Cross-functional, Multi-organizational STEM Camp Partnership: Teaching Technology and Human-Centered Design in a Project-Based Curriculum (Other, Diversity)

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Abstract

Summer STEM camps are one of the methods used to introduce middle and high school students to topics and careers in STEM. Frequently, these camps are produced and run by a single academic institution. This paper presents a novel partnership between four different organizations that included a nonprofit community organization, technical university, professional sports team, and major technology company that came together to develop and run a STEM camp for minority middle and high school students. The STEM camp content was split between design and technical topics and was designed to meet the individual goals of each member of the partnership. This paper describes the camp development and activities, the relationships and interactions between the partnering organizations, and presents key takeaways from multiple years of running the camp.

1. Introduction

Summer STEM camps have been shown to be an effective means of introducing middle and high school students to STEM disciplines [1]. Many STEM camps are used as a means to attract women and minority students to STEM fields [2] [3] [4] [5]. STEM camps have even been used to introduce and encourage cross-cultural relationships and experiences [6]. Frequently, these STEM camps are developed and run by academia [5] [7]; however, there are a growing number of camps that are developed and run by partnerships between different organizations. These partnerships can range from an academic institution running a camp that includes special sections focused on industry [4], a national professional society partnering with academia on running and evaluating multiple camps [8], a local non-profit collaborating with a university [9], and even a major defense contractor partnering with an NFL franchise [10]. Strengthening these types of partnerships has been identified by the U.S. federal government [11] as a critical pathway in achieving its goals related to STEM education.

This paper presents a unique partnership between ALIVE Milwaukee (ALIVE) [12], a local non-profit community organization, the Milwaukee School of Engineering (MSOE), a teaching-centered technical university, the Milwaukee Bucks NBA team, and Motorola, a corporate technology leader and sponsor for the Milwaukee Bucks. This partnership collaborated to produce three different summer STEM camps run over three summers for minority middle and high school students. The last two of these STEM camps presented the students with a real-world design project posed by one of the partners and introduced students to both human-centered design and traditional STEM content. The camps leveraged each partner's strengths and included visits from representatives of the Milwaukee Bucks and Motorola, stadium tours, panel discussions, and a field trip to Motorola's research and development facility in Chicago.

The continuation of this paper describes the partnership, the details of the three iterations of the camp, lessons learned and key takeaways from running multiple iterations of the camp.

2. Partnership Development, Goals, and Collaboration

This section describes the partnership formed between four very different entities that leverage their diversity and strengths to produce a one-of-a-kind STEM camp for minority students. The rest of this section describes how the partnership developed, the goals driving each member to continue in the partnership, and how the different partners were able to collaborate to produce the various iterations of the STEM camp.

2.1 Partnership Development

In early 2021, a faculty member at MSOE was approached by an undergraduate student who worked with ALIVE, a local nonprofit. ALIVE was specifically looking to provide STEM experiences for their students who are predominantly underrepresented in STEM fields. This initial conversation was the beginning of an ongoing multi-year STEM program targeted to minority students.

The faculty member connected ALIVE with the MSOE's STEM center. ALIVE then worked with the MSOE's STEM outreach center to craft a weeklong exploratory STEM camp for middle and high school students. The STEM center hosted the camp, but due to other scheduled activities, could not staff the event. Therefore, the original faculty member plus two others from

their academic department were added to the team and were tasked with teaching the camp to the students. This group defined the initial partnership.

A year later, the university STEM center was approached by the Milwaukee Bucks to partner on a STEM program for underrepresented students. In exploratory conversations, it was discovered that the Bucks already had a relationship with ALIVE and had committed to invest in the organization. Based on this information, the Bucks were added to the partnership that had produced the STEM camp the previous year. The Bucks then added their existing technology partner and sponsor, Motorola, to the STEM camp partnership. The Bucks and Motorola both invested time, funding, and camp content. This allowed the STEM camp partnership to expand again, by bringing in faculty members from MSOE's User Experience (UX) program.

The new members to the STEM camp partnership, with help from ALIVE, allowed the focus of the program to change from a general exploratory STEM camp to a high school program focused on concepts in human-centered design, programming, and mobile app development, with no prerequisites for students.

This partnership has persisted across three years and three camp iterations (one camp per year). The first iteration involved only the community partner and the university, and the second and third iterations involved all four partners. The shared goals between the partners has been a glue to keep this partnership strong. These goals will be discussed in the next section.

2.2 Goals

One of the unique aspects of the partnership is that all of the organizations are committed to producing a hands-on STEM camp experience to underrepresented students. This shared goal has persisted across multiple iterations of the camp. Beyond that, each organization brought their own set of goals to the camp, and these goals shaped camp content. Each organization's goals are as follows:

2.2.1 ALIVE Goals

The goals of ALIVE centered around giving their students, primarily from a demographic underrepresented in STEM, access to experiences and information not readily available to them. Specifically, ALIVE wanted to get students excited about STEM, introduce them to technology-related careers, and provide them with opportunities to learn with equipment, faculty, and facilities on a college campus.

2.2.2 MSOE STEM Center and Faculty Goals

The MSOE STEM Center's goal was to bring new programs to the Center that align with their mission to "create and support inclusive, meaningful experiences for all students to explore the possibilities of their future, regardless of where their post-high school journey may take them." [13] The university faculty's goal was to introduce students to technology and human-centered design concepts.

2.2.3 Milwaukee Bucks Goals
The Buck's goal in this partnership was to support a STEM experience for high school youth in the community. They also wanted to showcase STEM careers in their organization, and to allow their employees play a meaningful role in the program through volunteerism.

2.2.4 Motorola Goals
Motorola's goal in this partnership was to expose a new generation of students to their technology, and to showcase the skills useful in a career within their organization. They also wanted to provide opportunities to their employees to engage in STEM outreach.

2.3 Collaboration
Producing a high-quality STEM camp with a variety of organizations and goals naturally requires a significant amount of collaboration. This collaboration took the form of allowing each of the organizations to leverage their strengths and areas of expertise when contributing to camp content. Each organization offered the following expertise.

2.3.1 ALIVE Responsibilities
ALIVE marketed the STEM camp to their students and vetted students to make sure their interests aligned with the content of the camp.

2.3.2 MSOE STEM Center and Faculty Responsibilities
The MSOE STEM Center provided state-of-the-art facilities and handled the logistics of planning, organizing, and running the camp. The STEM Center was also the primary communicator between the different partners and was critical to facilitating and building the partnership. The faculty members brought domain knowledge, curriculum development, and the teaching skill required to engage students effectively.

2.3.3 Milwaukee Bucks Responsibilities
The Bucks provided the overall direction and focus of the camp. They also provided staff to engage with students and provided feedback to camp participants at key points during camp. The Bucks also facilitated high-impact experiences such as a behind-the-scenes tour of their stadium. Finally, funding from the Bucks offset costs for students, allowing them to attend the camp free of charge. Funding also provided compensation to the faculty for developing and delivering camp curriculum.

2.3.4 Motorola Responsibilities
Motorola provided smartphones for students to use during the camp, which were given to students the end of camp as a surprise and thank you for their work. In the third iteration of the camp Motorola also hosted a full-day event for students at their research and development facility. While there, Motorola provided feedback to the students on their app design. Motorola also shared insights into their product design cycle and gave students the opportunity to incorporate these insights into their app. They also provided funding through their partnership with the Bucks for this program.

3. Camp Details[1]

The partnership developed over three years, and as the partnership developed so did the STEM camp. The following sections describe the curriculum, schedules, and lessons learned from each camp iteration.

3.1 Summer 2021: First Camp Iteration

The first iteration of the camp ran in the summer of 2021 and was a partnership between the MSOE STEM Center, faculty from the university Electrical Engineering and Computer Science Department (EECS), and ALIVE. Student participants were recruited and vetted by ALIVE. The goal of this camp was to provide middle and high school students with an introduction to a variety of different areas of STEM.

3.1.1 Camp Outline

Each day of the camp students had one to two morning activities and one to two afternoon activities. Lunch was provided in the on-campus cafeteria. The schedule of the camp was as follows:

	Morning	**Afternoon**
Day 1	**Session 1:** Underpass Challenge **Session 2:** Industrial Engineering Challenge	**Session 1:** Heart Valve Design **Session 2:** Circuits
Day 2	**Session 1:** Tower Challenge **Session 2:** Materials Challenge	AI & Neural Networks Experience
Day 3	Robotics	Video Game Controller
Day 4	Robotics	Embedded systems
Day 5	Programming Drones	No Afternoon Activities

Figure 1: Schedule for the first iteration of the camp (2021).

3.1.2 Camp Content

Most activities were stand-alone activities, and only one activity carried over across multiple days. Many of these activities had been previously developed and offered by the MSOE STEM Center. The STEM Center staff and the EECS faculty coordinated teaching responsibilities depending on availability and familiarity with the activity.

[1] In the interest of an appropriate length paper, the full details of these activities will not be presented here, but the authors are more than happy to share details if the reader is interested. Please reach out for more information.

The activities were generally organized so that the students were given a high-level overview of the STEM topic, followed by a hands-on activity that related to what was learned. For example, in the Industrial Engineering Challenge, students learned about what Industrial Engineers do and why they do it, followed by an activity demonstrating roles an industrial engineer might play in a manufacturing plant.

The camp's culminating activity involved drone programming. Students used a visual programming language to specify the flight path of a drone through an obstacle course. While drones have become a popular STEM tool in the area in recent years, at the time of this camp it was still a novelty for middle school students. There was significant media attention to the drone activity underscoring that the focus to bring unique activities to students was achieved [14] [15] [16].

3.1.3 Camp Evaluation

This camp was considered a success by ALIVE and MSOE. It met the goal of introducing students to a variety of fields in STEM, and the students were excited and motivated to return each day.

3.2 Summer 2022: Second Camp Iteration

The second iteration of the camp saw the addition of the Milwaukee Bucks, Motorola, and faculty from the MSOE's UX program to the existing partnership. These new members resulted in a dramatic change of focus for the STEM camp, largely driven by the Bucks and Motorola. The Bucks' problem statement for the students was to develop new ways for their fans to interact with the team, no matter if they were in the stadium, at home, or on the road. Motorola had the goal of having students interact with and use their technology. With those goals in mind, the focus of the camp was changed so that over the course of the camp the students would design, prototype, and program an addition to the Bucks' mobile app intended to drive fan engagement with the team, and it would be prototyped on devices provided by the Motorola. ALIVE, kept the camp targeted at middle and high school students.

With this new focus, the entire camp was redesigned from scratch. The camp would take students through an abbreviated design thinking process of ideation, design, and programming that culminated in the students presenting their working app prototypes to Milwaukee Bucks and Motorola representatives. This combination of both design and programming in one camp is a distinguishing feature of this model.

3.2.1 Camp Outline

The camp ran over 4 days. Lunch was again provided to the students in the university dining hall. The high-level schedule is shown in the below table:

	Morning	Afternoon
Day 1	**Session 1:** Introduction to Camp, Overview of University Programs, and problem statement **Session 2:** UX Ideation and question development	**Session 1:** Background on the app, questions to Bucks representatives **Session 2:** Sketching and peer feedback
Day 2	**Session 1:** Figma Introduction **Session 2:** Figma prototyping of initial app design	**Session 1:** Introduction to programming tools **Session 2:** Programming tutorial specific to sports app
Day 3	App Programming	**Session 1:** Behind the scenes tours at stadium **Session 2:** Panel discussion with team representatives at stadium
Day 4	**Session 1:** Finish programming and work on presentations **Session 2:** Peer presentations practice	**Session 1:** Present presentations to Bucks and Motorola representatives **Session 2:** Celebration and camp end

Figure 2: Schedule for the second iteration of the camp (2022). The orange background are design activities, the green are programming activities, and the gray are general camp activities.

3.2.2 Camp Content: Design Thinking

The UX portion of the camp used an abbreviated version of design thinking and design sprinting [17]. First, students learned about the app requirements provided by the sponsors then took time to explore the current app. Students then started the UX process with "Define" determining who the users are for the app. Students individually used post-it-notes to identify potential users of the app. Once completed, the students returned to their groups and identified a primary and secondary user of the app.

After exploring the users, students then went into ideation with an exercise called "How Might We?" [18]. In this exercise students, using post-it-notes, generate ideas on how might they solve the problem to meet the user needs identified in "Define". Students then got the opportunity to meet with Milwaukee Bucks representatives to ask questions to validate their thoughts on users and how they might solve the problem.

The next step was Sketching. Using the Crazy 8's [19] method of sketching, students engaged in two rounds of sketching where they report out [20] to their team members their ideas after each round. The second round provided the opportunity for the students to iterate on their ideas from round one after getting feedback from their teammates. Once sketching and reporting out was

completed, students moved onto the next phase “Decide” [21]. Using dot stickers, each student got three votes to cast. The ideas with the most votes were the concepts that moved forward into prototyping.

In the final phase “Prototyping”, students were provided an interactive tutorial on a free software tool called Figma [22]. Figma allowed the students to collaborate live with each other to design and create their app screen. Students were able to easily apply UX design principles, use the style guide provided by the Milwaukee Bucks, be creative, and quickly try out different ideas. The software tool also allowed the students to link their screens together for the stakeholders to interact with the app to be able to better visualize the interaction and workflow. Figma also worked on the smartphones provided by Motorola to be able to see and interact with the app on an actual mobile device.

3.2.3 Camp Content: App Design

After the students created a simple app prototype in Figma, the EECS faculty taught the students simple app programming using Thunkable [23]. Thunkable was chosen because it had a graphical programming interface that the faculty thought the students would be able to quickly grasp (partly based on the student’s proficiency with graphical programming the year prior), and because it had an interface for importing designs from Figma. The hope was that this interface would allow the students to directly leverage the work they had put into Figma when creating their app prototypes. However, in practice this did not work as well as hoped and the designs that Thunkable created from the Figma prototypes were too complex for the students to use, so most groups ended up starting over from scratch.

The Thunkable programming lessons were taught through live demonstrations that the students followed on their own computers and smartphones. The first example the students were taught was designed to help get them comfortable with Thunkable. To do this, the faculty member led the students step-by-step in the creation of a simple game where a ball would fall from the top of the phone screen and the user had to try to catch the ball by moving a picture the Bucks mascot at the bottom of the screen left and right. This introduced students to setting up an app in Thunkable, creating simple logic, having different objects on the screen interact, and sending the app to their phone for testing.

The second program that the students created was more complicated and was designed to expose them to more advanced capabilities on the phones. This example had the students create a game where they had to sense the phone’s orientation using the gyroscope sensor, and then try to use that information to get a ball to go into a goal. This example exposed the students to phone sensors and gave them experience in managing and switching between multiple phone screens.

After the Thunkable training/tutorial sessions, the students were instructed to work on creating the apps they had designed in Figma. The students were allowed to work on their apps for most of the morning on Day 4, along with any other spare time they had in the camp.

3.2.4 Camp Content: Stadium Tour

On the afternoon of Day 3 of the camp the students and camp leaders were treated to a tour of Fiserv Form, the arena where the Milwaukee Bucks play their home games. This was a highlight

of the week. The tour included several luxury boxes that are not open to the public on game days. The Bucks also showed the technology room that manages all video for the games, graphics and sounds for the various displays in the stadium, and that controls replays and saving video for the team to review later. Another highlight of the tour was getting to see the home team's locker room. Finally, the tour concluded with a panel discussion of team representatives that discussed how STEM is used in the team organization, and how diversity plays into the organization's goals and policies.

3.2.5 Camp Content: Conclusion

The final day of the camp was dedicated to preparing the students to present their app designs to representatives of the Milwaukee Bucks and Motorola. The students were given a presentation template, time to fill it out, and then time to practice their presentations. Each group of students also practiced their presentations to all students in the camp. In the afternoon the students gave their presentations to representatives of the Milwaukee Bucks, Motorola, and any parents that attended. Any extra time between the presentation practice and the final presentation were dedicated to improving the student's apps.

In an exciting surprise for the students, after the final presentations Motorola announced that the students were able to keep the smartphones they had been using all week. This was planned ahead of time, but the students were not told about keeping the smart phones until after their presentations to ensure devices were treated as instructional assets instead of personal devices.

3.2.6 Camp Evaluation

Overall, despite the compressed timeline, the camp was very successful. The Milwaukee Bucks and Motorola were happy with the interactions they had with the students, and happy with the designs that the students produced. The community organization enjoyed the camp and appreciated the STEM introduction it gave to the students. The university staff and faculty also felt that the camp went well with the two major challenges being the limited time of the camp (only 4 days) and the complexity associated with having both middle and high school students. The high school students were able to complete the open-ended design tasks, while the middle school students struggled with the same tasks. The high school students were also able to pick up the different design tools very easily (Figma and Thunkable) while the middle school students struggled transition between the different tools. As a result, the university staff and faculty proposed limiting the camp to just high school students and significantly extending the length of the camp to 8 days. All partners were supportive of these changes, and they were implemented the following summer.

3.3 Summer 2023: Third Camp Iteration

The third iteration of the camp ran the summer of 2023 and leveraged the lessons learned from the previous iteration, while keeping the same overall problem statement: design an app to drive fan engagement with the Milwaukee Bucks and let the students interact and develop a solution with Motorola smart phones. Additionally, a private registration page and marketing flyer was developed by MSOE for ALIVE Milwaukee. Both items contained specific information about what interests students should have to attend the program, age requirements, and what would be

covered in the camp. Motorola again provided smart phones for the students to use during the camp.

3.3.1 Camp Outline

The camp followed an expanded model of the 2022 camp. Curriculum was broken into two primary legs – design thinking and technology modules. The students would no longer develop their app idea in a visual programming language but would instead limit their work to designing an interactive prototype of the app in Figma. The extended time and slight change of content allowed the camp to go deeper into the app design, while at the same time free up the technology modules to cover a wider range of topics compared to the previous iteration. The Bucks again hosted a half-day tour of their stadium, and again had a panel discussion about how STEM is used in their organization and about the team's commitment to diversity. A new element of the camp was a whole day field trip to Motorolas 312 Labs [24] research and development facility in Chicago, IL.

The high-level schedule for the camp is shown below:

Day	Morning	Afternoon
Day 1	Ice breakers and introduction to problem statement	**Tech Module 1:** 2D Game Development
Day 2	**Tech Module 2:** Phone Technology	Tour of Bucks Stadium
Day 3	**Design Thinking 1:** Ideation	**Tech Module 3:** Machine Learning
Day 4	**Design Thinking 2:** Sketching	**Expert Panel**: Students collect feedback from Bucks and Motorola representatives
Day 5	**Tech Module 4:** Biometrics	**Design Thinking 3:** Prototyping in Figma
Day 6	Tour of Motorola's 312 Labs – Chicago, IL	
Day 7	**Design Thinking 4:** Prototyping in Figma – refining designs	
Day 8	**Create Presentation and Practice**	**Present**: Deliverables to Sports Team

Figure 3: Schedule for the third iteration of the camp (2023). The orange background are design activities, the green are tech modules, and the gray are general camp activities.

3.3.2 Camp Content: Design Thinking
The UX faculty leveraged the same curriculum as the 2022 program with some changes aligned with the scope of both a longer program and more engagement from the technology partner. Faculty once again used design thinking and design sprint activities and concepts to take students through ideation, sketching, and prototyping. While some minor curricular changes were made, the newest component was the opportunity for students to get into the testing stage of the process.

Students prepared their prototypes to be ready for testing at Motorola's offices in Chicago. This trip was a major addition to the camp from the previous iteration. The students were treated to demonstrations of Motorola's latest products – including some that were only prototypes that might never be released! While on site, Motorola's UX and design team provided a brief lesson in their design process. The students were then able to practice the part of that design process that related to getting and giving feedback. The student groups were paired up, and then they briefly presented their design to the partner group, and then the partner group provided some simple feedback to the presenting group. Finally, the roles were switched so that both groups presented and provided feedback to the other group.

3.3.3 Camp Content: Technology Modules
Similar to the second iteration, the camp included a second parallel track aimed at exposing students to various technologies. The goals of these "technology modules" were two-fold: (1) provide hands-on learning experiences in a range of technology areas, including areas of interest to the project stakeholders, and (2) provide inspiration for ways in which the students might include relevant technologies within their app design.

The camp included a total of four technology modules spread throughout the two-week schedule. The activities included 2D game development, an exploration of some of the sensors available on a smartphone, a hands-on introduction to and activity with machine learning, and an exploration of biometrics. The programming for the 2D game, machine learning, and biometrics used the mBlock [25] programming environment. Any phone app development was done using MIT App Inventor [26]. Thunkable was used in the second iteration of the camp, but the faculty made the switch because MIT App Inventor was judged to be more user friendly. The 2D game was a simple "asteroids" style game that one of the EECS faculty taught the students how to create by having them follow a live step-by-step example. The phone sensors activity had the students explore the gyroscope on the phone and then make a simple program where a ball on the screen moved in response to the phone orientation. The machine learning activity had the students train a robotic hand so that it learned the hand motions for "rock, paper, scissors", and could mirror the motions the students made. Finally, the biometrics activity had the students use a simple heartbeat sensor to detect and plot their heartbeat in real time.

3.3.4 Camp Content: Conclusion
After the student's prototypes integrated feedback from Motorola into their designs, the students prepared their final presentation. Students practiced their presentation a faculty member and a mentor, who provided feedback on delivering a professional presentation. These final presentations were then delivered to representatives from the Milwaukee Bucks and Motorola. After each presentation, the stakeholders (Milwaukee Bucks and Motorola) asked questions to

learn more about the app and they also had time to “play” with the app and discuss the concepts more in-depth with the students in their groups.

A student-stakeholder-faculty celebration was the finale of the two-week camp. During the celebration Motorola surprise gifted the smart phones used during the camp to the students to thank them and to celebrate the great work over the past two weeks. And, of course, there were cupcakes!

3.3.5 Camp Evaluation

ALIVE Milwaukee made significant changes to the student recruitment process for this iteration in an effort to expand student access to the program. These changes resulted in new, unexpected challenges. The first challenge was that over half of the registered students did not arrive for the first day of the program, and when contacted on the first day, indicated they would not be attending. The second is that, even with detailed marketing describing the content of the camp, nearly half of the students who attended the first day had a misunderstanding of what the camp was about and after the first two days either did not return or were asked to leave due to behavior issues. To fill the gap, ALIVE Milwaukee quickly recruited additional students with demonstrated interests in STEM to join the camp. This helped add interested students to the roster but added additional challenges as faculty had to re-present content to get the new students up to speed. This confluence of challenges meant the camp ran with 9 students, which was only half of its capacity of 18 students.

Despite these challenges with student retention and participation, the partners were all generally pleased with the camp results and remain committed to producing a high-quality STEM camp for underrepresented students. The students produced interesting ideas to enhance the Milwaukee Buck’s app to drive fan engagement. The tours of the stadium and R&D facility were highlights for both the tour hosts and for the students. Anecdotally, the students enjoyed the Tech Modules. One student reported that they were considering engineering as a career field, and another student, after completing a Tech Module that created a simple 2D game, went home and recreated the game from memory to show their parents. The longer 8-day format was also beneficial because it allowed for more time to achieve the goals of the participants.

Even with the challenges mentioned above, the fourth iteration of the camp is on the calendar for July 2024, and no significant changes to the camp content or schedule are planned.

4. Challenges

There were various challenges experienced in all iterations of the camps. These can be broken into a few distinct categories: student recruitment, logistics and scheduling, and volunteer engagement.

4.1 Student Retention and Recruitment

All iterations of the camp were externally funded and were therefore free for the students. As the MSOE STEM Center has found with all free programs, this resulted in fewer students attending the camp than had signed up. This is disappointing to the organization providing the funding

because it means that the money they spent to have the faculty develop the content of the camp did not go as far as it could have.

Student interest and understanding of the program was a secondary contributor to poor retention. In each of the iterations with the Milwaukee Bucks (second and third iteration), many families signed their students up for the camp thinking it was a basketball camp – even when clear information was provided on what the program entailed. If a student has no interest in STEM, especially in technology and design specific to this program, it is difficult to engage them in a camp. As a result, behavior issues such as distracting other students, not wanting to engage positively with program personnel, and inconsistent attendance tend to be more prevalent. While some students left on their own accord, some students did not continue the camp due to difficult conversations with families and students about not returning to camp.

The university indicated to all partners that an application process of some form will be required for any future camps, regardless of whether or not there is an enrollment fee, to ensure students know what they are signing up for and to help provide a structured process to check interest. The Milwaukee Bucks would also like to open the opportunity to more students, versus limiting to one community partner, which necessitates a centralized process owned by the university to ensure consistent recruitment practices among organizations and students invited to the program.

An additional topic around student recruitment and retention is trying to bring more summer program style fun elements to the program. Ideas have included awards at the end of the program or, for students who do exceptionally well, one-of-a-kind opportunities like shadowing days at the Bucks or eligibility for internships.

4.2 Logistics and Scheduling

The introduction of the field trip to Motorola was a highlight for everyone in the program. Due to travel time to Chicago (about 1 hour and 45 minutes), for the next iteration of the camp the partnership would like to extend the time window for the day of the field trip to allow for more time spent in the city. The other field trip to the Milwaukee Bucks facilities is also a highlight, but faculty have recommended framing this tour as a research visit to provide more structure around the experience and to have students tie it into their projects.

Core content led by faculty went very well, especially the technology modules being dispersed throughout the program. Faculty noted some sessions that did not go as smoothly as intended were hard to discern the root cause of: were they not smooth because the students weren't interested, or were they not smooth because of the session itself? Ideally, with the right student mix for the next iteration this will become easier to discern.

The faculty are hoping to work with the Bucks and Motorola to migrate towards a more specific problem statement. An intentionally broad problem statement has been provided the last two iterations with the idea it would enable students to explore the topic in their own manner. The student mix has shown that most students attending need a little more structure and specific bounds to operate within for their projects.

Lastly, all partners would like to see the program continue to grow. Along these lines, activating final presentations and other elements in the Bucks facilities to bring in a larger audience has been expressed as something to explore for the next camp iteration.

4.3 Volunteer Engagement

Having volunteers from both the Milwaukee Bucks and Motorola each year is a significant asset. One lesson learned each year is finding ways to integrate volunteers at the right point in the program and in the right ways.

Volunteers from the Bucks expressed that they liked being a part of student ideation sessions early in the program and enjoyed hosting the students at their facility. One lesson learned from the Bucks was the need to internally prep their volunteers to engage with the students. Some volunteers weren't expecting to speak to the students, ask questions and dig into the student work with them and this added some logistical hurdles to getting the volunteers situated upon arrival.

Volunteers from Motorola had a great experience hosting the students at their facility. They would like to have more time with the students and have been ideating on ways to expand the interactive pieces for students in 2024 including presenting skills, prototype testing and feedback, and other topics.

5. Takeaways

The experience of putting on the camp has been full of opportunities and challenges, and continues to evolve moving into the fourth STEM camp. Overall, though, there are five key take takeaways to share as follows:

1. *The value of partnerships is in the expertise of everyone, including students.*
   Each partner brings unique expertise to the program, which is the true value of the collaboration between organizations. For us, our faculty brought expertise in human-centered design, programming, and machine learning, while our partners brought a strong background in marketing, app development, and the cutting-edge devices. It is advisable to have early conversations to understand each party's expertise to make it easier for individuals to stay focused within their wheelhouse and not overlap work. Additionally, it is important to understand that students are also key partners, and their interests and knowledge are important to the overall success of the STEM camp. By recruiting the right students, it is easier to create program curriculum to meet their interests. By understanding the collective expertise of the group will help to set expectations and define guidelines for the types of students that are a good fit for the camp.

2. *Open and honest conversations are needed early and often.*
   Open and honest conversations can be hard, but they are important to the success of the camp and should happen early and often. These conversations are the foundation of the partnership between each organization and keep the relationships strong by fostering transparency, trust, and sets clear expectations for what can be accomplished during the camp. In our third iteration of the camp, we moved from one week to two weeks and although we had four more days, there were still limits to what we could include in our curriculum. Additionally, students benefit from a steady drumbeat of open and honest

conversations which help to clarify the scope of camp, expected behavior, and outcomes of their work. During the third iteration of camp, we had to discuss the motivations and behavior of our students as a result of feedback from the Bucks after interacting with students. Crucial conversations may also be needed along the way with students and partners if expectations are not met, which help to address any unexpected issues.

3. *Flexibility and responding to change are important to the program's overall health.* Flexibility and responding to change are natural components of the maturation of the camp overall. It is everyone's responsibility to keep track of challenges and opportunities that may arise, bring them to the table, and offer solutions that may be implemented real-time during the event or in subsequent iterations of the camp. After each day of camp, the STEM center and faculty checked in with each other to see how the day went and if any adjustments were needed for the next day. This was done via email and/or text, which was helpful because not all faculty members were present for all parts of the camp. Additionally, at the conclusion of camp, we set up time up time to discuss and document our overall lessons learned to carry forward to our partners, which then gave us ideas for camp enhancements, which required changes to curriculum and format for future iterations, which require additional time and budget. Overall, we recommend building a flexible approach to program development with a responsive curriculum and responsive teaching style. By building in flexibility to the program, you will help students to engage more deeply with the program's content and to ensure partner's goals are met.

4. *Delivering quality STEM programs requires a significant investment.* STEM programs require an investment in both time and money and should be discussed and estimated early in the partner discussions. It is important to understand that it can take months to plan for a one-to-two-week STEM event, even if the camp has been run multiple times. This is especially true for a program that runs a comprehensive, interconnected curriculum versus one with exploratory, standalone activities. Faculty should be fairly compensated for this time. The university STEM director helped keep track of budget and advocate for additional funds for faculty to allow them to stay focused on creating high-quality curriculum and ensure that there were no monetary surprises for the partners that are paying for the event.

5. *Make the camp real by having a tangible project for students to deliver*. Tangible projects make STEM real for students. In this case the camp had the students designing an improvement to a real phone app for a real professional basketball team. A tangible and real project helps to keep the students engaged in the project, and it helps to provide a framework to explain why different topics are covered in the camp. A real project also opens up the type of topics covered in the camp beyond traditional STEM activities to include human-centered design. In addition, it fosters excitement, sense of accomplishment, and provides students with a project they can include in a college application.

These takeaways have remained consistent throughout each camp offering. Entering the next iteration of the camp in the summer of 2024 will provide a renewed focus on these takeaways and a chance to further improve the camp to focus on value to the students and partners.

6. Conclusion

This paper presented a unique partnership across four very different organizations that resulted in a one-of-a-kind summer STEM camp for minority middle and high school students. The last two iterations of the camp presented the students with a unique problem to solve that was driven by the Milwaukee Bucks and allowed the students to interact with representatives from the Bucks and Motorola. The camps had a dual focus of app design and exposing students to different aspects of technology. During the camps the students also went on tours of the Bucks' stadium and Motorola's research and development facility. The combination of the partnership between the organizations and the camp content resulted in a one-of-a-kind STEM camp for underrepresented students to help motivate them towards a career in STEM.

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