators and faculty identify areas for improvement [10, 11]. This data and other factors can be used to inform the development of a gender equity plan that focuses on inclusive recruitment and retention strategies, increasing enrollment of females in STEM programs, creating a welcoming environment, and empowering students (both female and male) to create long-term change in this gender gap [10, 11]. The plan should also include implementing professional development for faculty, staff, and students that raises awareness of gender and other biases in STEM [12]. Along with engaging students, the gender equity plan should examine hiring practices and create tools such as gender bias training for hiring managers/committees, identify strategies for recruiting and retaining female faculty, and empower female faculty as role models [11].

- Build a sense of belonging. Similar to the idea of a STEM club mentioned above, colleges can create a sense of belonging by building connections to support networks for women in STEM create spaces and structures that provide resources and support [10]. This can include strategies such as creating a STEM Navigator position or peer mentors, responsible for connecting students to trained STEM mentors, advisors, tutors, and wrap-around support services, including childcare, housing support, scholarships, and other assistance. Equally important is the cultural change of destigmatizing these resources. As the RCNET Girls in STEM participants noted, accessing help must be normalized, or it will just be another contributing barrier to the challenges for all students in these programs [11].
- Engage employer partners in this work. Work with local and regional employers to identify internships and other work-based learning opportunities that can provide girls and women with the opportunity to work alongside women in STEM careers and strengthen their professional network [10]. As part of this strategy, colleges should provide clear expectations about the experience, information to promote awareness of gender bias, and feedback mechanisms for students that provide data for continuous improvement [11]. In Career and Technical Education programs with a STEM focus, recruit women working in STEM fields to participate in Industry Advisory Committees. Engaging these women in developing and revising curriculum, recruitment and retention strategies, and job placement will support a welcoming and inclusive program culture for female students.

Conclusion

While there have been decreases in gender disparities in STEM education and careers, significant gaps persist. Interventions that provide exposure to and engagement in STEM education for girls are critical to decreasing and eliminating the gender gaps in education attainment, career pursuit, and wages in STEM careers. While adults such as parents, teachers, and mentors are essential to this work, empowering girls as leaders is also incredibly powerful. Programs like RCNET's Girls in STEM have the potential to build STEM champions, empower women to pursue STEM careers, and create life-long STEM ambassadors. These women become the adults who will continue to share the message about the importance of girls and women participating in STEM. As these projects are designed and implemented, it is crucial to learn from these programs, adjust approaches, and seek support for long-term funding to build the capacity needed to sustain and grow these efforts over time. Long-term sustainable funding and the seamless connection to higher education would strengthen these efforts and continue to change the culture of STEM education, moving toward a more inclusive ecosystem and increasing STEM participation overall.

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