Latinas' Perceptions of Features of an OST STEM Program That Create a Supportive STEM Learning Context: A Qualitative Case Study

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***Abstract*—This study developed and implemented an out-of-school (OST) STEM program, which aimed to introduce more underrepresented girls into the fields of STEM through projects involving robotics, computer programming, and graphic design. Utilizing a qualitative research design, the study investigated the learning experiences of forty-one underrepresented minority girls, ranging from middle to high school (grades 6-12), all of whom have engaged in this program for more than two academic years. The results revealed the OST program benefits girls by creating a conducive learning environment, encouraging STEM participation, and facilitating meaningful interactions with adult mentors. Following the Social Cognitive Career Theory (SCCT) model, the study further explored how participants' learning experiences shaped their career interests in STEM fields. Key factors include engaging conversations with professionals, collaborative opportunities, and the integration of diverse subjects. This study provides important insights into tactics for encouraging STEM engagement among underrepresented minority girls and highlights the pivotal role of the OST program in addressing gender disparities and offers valuable insights into strategies for fostering STEM engagement among underrepresented minority girls.**

Keywords—STEM Education, After-school STEM Program, Underrepresented Minorities in STEM Education, STEM Career Development

I. INTRODUCTION

STEM education is a pivotal issue in current educational development and reform. In line with the rapidly changing technological era, the United States places much effort into refining and promoting STEM education. The U.S. government, along with Congress, State legislatures, and school STEM programs, has implemented extensive efforts to reform K–12 STEM education and cultivate the next generation of skilled scientists, engineers, technicians, and science and mathematics educators [1]. All efforts emphasize the importance of preparing youth to apply knowledge and skills to solve problems, make sense of information in future careers, and use them in real-life situations.

As the largest ethnic minority in the United States, Latinos encounter unique challenges in STEM education, demonstrating lower academic achievement rates, reduced degree attainment, limited educational opportunities, and a diminished presence in STEM professions [2]. Despite a declining dropout rate, Hispanic youth consistently exhibit higher dropout rates than their White and African American counterparts [3]. Compounding this, schools with high enrollments of African American and Latino students offer fewer advanced mathematics and science courses than those with lower enrollments [4]. Gender disparities persist among Latinos in STEM careers, particularly affecting Latina girls. Influenced by ethnic identities and socioeconomic status, Latina girls may face challenges in STEM interest, perceived ability in STEM fields, and career motivation [5]. Cultural influences, such as the preference for attending schools close to home, further impact educational choices for Hispanic youth [6].

To address these challenges, STEM enrichment programs emerge as a pivotal solution. These programs, including afterschool activities, summer camps, and competitions, bridge educational gaps by providing content knowledge, fostering real-world connections to STEM, and promoting informal learning opportunities [7]. Research has demonstrated that STEM enrichment programs boost students' interest in STEM content and careers [8], STEM self-efficacy [9-10], school connectedness, self-identity, and excitement about STEM subjects [8][11]. When looking into the results of girl-focused STEM programs, research demonstrated positive outcomes in girls' self-efficacy in STEM, interest in STEM-related subjects, and excitement of STEM-related careers [12]. For instance, Ogle recruited middle school girls from underserved districts and integrated fashion to ignite curiosity about STEM fields[13]. The results of study revealed positive influences on girls' self-efficacy in math and science, while the learning may foster future educational interest and achievement in the STEM fields [13].

Despite these positive findings, there are fewer programs specifically designed to cater to the needs and interests of Latina girls, aiming to promote their active participation and success in STEM fields. Prior research was limited in terms of methodological issues to study OST STEM programs. Most study samples used only single-item survey measures to assess the importance of STEM summer programs on student outcomes, which have a low level of measurement reliability and validity[14]. Most research brought in qualitative findings only during the final discussion section, which undervalued the functions of qualitative studies in improving the quality and the application of studies [15]. Thus, this study employs a qualitative case study design to delve into Latinas' experiences participating in an OST STEM program, aiming to offer a comprehensive understanding of their journey in the STEM educational landscape.

II. Site And Settings

The GEMS (Girls in Engineering, Mathematics, and Science) OST STEM program, launched in 2015 at the University of the Incarnate Word in southern Texas, aims to inspire and empower girls from underrepresented minorities to pursue careers in STEM. Providing complimentary access to robotics and STEM learning opportunities, the program has established an all-girls learning environment, with a special focus on those from underrepresented minority backgrounds in low-income families. As showed in Table 1, the GEMS OST STEM program offers a diverse range of initiatives, spanning from a 2-week summer camp (miniGEMS and megaGEMS) to a 6-week research camp (megaResearch) and a year-round program(miniRobots). The following will show the detailed information about each program.

TABLE I. OVERVIEW OF THE GEMS STEM PROGRAM

Grade Level	Length	Core Curriculum
miniGEMS (6th to 8th) megaGEMS (9th to 12th)	Two-week	Robotics Programming Game design Hands-on STEM activities Career Exposure Guest speakers Nutrition and gardening Art activities
megaResearch (9th to 12th)	Six-week	Research-based projects Academic writing course Presentation training Other STEAM hands-on activities
miniRobots (6th to 8th)	Full year	Weekly hands-on robotic Programming practice

A. Designing STEM Program for Middle School Girls

The miniGEMS program, a cost-free two-week summer camp, emphasizes the fields of engineering and programming (Figure 1). It aims to expose middle school girls to STEM disciplines through hands-on experiences, including robotics, computer programming, graphic design, and inspiring guest speakers. The miniGEMS program integrate arts to accommodate a broader range of interests. The program extends its impact through miniRobots, a year-round robotics club that serves as an extension of miniGirls, aiming to enhance STEM interests and programming skills for middle school girls.

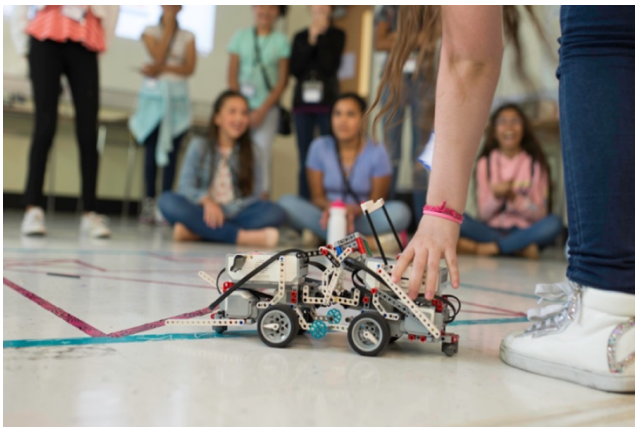

Fig. 1. Programming in miniGEMS Program

The miniGEMS program has its uniqueness. Although there are some STEM programs in South Texas (e.g., iD tech, Interactive Technology Experience Center, SASTEMIC), not all of them are free and specially design for middle school girls who are studying in Title I public schools [19]. The project-based learning environment helps students to translate abstract mathematics and science concepts into concrete real-life applications, and connects areas (e.g., music) that typically seem disconnected with STEM subjects. In this OST program, many participants stated the single-gender learning allowed them to ignore the gender differences (i.e. boys' negative behaviors), become relaxed (i.e. speak louder), and build a sense of fit in STEM subjects (i.e. express more on robotics and engineering topics) [18].

Secondly, miniGEMS program particularly serves students from Title I school districts and schools. The Title I schools and school districts in this study have high percentages of students from low-income families and high ratio of at-risk students. Taking the Treviño Middle School as an example, the school has 94.2% of economically disadvantaged and 81.5% of students were considered at risk of dropping out of school.

Lastly, most of participants are Latinas and did not have many opportunities to learn robotics and engineering in their school classrooms. Our previous studies showed 76.3% of our participants stated their Hispanic racial identity and believed they belonged to the Hispanic culture [18]. The reasons included their Mexican heritages, family origins, languages, and cultural traditions. The majority of the campers did not know any scientists and engineers among their friends and family members. Most of them did not have prior STEM camp experiences other than the miniGEMS program. There was a consistent presence of students for whom English was not the primary language, highlighting the program's outreach to diverse linguistic backgrounds.

The curriculum of miniGEMS program is meticulously designed according to Texas state standards. This means that the curriculum not only meets state educational requirements but also emphasizes providing students with learning experiences that are relevant to real-world applications. By integrating Texas state standards, the GEMS curriculum ensures that students receive high-quality, state-aligned knowledge and skills as they engage in STEM education. This curriculum is dedicated not only to enhancing students' academic abilities but also to fostering innovative thinking and problem-solving skills through various hands-on activities and projects.

As showed in Figure 2, the first five days aim to explore STEM fields and introduce campers to computer programming through Lego Mindstorms EV3 robots and Scratch Programming Language. Campers form groups to design robots for a challenge in the following week. The second week focuses on using MATLAB programming language to teach basic coding syntax and operations. The campers also advance in their robot projects, working towards a challenge involving sensors, closed-loop feedback, and structured real-time programming. The curriculum is designed to gradually build campers' skills in

STEM, with a strong emphasis on hands-on activities, programming, and robotics. The program culminates in a challenging robot competition, allowing campers to apply what they've learned.

	Monday	Tuesday	Wednesday	Thursday	Friday
Subjects	Science	Technology	Engineering	Robots	Programming
Week1	○ Icebreaker ○ Make slime ○ Toothpick towers ○ Egg Drop ○ Elephant Toothpaste ○ Journaling ○ Newspaper Tower	○ Intros to EV3s ○ Programming and Coding ○ Building Robots ○ Programming ○ Sumo Wrestling ○ Journaling	○ Energy ○ Meteorology ○ Straw bridges ○ Clay boats ○ EV3 Robot ○ Programming ○ Journaling	○ Bionic Fish ○ Graphics design ○ Guest speakers ○ Journaling	○ Programming and game design ○ Journaling
Introduction	The first five days of each summer camp focuses on exploring the STEM fields and introducing the campers and STEM teachers to the field of computer programming through the Lego Mindstorms EV3 robot and the Scratch Programming Language. During this time, the campers form groups and begin to design a robot that can meet the robot challenge that is held during week two of the camp session.				
Week2	○ Food science ○ Guest speaker ○ Journaling	○ Programming ○ First Lego League Obstacles	○ Yoga ○ Music Singing ○ Astronomy ○ Guest speaker ○ Journaling	○ Building and ○ Programming robots ○ Robotic competitions	○ Rollercoaster design ○ Clay boats ○ Nutrition ○ Gifts and awards ○ Journaling
Introduction	In the second week of each camp session, campers spend four days using the MATLAB programming language and learn the basic syntax for coding simple programs that can perform such operations as plotting math equations, performing arithmetic operations, and solving algebraic equations. Additionally, the campers work on the Lego EV3 which culminates in an advanced challenge which requires the use of sensors, closed- loop feedback, and structured real-time programming.				

Fig. 2. The Curriculum of miniGEMS Program

B. Overview of miniRobots program

The miniRobots program is a full-year course designed specifically for students in grades 6 to 8, offering weekly hands-on robotic programming practice. This engaging program introduces young learners to the fundamentals of robotics and programming through interactive and practical activities. Each session provides students with opportunities to design, build, and program robots, fostering their problem-solving skills and creativity. By participating in miniRobots, students gain a solid foundation in coding and robotics, preparing them for more advanced studies in STEM fields while igniting their passion for technology and innovation. In miniRobots program, students could apply the robotic concepts in real-life situations (i.e., FLL competition) and recap the knowledge that they have learned in the summer.

C. Designing STEM Program for High School Girls

Launched in 2019, megaResearch is a six-week summer camp designed for juniors and seniors in high school. The program borrows the NSF REU model but introduces high school girls to faculty-guided research on a STEM project and culminating in a research paper, presentation, and poster. The goal of the camp is to provide high school girls with valuable research learning experience, which in turn may improve their research skills, STEM interests, and 21st century skills. Participants engage in practical research projects under faculty guidance, utilizing a Project-Based Learning (PBL) approach that grants girls flexibility in managing their time, encouraging their interest in pursuing STEM majors and independence.

In the research camp, the project-based learning (PBL) approach and hands-on STEAM experiences were applied to encourage cooperative learning and build a positive learning environment. The girls in the research camp are treated as undergraduate students by giving a sense of liberalism to organize and manage their own time to work on their projects. This flexibility was given to them to create interest in choosing the STEAM major in their future endeavors. We emphasize mainly on Science, Technology, Engineering, Robotics, and Art fields in this camp by including field trips such as visiting the solar house on the campus, baking and cooking in the nutrition lab, making slime, and programming EV3s in the Autonomous Vehicle Systems (AVS) laboratory. Continuous support was provided from the staff members (e.g., UIW research assistants, camp counselors, and professors) of the GEMS program and the AVS lab in completing these projects.

The research camp curriculum is structured around five key projects, each designed to be completed within six weeks and aimed at providing students with hands-on experience in various emerging technologies and practical applications.

The first project focuses on designing an Explosive Ordnance Disposal (EOD) simulation using Unity3D and a Geomagic touch haptics device. The primary objective is to expose students to haptic technology and give them practical experience in using the Unity3D game engine while developing a real-world application for bomb disposal squad training. This project not only teaches students about the hazards faced by bomb disposal teams but also the necessary steps in developing a simulation that incorporates touch, feel, and sense capabilities.

The second project involves designing a haptics robotic surgery simulation. Here, students work with the same Unity3D game engine and C# programming language to create a simulation that mirrors the precision of robotic surgery, an increasingly important technology in healthcare. By incorporating haptic feedback, students gain a deeper understanding of how technology can enhance surgical procedures and improve outcomes in complex operations.

In the third project, students design a pharmacy sorting simulation, aimed at reducing errors in prescription filling through the use of robotics. By developing this simulation in Unity3D and utilizing the Geomagic touch haptics device, students learn how robots can be effectively employed in the medical field to improve patient safety. This project underscores the importance of technology in minimizing human error in critical tasks.

The fourth project centers on the use of drones for search and rescue missions (Figure 3). Students are tasked with researching how drones can be utilized in disaster management scenarios where human access is limited. The project involves learning about the rules and regulations for drone operation, preparing for drone pilot certification, and understanding how to gather and use sensor data in search and rescue efforts. This project emphasizes the growing role of drones in emergency response.

The final project is focused on developing a healthy diet through the practice of solar cooking (Figure 4). Addressing environmental concerns, this project encourages students to explore alternatives to conventional cooking methods, such as using solar energy instead of natural gas. Students research and create a healthy diet plan that incorporates solar cooking techniques and develop a prototype solar oven. They receive guidance from food scientists, solar engineers, and nutritionists, underscoring the importance of sustainable practices in everyday life.

Overall, these projects are designed to provide students with a comprehensive experience in applying innovative technologies to solve real-world problems, while also

fostering an awareness of the broader implications of their work.

Fig. 3. Drones Research Project in megaResearch Program

Fig. 4. Nutrition Activity

D. .High-impact STEAM Activities in the GEMS STEM Program

In the curriculum of GEMS program, PBL is used as a pedagogy to offer students more hands-on opportunities and help them connect the content with real-world situations. The following provides a detailed introduction to high-impact STEAM activities in the camp.

Introduction to Science. Students engage in making slime and elephant toothpaste to study the basic concepts of mixing different elements and observe their reactions entertainingly. After creating slime, students explore the outcomes of mixing different elements and learn about the diverse effects of chemical reactions, making science interesting and enjoyable.

Introduction to Technology. The game design and programming activity aims to teach students game design and programming using visual block-based programming. Through this, students get introduced to programming in a fun way by creating video games. They design games where players move to target locations by avoiding obstacles, combining programming with visual block-based programming. Python programming is introduced to high school girls, creating an engaging learning environment and increasing their interest in computer science.

Introduction to Engineering. The "Oil Spill Clean-Up" activity aims to teach students how to use natural resources effectively with minimal wastage. In the event of an unexpected oil spill, it teaches students to think like environmental engineers and oil company owners, guiding them to take effective measures to save the environment. Students work in teams to recreate oil spill scenarios, experiment with various clean-up methods considering effectiveness and cost, and analyze the scenarios, gaining insights into environmental safety.

Introduction to Robotics. The Lego Mindstorms EV3 Programming activity is designed to teach middle school students' math and robotics concepts. They learn how to design, build, and program their own EV3 Lego Mindstorms Robot, a common platform for learning basic engineering and programming skills. Students use block-based programming and MATLAB scripting, designing robots to perform specific tasks like navigating a maze, competing against other robots, and even playing music.

Introduction to Art into STEM. The curriculum integrates art into various activities, including sound recording, music instruments, storytelling, clay boat making, and toothpick towers. Students engage in hands-on activities that showcase the fusion of art with science and engineering. For instance, in the clay boat activity, students design boats considering density, mass, and buoyancy. The "toothpick towers" activity integrates art and civil engineering, fostering creative thinking, problem-solving, and teamwork skills through blueprint design and collaboration.

In addition to the mentioned high-impact activities, nutrition and gardening will continue to expose students to different fields. Efforts are being made to create a fun and integrative STEM learning environment and community for middle and high school girls. The program is also exploring the integration of artificial intelligence (AI) and advanced programming language training into the high school curriculum to provide essential programming skills for STEM.

III. Research Design

A. Theoretical Framework

SCCT is utilized to explain the evolution of career and academic interests, the formation of career choices, and the achievement of performance outcomes according to [16]. It particularly addresses issues related to career entry and early life stages, emphasizing the crucial influences of academic development on career development. SCCT underscores the interplay between self-referent thought and social processes in guiding human behavior, especially during adolescence, when exposure to various potential career-related activities occurs, and individuals engage in occupational tasks through observation and modeling.

In the SCCT framework, self-efficacy is considered a predictor of interests, suggesting that individuals with higher self-efficacy are more likely to develop certain interests. The bidirectional relationship also indicates that interests can promote opportunities for self-efficacy development, influencing knowledge, career orientation, and performance through career outcome expectancy and self-efficacy. Thus, students are more likely to pursue careers in areas of interest and achieve success in subjects aligned with their interests.

B. Research Questions

RQ1: What are participants' learning experiences in the GEMS OST STEM program?

RQ2: What are the influences of participating in the GEMS OST STEM program on girls' career interests?

C. Sampling and Data Collection

The sample for this study consisted of 41 middle and high school girls (grades 6th to 12th) who either participated in the program for at least two consecutive academic years or attended the summer camp twice, with high levels of engagement in the program. All participants identified their ethnicity as Hispanic.

Semi-structured interviews with open-ended questions are the major source to gain participants' experiences within the research scope. The interview protocol can be found in Appendix I and Appendix II. The researcher used three-interview series and treated all interviews as opportunities to have participants reconstruct their experiences within the study contexts. Considering the participants were all middle school and high school students, each interview took fifteen to twenty minutes in this study. The researcher is also preparing for other rounds of parents and teachers interviews if needed. The study protocol follows the federal government's "Common Rule" for the protection of human subjects and was approved by the University Ethical Review Board for the Humanities and Social and Behavioral Sciences at the institution of the first author.

D. Data Analysis

Followed by Stake (1995) and Yin's (1993) data analysis strategies, a constant-comparative method [17] was employed to compare participants' learning experiences. The interview data were audio-recorded and transcribed using Temi software. To ensure accuracy, the researcher made the final corrections to the transcripts. Additionally, during data collection, the researcher created short memos for each participant, coding each memo in Dedoose. The analysis began with content analysis, focusing on analyzing text and documents. Subsequently, thematic analysis was conducted, with a special emphasis on developing themes. The final phase gave more attention to the selection of themes.

The data analysis process in this study was conducted in three distinct stages, each with specific objectives and methods. The first stage, coding, aimed to generate themes that accurately captured the STEM learning experiences and research-related concepts reflected in the data. The researcher began by thoroughly familiarizing themselves with the data, repeatedly reading all transcripts to ensure a deep understanding. Prior themes and memo-writing were employed to explore potential emerging themes. Data from interviews were imported into Dedoose, a software that facilitated data management, coding, and analysis. Through constant comparative analysis, the researcher compared different participants, time periods, and data types.

In the second stage, thematic analysis, the focus shifted to connecting the theoretical framework with the data to derive meaningful interpretations. The researcher adhered to theoretical propositions to selectively analyze data, following Yin's (1993) guidance on using theoretical propositions to organize the case study and consider alternative explanations [17]. This stage involved three coding cycles: initial coding (an open-ended approach to develop all possible initial codes), selected coding (focused on generating codes based on the theoretical framework and themes from the first stage), and emerging coding. After categorizing the data, emerging themes allowed the researcher to aggregate the categories and fully understand the case.

The third stage of data analysis involve synthesizing the findings from the thematic analysis to draw broader conclusions and implications for the research questions. This stage includes the integration of different data sources and the identification of overarching patterns or insights that contribute to the understanding of the research topic. The synthesis would culminate in a cohesive narrative that ties together the various themes and categories identified in the earlier stages, providing a comprehensive understanding of the study's outcomes. Fig 5 showed the emerging codes and selected codes in this study.

Emerging Codes	Selected Codes
Environmental Factor	◊ Family perspectives of STEM ◊ Influences from friends ◊ Influences from teachers ◊ Other girls/people's perspectives of STEM ◊ STEM learning in school ◊ Social support from family, school, and teachers ◊ Description of girls' life
Behavioral Factor	◊ Advanced study and post-secondary school plans ◊ How to achieve career goals ◊ Motivation factor
Personal Factor	◊ Factor impact career interests ◊ Girls' perspectives ◊ Girls' perspectives of gender differences in STEM ◊ Girls' perspectives of school, community, living environment ◊ Girls' perspectives of STEM ◊ Girls' self-perceived STEM abilities ◊ Identity/Beliefs • Culture identity—being a Latina/Hispanic girl • Group identity—being members in program • STEM identity—being in STEM fields ◊ Personal learning interests ◊ Personality ◊ Latino role model
Learning Experience in an OST STEM program	◊ Learning outcomes ◊ Perspectives of activities in the program ◊ Working with all-girls ◊ What is an OST STEM program? • Differences between school • Differences between each program
Self-efficacy	◊ Influences of program on self-efficacy ◊ Mastery experience • Challenges in an OST STEM program • Success or negative experience in an OST STEM program ◊ Physiological states ◊ Verbal persuasion • Influences from teachers • Encouragements from others ◊ Vicarious experience • Influences/observing from others girls in an OST STEM program
Career interest	◊ Family influence on career development ◊ Career aspirations ◊ Challenges to achieve career/future goals ◊ Influence of an OST STEM program on career • Influence on career development • Influence on career interests ◊ Reasons to achieve certain careers
Outcome expectation	◊ Expectation from program learning experience ◊ Self-expectation ◊ Expectation from social environment

Fig.5. Data Codes

IV. Results

A. Learning Experiences in GEMS

Girls participating in the GEMS STEM program had positive and varied learning experiences. The program has unique features, such as being free and inclusive with transportation and meals provided, which were appreciated by participants. The focus on hands-on activities and

projects, as described by Amanda, *"The camp is like a science and math based club where we do different projects and it's, it's fun. We have to be creative and think outside the box of like that."* The diverse levels and types of the program offered distinct learning experiences for participants. This variation was deemed beneficial for high school girls entering postsecondary education.

The program created an all-girls learning environment that differed from formal schools, providing necessary materials like robots and drones for hands-on experience. The OST learning environment emphasizes the broader opportunities and behavioral options for middle school girls. Girls felt more comfortable making mistakes and trying new ideas in this setting, contrasting with the constraints of formal schooling. As Clara demonstrated, *"I feel more open here and I feel like, oh this is, I'm comfortable here. I guess I feel more relaxed. And at school I'm more like tenants. I'm more close and I don't, I just listened to the teacher and that's it. Like I don't really like talking but here I feel better. I feel like I have a voice."*

Communication and cooperation were essential components of the program, fostering effective teamwork. Girls worked together to solve problems and develop necessary skills, leading to significant improvements in solutions. For example, one girl described her experience of working in teams by saying, *"For the first one, it was my experience or like something that describes miniGirls summer camp. Um, and overall I learned how to work with people and friendship and just like working together to like come up with the new ideas."* Mentors played crucial roles in the program, providing positive mentorship, and creating a supportive learning environment. The level of mentor involvement varied, with heavy involvement potentially limiting students' engagement, but overall, mentoring contributed to a positive student-mentor relationship and a sense of community.

Students experienced personal growth through the program, gaining familiarity with activities and overcoming initial challenges. Elisa mentioned the robotic competition was less stressful for her and she achieved better performance in the competition by saying "*I've gotten like more calm about the robots and it felt easier this [second] year when we were like putting together the EV3 and doing the coding the first time"*. Longer-term participants, such as those attending two summer camps, exhibited increased calmness and better performance, indicating personal development. Some girls returned as mentors, campers, or volunteers, further contributing to the program's success and forming stronger bonds through shared experiences. Overall, the GEMS program facilitated positive learning experiences, personal growth, and a supportive community for Latina Girls.

B. Factors Affected Girls' Career Interests

Girls' career choices are significantly influenced by social and family factors. The social environment, including community, school, and neighborhood, played a crucial role in shaping participants' career aspirations. Many participants expressed a desire to change their perceptions of their surroundings, driven by frustration with discriminatory words and negative views. For instance, Ariana and her mother aimed to challenge stereotypes about their area and school by showcasing the positive aspects. Elisa, observing issues in her community, aspired to become a lawyer or therapist to contribute positively.

Family influences emerged as a substantial component impacting girls' career aspirations. The study highlighted how family members affected Latina girls' career choices through their influence on career decisions and self-efficacy appraisal. Families provided valuable information and perspectives on various careers, shaping the girls' understanding of the importance of education and experiences. Reya, influenced by her uncle, learned that both a college degree and experience were crucial for securing a good job. She said, *"People are not only looking at your college, they also look at your experiences, but it also helps if you go to a good college."* Similarly, Amada's interest in mechanical engineering was sparked by her father's experience in car-related fields and carpentry.

Supportive families played a crucial role in fostering girls' interests and helping them choose careers aligned with their passions. Savanna family's encouragement and her friends' motivation to explore STEM careers propelled her toward pursuing opportunities and preparing for her goals. The positive influence of family support was highlighted as indispensable in shaping and developing career aspirations. The external factors, including family encouragement and support, significantly contributed to guiding girls towards making informed career choices based on their interests and aspirations.

C. Influences of the GEMS Program on Girls' Career Interests

This study on the Girls in STEM program revealed its positive impact on students' STEM learning and the development of their interests in STEM fields. The program fostered a fun learning environment, covering various STEM concepts such as robotics, programming, and graphic design. Middle school girls improved their math efficacy, while high school participants gained familiarity with a college environment, motivating them to pursue additional STEM activities and classes. The exposure to different STEM concepts through presentations by guest speakers broadened participants' perspectives and influenced their career interests, fostering aspirations in engineering, coding, and related fields.

The data also highlighted the influence of gender disparities and stereotypes on girls' career choices. Many girls in this study realized the gender bias and stereotypes towards women in STEM. As one girl expressed her perspectives of gender bias by saying: *"With them being sexist, it's kind of bad because we females we probably don't have as much style as the men cause due to them like having been very picky. We're also picky but we like, work harder to achieve that cause just 'cause people think that men do better than women when actually women work harder. We, we try harder."*

Despite facing gender bias in STEM, participants expressed a willingness to consider STEM-related careers as alternative choices. Career aspirations centered around helping others, with girls aspiring to become dermatologists, therapists, and pursue careers that contribute positively to society. The findings indicated that the GEMS Program contributes to challenging stereotypes and encourages girls to explore diverse career paths, creating a pathway for them to pursue STEM-related goals.

V. Discussion

The results of this study highlight the beneficial effects of the GEMS OST program on raising participants' aspirations for STEM careers. However, it raises the crucial question: ***What can researchers and practitioners do to sustain and enhance the STEM interests of underrepresented minority girls?***

As middle school and high school girls are at an age where they desire to learn new things, it is beneficial for them to have long-term STEM exposure so they can explore various subjects and develop their interests in STEM learning. Creating a supportive learning atmosphere is crucial for helping students share their viewpoints and acquire necessary skills, which may impact their interests, self-efficacy, and professional development. Similar to numerous middle schools, engineering is not offered as a course option for students. In the classroom, engineering skills are hardly developed at all. Certain after-school programs incorporate multiple disciplines and could serve as an additional source of education beyond what is typically offered by schools.

Enhancing program outcomes also requires programmatic structure and continuous emotional and educational support. Based on the programmatic structure, the OST STEM program for middle school students could offer more engaging and interactive activities, while the high school curriculum may place more emphasis on education and professional experiences. It is significant to remember that middle school girls are going through physical, mental, emotional, and social changes as they make the move from elementary to middle school. They are also growing in terms of self-identification and self-awareness at this age.

Therefore, it would be advantageous for girls to receive assistance from OST program facilitators to enhance their academic learning and develop their social and emotional competencies. These facilitators can take on the role of teachers, encouraging students to learn and stimulating their curiosity in math and science. Students' motivation and efficacy may decline in the absence of support during the learning process, which also results in negative emotions. Programs for STEM OSTs may need to concentrate more on "how much" support than on "how many" activities and topics they can cover.

It is also critical to recognize how socioeconomic status and cultural backgrounds impact the educational and professional choices of Latinas. Gender bias and stereotypes in STEM are pervasive, and aligning social environments such as school, family, community, and the program can better support and encourage girls in persisting and developing interests in STEM fields. Collaborative efforts can foster an inclusive environment that empowers Latina students to pursue STEM education and careers despite existing societal challenges.

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Appendix A

Interview Protocol Part 1: Life and Culture Influences

Theoretical Framework	Structure of Interview Questions
Social Identity	• How do you and others think about being a Latino/female scientist or engineer?
Mastery experiences	• How do you believe your abilities and performance in middle school? • What negative or positive experiences have contributed to how confident you are in school classes? To what degree did these experiences affect your feelings about your abilities?
Vicarious experience/Social Persuasions/career development	• How have other people(Family/Teachers/Peers/Culture) influenced how you think you will do/are doing and your career choices? • What sort of sociocultural (Family/Teachers/Peers/Culture) messages did you get toward to your future development? • Please give examples of what types of supports you gained from Family/Teachers/Peers/Culture.
Physiological states/Social Persuasions	• What did people say to you as you were pursuing mathematics, science, engineering or technology?
Career Development	• When did you first form an opinion about your career? • Could you please list some jobs you may interested in or your career plans? Please explain or give an example. • Connect with the data from Art-based activity

Appendix B

Interview Protocol Part 1: Life and Culture Influences

Theoretical Framework	Structure of Interview Questions
Background	• years of camp experience, lists key activities in the camp
Social Identity	• How do you think about being an member in STEM program? What kind of group work affect your identities?
Mastery experiences	• Please describe a positive(success) or negative(failure) program experience that you feel shaped your feelings toward STEM. • To what degree did these experiences affect your feelings about your math/science/engineering/technology or others abilities?
Vicarious experience/Social Persuasions/	• How has the program and others in the program influenced how you think you will do/are doing and your career choices?
Social Persuasions	• What have other girls/ people in the program said to you that has affected your confidence in your study, especially related to STEM fields? Please give examples of what types of supports you gained from the program.
Career interest	• What participatory experiences contributed to pursue your career plan? Tell me about any experiences you had in the program that exposed you to the STEM careers. To what extent have the program affected your confidence in your study and career paths, especially related to STEM fields? • Did you ever consider working in a STEM field? If yes, what changed your mind? If not, why not?