Establishing Sustainable Programs: Creating Lasting Computer Science Summer Programs for Middle School Students (Evaluation)

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Abstract

Informal learning environments are among a number of ways to build learning experiences for students outside of the classroom. These experiences can create opportunities for students to engage and develop an interest in computer science and engineering outside the classroom. Creating more opportunities supports the growing need for a future workforce with students who have skills in computational thinking, engineering design, and programming. While informal programs are impactful in building skills and knowledge in students, they often experience attrition upon the conclusion of grant funding. This cycle limits the lasting success of a program. The Goldberg Gator Engineering Explorers (GGEE) program aims to develop sustainable methods to extend the impact of the program and create self-sustaining programs.

The GGEE Summer Program continues to provide these experiences to underrepresented middle school students to support the K-12 computer science pipeline by offering free summer programs for beginners in programming, artificial intelligence (AI), and machine learning (ML). Students learn to work with various types of software and hardware to create simple programs using advanced machine-learning models.

After a successful 2022 pilot year, reaching 100 students in 6 school districts through 8 camp sessions, the summer programs returned in 2023 and expanded to host over 22 sessions in 8 school districts across the state. The programs hosted nearly 320 rising 6th through 10th-grade students in either an introductory programming session or an advanced AI and ML session.

A single donor funded all the summer programs during the pilot year in 2022. Since this method was not a sustainable way to bring the program to more students over time, the GGEE program team investigated ways to make the program sustainable and lasting.

This paper provides an evaluation of the different ways to expand and host more programs across the state sustainably by looking at the following areas: 1) methods to recruit interested schools and districts, 2) increase program ownership by schools and districts, 3) engage cost-sharing partnerships, 4) recruit students to participate in programs, 5) research and program assessment, and 6) providing multiple opportunities for students to return to the program.

Informal learning environments allow students to explore new concepts, develop new skills, apply classroom understanding, and collaborate with other students across their schools and districts. This paper compares the GGEE program across its first two years of implementation by expanding on the six points above. The findings presented in this paper are anticipated to assist existing and future informal learning programs to develop sustainable opportunities for students.

Background

Informal learning is often defined as learning that occurs outside of the classroom. This definition allows for experiences ranging in structure from guided activities to passive learning experiences. Programs occur outside of school hours and are often held at schools, local libraries or museums [1], [2]. Summer and after-school programs can serve as a platform for diversity and equity by offering opportunities to students outside the traditional classroom setting. Such programs can be modified to fit the needs of schools and students across urban, suburban, and rural areas [3]. These initiatives can also help bridge the educational gap by providing additional opportunities in elective subject areas with limited classroom engagement [3], [4].

Outside-of-school programs provide opportunities not only to students, but also program facilitators, such as teachers and undergraduate mentors, to develop new skills in Science, Technology, Engineering, and Mathematics (STEM) education through inquiry and engineering design [4], [5]. These programs give students and facilitators the opportunity to increase their STEM literacy by engaging in activities that are set in real-world scenarios. Participants gain the knowledge, attitudes, and interdisciplinary STEM skills needed to identify and solve problems while constructing an understanding of how STEM impacts the world [3], [5], [6]. Informal programs provide opportunities for targeted enrichment, especially in the areas of computer science (CS), artificial intelligence (AI), and engineering design. Continuous learning is ensured by allowing students to engage with new technology resources supportive of coding and engineering [7], [8].

Summer programs complement traditional K-12 education by exposing students to STEM concepts through engagement in various activities and applications that provide the time, means, and resources for authentic STEM learning [6]. These opportunities have shown impacts on students' interest in STEM content, future careers, and grades. Studies on STEM programs for high school students reported positive influences on students' interest in STEM content and future careers in STEM after participation in said programs [9]. Another study reported that students were 1.4 times more likely to want to pursue a career in STEM after participating in a university-run program [10]. Similar summer program experiences resulted in positive and significant effects on students' grades following an educational summer camp [11].

Increased interest in STEM directly due to these camps led to questions of how to sustain interest and foster growth in this field after the camp has finished. When parents were asked why they had signed their students up for STEM summer camps and activities, they largely expressed the desire to provide "sustained exposure to the STEM curriculum and engage them in real-world applications" [10]. In other words, parents wanted to encourage their students to continue in STEM and foster a good relationship with STEM activities and learning.

Sustainability in K-12 programs encompasses the ability to operate independently over a prolonged period. Many programs begin with funding from local donors or small grants for development and implementation [7], [8], [12]. Long-term funding is a major factor in a program's sustainability. Programs are often offered free of charge, though some have a fee for attendance [7], [8]. There are benefits and downsides to both options: free summer programs increase access for underserved students; on the other side, charging a fee for attendance supports the maintenance of the program from personnel, locations, and even technology

requirements. Part of ensuring a program's sustainability involves establishing key community relations to build a network of supportive and engaged community members that bolster its longevity, allowing it to continue to provide these experiences to students [7], [13].

Equally important is the presence of well-trained program leaders. These individuals are not just facilitators but also custodians of the program's practices and vision. Their ability to effectively transfer knowledge and skills to others is essential for the continuous and consistent delivery of the program's objectives. Many programs have learned to identify teachers, undergraduate students, and even high school students to support programs local to their communities. Not only do these stakeholders gain the experience of learning and leading program materials but they are then able to apply those experiences to their own learning or classrooms [7], [8], [12], [13].

Another cornerstone of sustainability is designing multi-year programs that scaffold onto each other to engage learners for subsequent years and allow programs to reuse materials and technology [7], [8], [13]. By designing a series of curricula using materials that can be employed across multiple stages, not only are costs reduced, but a uniform standard of delivery is maintained.

The development and implementation of efficient systems and processes are crucial. These operational frameworks ensure that the program can be run smoothly and effectively, with the ability to adapt to changing circumstances or scales. It is the synergy of these elements—community relations, trained leadership, reusable materials, and robust systems—that collectively define and drive the sustainability of K-12 programs.

By developing partnerships with schools and districts, these initiatives ensure a broad and inclusive reach that impacts thousands of children and their teachers with varied backgrounds, allowing them to engage, learn, and grow together to build a more equitable future in STEM industry sectors.

Introduction

The Goldberg Gator Engineering Explorers (GGEE) Summer and After-school Program provides informal learning experiences to underrepresented middle school students across school districts in Florida. These programs are designed to support the K-12 STEM pipeline by offering free summer and after-school programs for beginners in programming, artificial intelligence (AI), and machine learning (ML) in the context of engineering design. The overarching goal of the GGEE program is to encourage students to explore STEM applications and incorporate skills into their future experiences in education and the workforce. In the GGEE programs, students learn to work with various types of software and hardware to create simple programs using advanced machine-learning models, as well as study their impacts on STEM [12].

The GGEE summer program was first designed and piloted in 2022 at the request of a donor to the University of Florida's Herbert Wertheim College of Engineering with a vision of providing authentic computer science (CS) and engineering design summer program experiences for underserved middle school students. The donor requested the program develop skills beyond programming, which led the team to create engineering design-based activities that required students to learn and apply skills in computational thinking and process mapping in addition to

learning to program [12]. Upon the conclusion of the 2022 summer programs, a series of after-school programs were developed to provide a continual experience for students throughout the 2022-2023 school year. With the support of multiple university donors and partnerships with school districts, a Year Two of summer and after-school programs were run over the summer of 2023 and 2023-2024 school year. The programs were funded for another year of summer programs in 2024 allowing for continued expansion and improvement of sustainable implementation.

The introductory summer program curriculum was designed as a series of three blocks, programming basics, micro:bit pet design as an introductory engineering design experience, and a technical engineering design challenge, that could be held in a four-day full-day format or an eight-day half-day format. The curriculum focused on developing computational thinking and engineering design skills in middle school students with strategic interdisciplinary activities that combined and engaged students in real-world STEM applications. The GGEE summer and after-school programs were centered around the BBC micro:bit and Makecode block coding environment [14], [15].

The flow of the activities in the GGEE programs were designed to scaffold knowledge by applying previously learned concepts in new scenarios, as seen in many CS summer program designs [7], [8], [13]. All of the activities were staged using the Elicit, Develop, Deploy, Refine conceptual model development cycle created and implemented in the Engage Quality Instruction through Professional Development (EQuIPD) grant run by, Dr. Nancy Ruzycki at the University of Florida, the same PI who worked to coach teachers through professional development [16]. This conceptual model development cycle provided the framework to stage activities in a sequence that supported the development of students' fundamental understanding of programming adjusted to their previous experiences, which segued to engagement in inquiry through engineering design to build new programming and engineering skills. The engineering design projects, micro:bit pet and technical design challenge, were framed using the Stanford Design Model [17]. During these activities, students completed a full design thinking development cycle to develop products based on other user feedback.

To research the short-term and long-term impacts of the GGEE summer programs on students, a study was designed to collect pre-, post-, and daily surveys during participation in the program. Surveys were designed to collect information on student's coding ability, enjoyment of the activities, identity as an engineer or scientist, and basic demographic information. Interviews during the program were also conducted to gauge interest, identify challenges that students faced, and identify their motivation to join the program. To study the long-term impact and influence of the program, student course enrollment and grades in STEM were collected from participating districts over the academic career of students in the program. The research study for the summer programs received IRB approval (IRB202102451) at the University of Florida to implement the surveys, interviews, and track longitudinal student data.

As an initial step toward sustainability, three after-school program tracks were designed, introductory, intermediate, and advanced, to continue learning and engagement during the school year. A Year Two Advanced summer program was also developed and piloted in 2023. This Advanced program was created for returning students interested in continuing their GGEE

experiences and to develop their understanding of concepts in artificial intelligence and machine learning.

This paper describes the evolution of the GGEE summer and after-school programs and the various strategies and practices that contribute its enduring success and growth. The evaluation and refinement initiatives focused on the following sustainability elements: 1) methods to recruit interested schools and districts, 2) increase program ownership by schools and districts, 3) engage cost-sharing partnerships, 4) recruit students to participate in programs, 5) research and program assessment, and 6) providing multiple opportunities for students to return to the program.

However, it is important to note that the data and detailed analysis supporting these insights are currently being prepared for a separate publication. Therefore, this paper primarily discusses the conceptual framework and overarching principles of sustainability in informal learning programs without the detailed empirical evidence that will be presented in the forthcoming publication.

Pilot Program Design

Flexible delivery formats were integral to initial program design. Content was developed to be delivered across multiple layouts with appropriate endpoints and transitions between days to accommodate the variety of school district summer schedules ranging from 4- or 5-day weeks with full or half-day operating hours. The Introductory Program was created as a beginner-friendly program for students who have no programming or hardware experience. Students learned how to program micro:bit microcontrollers through scaffolded activities designed to build their understanding of basic programming elements such as strings, loops, and conditional statements, to program the built-in sensors and LED displays on the micro:bits. During this process, students also learned how to develop process maps to think systematically and sequentially while programming. Students applied their foundational understanding to create a rock paper scissors game and collect and analyze light-intensity data. Students then moved into more complex collaborative engineering design projects, such as designing a micro:bit pet for a partner and developing a technical solution for an industry partner in need.

In the 2022 Pilot Year, eight summer program sessions were solely funded by the UF donor in a self-contained model that did not require cost sharing with districts to support program teachers, mentors, and materials. The program team identified six test districts utilizing prior connections made during the EQuIPD grant. Student recruitment was primarily conducted by teachers, schools and districts. Four teacher leaders were selected to travel and facilitate programs around the state outside of their home districts. The program staff consisted of a team of four teacher leaders and six undergraduate student mentors. All program staff was trained in the program activities by the research assistant who managed the program development and deployment, which was all overseen by the PI on the project. Additionally, program assessment was conducted through various surveys and interviews to study the short-term and long-term impacts of student and teacher participation in the program and to improve the program year-to-year.

Year One, pilot programs were held in six school districts across the state of Florida. Table 1 details the participating districts, the locale classification of the program site defined by the National Center for Education Statistics' Locale Lookup tool, and how many programs were held

at each location [18]. Program locales were classified as either city, suburban, town, or rural as dictated by the standard urban and rural designations defined by the U.S. Census Bureau, and each type of locale is either urban or rural in its entirety [18]. A total of 110 students were served across all of the pilot program sessions. Geographic locations of the summer program sessions are noted in Figure 1, along with student gender demographics and facilitator ratios. Sessions were led by a team of four teachers and six undergraduate students who traveled across the state to support these programs.

Table 1: *Year One Program Locations and Locale Classifications*

District	Program Locale Classification	Number of Programs
Alachua	City	1
Escambia	Suburban	1
Collier	Town	1
Sarasota	City	1
Orange	Suburban	3
Palm Beach	City	1

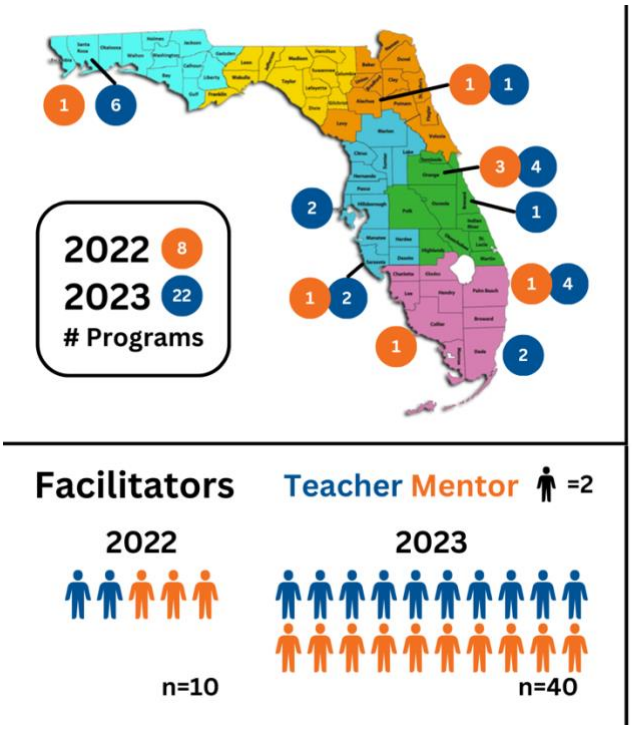

Figure 1: Goldberg Gator Engineering Explorer Summer Program Geographic and Demographic Results from Year One and Year Two

Recognizing that a single donor was not sustainable for expanding the program in the following years, the GGEE team identified the need to explore more viable options. The largest expenses included catering, technology, and travel accommodations, posed significant challenges to scalability. Consequently, the GGEE program team focused on investigating strategies to make the program not only sustainable but also established within school districts.

Expanding the Program Beyond Summer Programs

After successfully completing the Year One summer programs, teachers, leaders, and students showed an interest in continuing the program's concepts and the use of technology during the regular school year. Stakeholders recognized the importance of a program that maintained student engagement with the equipment and programming language year-round. The GGEE after-school programs were then developed in response to stakeholder interest and were then piloted by undergraduate student mentors for 10 weeks in each semester (Fall, Spring). Sessions were held once a week for one hour a week, virtual program sessions were developed, enabling middle school students to participate in online after-school sessions via Zoom from their own home. The after-school program was promoted directly to parents of pilot summer program participants. A total of 22 students joined introductory and intermediate sessions from home.

Following Year Two summer programs, adjustments were made to include on-site after-school sessions. Around 150 students participated from classrooms, where sessions were co-led by teachers who were physically present and undergraduate mentors who joined remotely.

Building Sustainability in Year Two

The GGEE team understood that a shift toward more sustainable practices and partnerships would allow for the program to continue into another year and expand across the state. When planning for the second year of GGEE summer programs, the following areas were identified to build out a preliminary sustainability plan: 1) methods to recruit interested schools and districts, 2) increase program ownership by schools and districts, 3) engage cost-sharing partnerships, 4) recruit students to participate in programs, 5) research and program assessment, and 6) providing multiple opportunities for students to return to the program. These six factors were chosen through a deconstruction of the program parts and identification of the main areas of concern.

Comparison from Year One to Year Two

The Year Two GGEE program held over 3.5 times as many summer program sessions as it did in Year One. Table 2 compares summer program growth and cost-sharing from Year One to Year Two. Four new districts were involved in the 2023 programs, and a total of 2 districts did not participate due to funding limitations. The expansion in the number of sessions could be attributed to a combination of the different elements of the sustainability plan listed above. In Year Two, a total of 319 students participated in the 22 sessions, and about 25% of the students were female. The sessions were led by 10 teachers local to the program sites and 10 undergraduate mentors that were from the regions, as shown in Figure 1.

Recruitment

In Year Two, the GGEE program underwent several significant changes to enhance its reach and effectiveness. One of the primary areas of evolution was in recruitment strategies of districts. To extend impact beyond established connections, the program implemented a comprehensive recruitment campaign to distribute emails and promotional flyers to Career and Technical Education (CTE) directors, principals, and superintendents across the state. Additionally, a series of online information sessions were organized to offer a detailed overview of the program and clarify hosting expectations. Targeted follow-up communications and meetings were held to fine tune the logistics and specifics of each program.

Table 2: *Comparison of all program locations from Year One and Year Two.*

District	Locale Classification	Amt. Yr 1	Amt. Yr 2	Y2 Est Cost Share (UF)	Yr 2 Est Cost Share (Dist)
Escambia	City	1	-	-	-
Sarasota	Suburban	1	2	$15400	$4600
Collier	Town	1	-	-	-
Palm Beach	City, Suburban, Town	1	4	$38700	$6300
Orange	Suburban	3	4	$27300	$12700
Alachua	City	1	1	$450	$4615
Santa Rosa	Rural, Suburban	-	6	$71600	$18400
Pinellas	Suburban, City	-	2	$11900	$8100
Miami-Dade	Suburban	-	2	$29500	$500
Brevard	City	-	1	$4100	$5900

Program Ownership and Cost-Sharing

Concurrently, a strategic shift was made to foster greater program ownership among schools and districts. This was achieved by forming collaborative partnerships that required as much coordination as funding. Districts played an instrumental role by connecting GGEE staff with school administrators, who handpicked teachers to spearhead program deployment. Teacher involvement in program setup paired with training and upskilling, significantly bolstered ownership at school and district levels.

To further ownership, cost-sharing partnerships were established, encouraging schools to contribute to their program's implementation. Schools were encouraged to provide meals for students, invest in necessary technology, and support their teachers through training and program leadership, estimated funding ratios are shared in Table 2. The cost-sharing initiatives allowed for more GGEE funds to be allocated toward supporting more local undergraduate students across the state. Program evolution was geared toward expansion but also about ensuring sustainable growth and fostering deeper engagement within each participating community. This approach was aided by an additional $300,000 dollars the PI secured from a grant modification using unspent funds from other sub-awards on the program (State of Florida Department of Education (291-1231C-2C001), 2023), as well as additional district-specific donors. These non-recurring funds allowed for the expansion of the program while allowing the program to build out a sustainability plan.

Student Recruitment

In Year Two, recruitment practices were refined to increase engagement of middle school students. Moving away from centralized promotion, communication networks of schools were leveraged to disseminate GGEE program information, flyers, and registration procedures. This shift in strategy resulted in higher numbers of registrations. Schools and districts promoted the program directly in their STEM and CTE classrooms paired with school-wide notification systems, and social media platforms for wider parent engagement.

Research and Assessment

A focus was placed on tracking the short-term and long-term impacts of the program for research and return on investment. To achieve this, teacher and student interview protocols were revised,

ensuring uniformity and consistency in data collection. The analysis of 2023 survey and interview data is underway. The GGEE research team aims to publish their findings in an academic journal.

Multiple Opportunities
Through analysis of the program, it was determined that the continuous opportunities to engage with the program during the school year and across successive summers was a crucial element of sustainability. Following the pilot year, virtual after-school programs were developed to allow students to participate from home. In Year Two, an advanced summer program for returning students was designed to delve into Artificial Intelligence (AI) and Machine Learning (ML). The advanced program engaged students in various ML models – image, text, gestures – and involved the creation of datasets using micro:bits to develop and test gesture recognition ML models. Students explored neural networks, specifically how they compare to other ML models and the effect of modifications on model outcomes.

Additionally, the after-school program structure was redesigned. In collaboration with schools, on-site after-school sessions were led by teachers supported by virtual undergraduate mentors. The program was structured into introductory, intermediate, and advanced tracks, each lasting eight weeks instead of the initial ten-week design. Teachers scheduled their own sessions, further enhancing the program's integration into existing after-school programming and program ownership.

Creating Sustainable Summer Programs
The GGEE sustainability initiative was designed to support the long-term development of school and district infrastructure to allow them to host their own summer and after-school programs. Informal conversations with various stakeholders, including district-level directors, principals, and teachers, were held to gain more insight towards shaping more sustainable GGEE programs. The main takeaways of the preliminary conversations were captured through field notes. The conversations delved into several aspects of informal programs beginning with district participation, school ownership of programs, and student recruitment.

Field notes were assessed using a simple word count analysis in R [19]. This text-mining strategy involved tokenizing, breaking the field notes into individual words. Then uninformative terms were removed from the notes. Uninformative terms can include words restated from the question such as “programs” and common *stop words* such as “the” and “it.” The remaining terms helped to identity important elements in the field notes, referred to as big ideas. Word counts were generated for each session’s field notes as well as aggregated field notes from all sessions. This was done to identify big ideas in the individual session as well as the collection of sessions.

Informal conversations began with an exploration of factors influencing participation in informal learning programs such as summer and after-school programs, Table 3. The following questions guided these conversations:

> *1) What factors influence a district's decision to participate in summer programs, including considerations of funding, existing programs, and barriers at both district and school levels?*

2) Who are the key decision-makers within a district for engaging in these programs, and should outreach focus on individuals associated with CTE, STEM, or other areas?
3) What criteria do districts use for selecting schools and teachers for these programs, including aspects of location, status, and teacher qualifications?

The big ideas that arose from these conversations included factors to participate, key decision-makers, and criteria for school and teacher selection, Table 3. Factors influencing districts participation in summer programs included: students, funding, district, engineering, and industry connections. Key decision-makers for programs include district-level persons, such as CTE departments, STEM departments, and superintendents, and school-level persons, such as principals and leadership teams. Criteria for school and teacher participation included: county perspectives, school location, STEM focus, and barriers to student and teacher participation. Multiple conversations emphasized the importance of teachers being willing to put in the effort to facilitate programs.

Table 3: *Terms from conversations around district participation by individual and aggregate field notes. The terms in the aggregate column are those that appeared across all conversations that were not identified by individuals.*

Big Idea	District	District	District	Teacher	Principal	Aggregate
Factors to participate	Funding, students, after-school, district, teachers	-	Students, engineering, industry, align, certifications	Campus, host	Ability, existing, fund	Operations, school
Key decision-makers	Schools	CTE	CTE, principal, superintendent, academic, district, funding	Coordinators, STEM	Leadership, Schools	-
Criteria for schools and teachers	County, willingness	County	STEM, Schools	Effort	-	Location, schools, students, teachers

The next portion of the conversations focused on the ownership and funding required to support programs, Table 4. The following questions guided this part of the conversations:

5) What are the primary sources of funding (e.g., grants, PTA, set-aside funds, government or CTE funds, ESSR) for these programs?
7) What are the barriers to achieving ownership and sustainability of these programs?
8) Can you provide insights into the long-running informal STEM programs in your district, including their structure, reasons for continuation, integration into school hours, and support mechanisms?

The big ideas that arose from these conversations included primary funding sources, barriers to ownership, and insights on existing, Table 4. Stakeholders shared the primary sources of funding for summer and after-school programs for past and upcoming programs. Many locations rely on

funding from CTE departments from certifications, Title I funds, and – in past years – ESSR funding. Barriers to ownership were focused on school-level involvement regarding principals and teachers, training, and permission. Insights about existing informal programs in their school or district included: STEM or STEAM orientation, defined program goals and materials, community, career, and cultural connections.

Table 4: *Terms from conversations around ownership of programs by individual and aggregate field notes. The terms in the aggregate column are those that appeared across all conversations that were not identified by individuals.*

Big Idea	District	District	District	Teacher	Principal	Aggregate
Primary funding sources	CTE, Title I	CTE	Certifications, ICT, Digital Tools	ESSR, Title I	-	CAPE
Barriers to ownership	Principals, overwhelmed	Training, understanding	Funding, teachers	Permission, school	Options, time	Host, staff, students
Insights on existing programs	STEAM, careers, defined, community, culture, innovators, PD	Goal, school	-	Materials, sites, STEM	STEM, core, pathways	Classes, curriculum, director, district, funding, students, teachers

The final portion of the conversations focused on student and parent engagement, Table 5. Conversations included discussion on optimal timelines, program formats, and the obstacles districts encounter in recruiting students for these programs. The following questions guided this part of the conversations:

> *9) What are the primary barriers faced by schools when recruiting students for summer programs?*
> *10) What are the most effective timelines and formats for engaging students and parents during the recruitment process?*

The big ideas that arose from these conversations included barriers to student recruitment and effective engagement of students and parents, Table 5. Barriers to student recruitment included: parents, days, hours, and transportation. The month of April was identified as the ideal time for student and parent engagement.

Table 5: *Terms from conversations around parent and student engagement by individual and aggregate field notes. The terms in the aggregate column are those that appeared across all conversations that were not identified by individuals.*

Big Idea	District	District	District	Teacher	Principal	Aggregate
Barriers to student recruitment	-	Parents, day	Parents	Hours	-	Transportation
Effective student and parent engagement	April, schedules	-	Plan, recruit	-	-	List

After the assessment of the field notes, the GGEE research team strategized how to include the various insights gained from these conversations toward making the programs more sustainable and suitable for future schools and districts to run on their own. From these field notes, the research team was able to identify factors of district participation as funding, student and teacher engagement, as well as program alignment to content and certifications. It was also determined that key decision-makers to target district recruitment efforts include CTE departments, principals and administrators as well as superintendents to engage in multi-directional school recruitment initiatives within districts. Conversations indicated that program location and distribution in a county was important. Similarly, considerations of teacher willingness and effort played a role in who would facilitate programs.

Regarding program ownership, conversations revealed that many districts participating in cost sharing initiatives utilized funds from CTE departments through student certifications, Title I funds, and previously ESSR funds. Barriers to ownership were identified as principal engagement at the school level, limited hosting options, as well as district-led training to prepare teachers. Existing informal programs were defined as STEM or STEAM oriented with defined program curriculum and materials that engage students in community, culture, and careers.

The from a stakeholder perspective, big ideas around student and parent recruitment and engagement focused on which dates programs were offered, the times programs were offered, and transportation options. In regard to recruitment, April was offered as a target month to share registration materials with students and patents.

Collectively, these insights led to the addition of a survey for district- and school-level partners in Year 3 programs to investigate the characteristics of sustainable summer programs.

Conclusions

Informal learning opportunities in STEM play a crucial role in addressing the educational disparities faced by many students, particularly those with limited exposure to authentic STEM engagement during traditional school hours. Research has consistently demonstrated the positive impact of such programs on student outcomes. The GGEE program stands as an example in providing valuable opportunities in STEM, computer science, and engineering design to underserved students across Florida. Moving forward, it is imperative to embed sustainability into the planning and execution of these programs when collaborating with interested schools and districts. This entails implementing tailored recruitment strategies, fostering ownership by schools and districts through funding and cost-sharing initiatives, and developing sustainable funding mechanisms within local communities. Additionally, efforts to enhance student recruitment and engagement for greater diversity and inclusivity, as well as the continuation of learning through after-school programs between summers, are essential components of sustaining the impact of these initiatives. Furthermore, ongoing research to substantiate the effectiveness of these programs and inform sustainable practices for long-term implementation is crucial. Through collaborative discussions with school district and teacher officials, the GGEE team aims to further refine and strengthen the strategies outlined here, ensuring the continued success and expansion of STEM learning opportunities for all students.

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