Understanding Parents' Perceived Barriers to Engaging Their Children in Out-of-School STEM Programs

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Abstract— **To encourage youth from diverse backgrounds to participate in science, technology, engineering, and math (STEM) fields, it is important to take an ecological approach. Outside of school, parents' values and knowledge have a strong influence in the development of their children's learning in STEM related fields. Based in Digital Youth Divas (DYD), an out-of-school time (OST) STEM program for underserved middle grade girls in Evanston, IL, this exploratory study examined parents' decision-making process when selecting OST STEM programs for their children. We facilitated a parent workshop and conducted interviews with five parents of DYD participants and two staff members. Participants in the study expressed preferences for programs that are free, situated in locations that are easily accessible, and run by highly regarded educational institutions. Parents also identified barriers to participation such as the lack of a parent network, conflicting schedules with other OST activities, and difficulties in understanding the term "STEM". These results suggest several recommendations for programs to address these barriers, such as designing intriguing program flyers, fostering a parent network, and providing accessible program locations. For researchers and designers of OST STEM programs, this study highlights the importance of taking a family and community-based approach to understanding parent perceptions and challenges.**

Keywords—out-of-school STEM program, learning ecosystem, parents, barriers

I. INTRODUCTION

Mirroring computing related college majors and careers, out-of-school time (OST) STEM programs are filled with a majority of males from dominant populations [1]. To enhance equity in those fields, it is important to invite more youth from underrepresented populations (e.g. girls, ethnic minority populations). In an ecological view of learning, learners are strongly influenced by the environment around them, including the people they interact with, resources they encounter, and various physical and virtual spaces where they spend time [2].

Home is viewed as an influential environment in a child's learning ecosystem. Parents' values, knowledge, and interests have a huge impact on their children's learning in STEM fields [3], especially in how they consider and decide to enroll in programs. Despite the increasing number of STEM programs targeting underrepresented populations in those fields, underrepresented groups of youth still face difficulties participating in them. The research focus in this study is identifying what types of barriers parents perceive when they consider OST STEM programs for their children.

II. BACKGROUND

In the concept of Activity Theory, an ecological system consists of a microsystem (individual environments), mesosystem (interactions of two or more micro environments), exosystem, (an outer level operating indirectly on the environment), and macrosystem (outermost level defining the global context). Each system is situated in a broader context of networks of interacting systems [4]. Given their interconnectedness, changes in one system cause changes in another. According to Barron, an ecological view of learning addresses how youth interests develop through dynamic interaction across spaces of home, school, and community [2].

Scholars have been studying how, in home environments, parent involvement impacts youth interest, motivation, and persistence in STEM. Parent involvement in youth STEM learning could be challenging due to the fact that many parents may lack the expertise. However, one study indicated that the impact on youth success and persistence in STEM was not necessarily determined by parents' prior STEM knowledge [5].

Building parents' technological confidence, expanding family social networks, and encouraging parent-child collaboration on STEM invite new opportunities and resources for youth STEM learning [6]. Barron and her

colleagues also described various ways parents can support their children's STEM learning, such as collaborating with children on STEM projects, brokering new learning opportunities through relevant networks, and providing non-technical support [7].

Although an increasing amount of OST STEM programs have emerged, youth from ethnic minorities and female populations are still underrepresented in those programs. Prior research has identified structural barriers to participation, such as registration fees, a lack of transportation, competitive application processes, and inability to demonstrate preexisting interest in science [8]. This study extends prior literature by looking into potential barriers from parents' perspectives that can subsequently impact youth participation in such programs.

III.   METHODS

There are two parts of our study: a parent workshop and individual interviews. All the parent participants identified as either Hispanic, African American, or Asian and lived in an underserved geographical area.

We first facilitated a 120-minute workshop for nine parents (6 females, 3 males) of eight girls in DYD (see Table 1). The workshop took place at the same time as one of the DYD sessions in MetaMedia, one of the arts-focused community centers in which DYD was held. The workshop sought to spark conversations between researchers and parents about the role that parents (which we define as guardians and primary caretakers) played in their children's learning. We also wanted to give parents an opportunity to share their feedback and experiences with the program and begin to identify barriers they faced when enrolling their children in DYD. Throughout the workshop, we took field notes, which we then used to inform our interview protocol design. We recruited workshop participants for individual interviews at the end of the workshop session.

Using the Activity Theory framework and the insights we collected from the workshop, we created interview protocols for parents and staff members. We later conducted interviews with five parents of five girls and two DYD staff members (see Table 2) to understand parents' perceptions that could impact OST program selection. Three of the interviews were done in person in a quiet lounge at MetaMedia, and two were conducted over the phone. Four of the interviews were conducted in English, and one was conducted in Mandarin. Interview questions for parents centered around their program selection process and challenges they faced when engaging their child in DYD, as well as how they engage with other parents in their community and within the context of Divas.

We also interviewed two DYD staff members. The interview questions for staff members focused on identifying instances where parents declined to or were not able to enroll their children in DYD as well as observed parent behavior at DYD open house events.

We audio recorded all the interviews and manually transcribed them. Using an inductive coding method, we analyzed and synthesized the qualitative field notes and interview data and developed themes that emerged from our research question.

TABLE 1. WORKSHOP PARTICIPANTS

Total Participants	9
Gender	6 women, 3 men
Language(s) Spoken	8 English, 1 Spanish and Mandarin

TABLE 2. INTERVIEW PARTICIPANTS

Interviewees	Number of Participants	Gender	Languages Used
Parents	5	3 women, 2 men	4 English, 1 Mandarin
Program Staff	2	2 women	2 English

IV. RESULTS

This section summarizes results from analyzing our field notes and interview data. In our findings, parents identified several major barriers they faced when considering STEM programs for their children.

Affordability and location accessibility were the two main factors mentioned. All the families we interviewed were economically underserved. One parent remarked, "I like that it's free, that's important. I'm a single parent and resources get really tight." Location was also critical as parents are often the primary transport for middle-school aged children, balancing their children's OST activities with other commitments. For example, one parent stated, "Accessibility, sometimes you know the travel or commute to and from are difficult for parents."

Parents encountered difficulties in understanding what the acronym "STEM" means and what kinds of activities these programs involve. They expressed that they would often not pay attention to advertising for STEM programming because they did not have prior knowledge of what the acronym stood for and were looking for a simple and clear explanation of what it involves, with one parent stating that "[OST program advertising] isn't giving me a visual of what STEM is." Another parent said, "I can only recall it just saying STEM. I can't tell what it said...It's cute but what is STEM?"

In addition, unattractive promotional materials and an overwhelming amount of information were concerns. One parent expressed that they did not have time to dig into some of the information about programs they received due to the sheer volume of it, saying "We get bombarded with information from the school. Sometimes you put it in your

delete folder." Another parent explained, "If the text font or the image doesn't draw my attention, I probably won't even look at the details on the flyer," while another suggested, "Make a little 30 second visual presentation and send out the link so [parents] can get a visual."

Conflicting schedules with other activities proved to be another significant barrier, with one parent sharing that they struggle to make DYD work for their child because of its Saturday sessions: "Unfortunately, Saturdays are popular for extracurriculars, leisure as well...We are signing up for too much stuff, after school programs, they go to the Y, have swimming, so it's non-stop, there's always something."

Parents in this study found it hard to make time in their schedule to network with other parents and build a strong parent community, even though they expressed that they found it to be beneficial, as they often hear trustworthy recommendations about opportunities for their children from other parents. One parent said, "We have to get information from other parents, since we've only been here for a couple of years. Communicating with other parents, we will know of some events or activities or some benefits for kids. Most of the information it's from other parents...I just don't have time."

Our interviews with parents also illuminated some additional criteria that, while not being explicit barriers, impact their selection of OST programs for their children. Parents seek out and commit to programs based on their children's interests. Parents shared that they do not typically try to persuade their children to join particular programs, but rather are guided by what their children express an affinity towards. One parent remarked, "It really depends on whether they are willing to come or not." Parents also emphasized the learning aspect in OST STEM programs, expressing frustration with previous experiences in programs that lacked academic structure. One parent mentioned the importance of curriculum in a program, "Just have an actual curriculum, something that she's going to learn, something that benefits". Parents also prefer programs that are run by higher educational institutions. When asked about programs that are facilitated by their child's elementary school, a parent shared, "[As opposed to elementary school], we will pick one in middle school or high school that we think will provide a higher quality program."

V. DISCUSSION

Given the low participation rate of ethnic minority groups and girls in OST STEM programs, understanding what might keep them from enrolling in a program is critical to addressing this problem. The findings of this study support some findings from our literature review. For example, fees are one of the top factors that prevent some youth from participating in programs. Our findings also extend the literature, indicating that barriers like inaccessible locations, difficulty in understanding the term "STEM", lack of a parent network, and conflicting schedules with other extracurriculars can also prevent parents from engaging their children in those programs. Furthermore, this study provides implications for DYD and future studies by suggesting ways that program facilitators can better design their offerings to recruit and retain children in their target demographic.

A. Implications for DYD

To attract more parents' attention in emails or flyers, it is necessary to emphasize elements they care about an OST STEM program, such as being free or reasonably priced, operated at a convenient location, run by trustworthy academic organizations, and implementing a curriculum and hands-on learning. Regarding information presentation style of promotional materials such as flyers, using images to display girls' projects and an explanation of the program narrative can help to clarify what the program is about and what girls' experience might be like in it. With these design decisions in mind, parents will be less likely to feel confused about what the term STEM refers to and will have a better understanding of what the program entails.

An important area DYD has been focusing on in program development is the concept of the parent network, which provides parents with a space to network, share resources, and help their children. Our results suggest that DYD should create more opportunities to foster a parent network, such as workshops and social events. When asked "What do you think could be done to foster more community among parents?" one parent said, "Last time, the school organized an activity where parents come to school to have lunch with students. Then, there's time for parents to meet each other and talk." Because many parents have full schedules throughout the week, creating networking events that are already built into regularly occurring weekly activities can make them easier to attend. Additionally, DYD should keep looking into how to use social media to help connect parents, how trustworthy the information shared among parents is, and what communication channels parents feel comfortable using.

Another avenue of research that could be pursued is assessing what other kinds of OST programs the target youth in the area are already involved in. By identifying popular activities and practices among a particular community, program facilitators can better schedule their own sessions to accommodate for the issue of program conflicts. Furthermore, partnering with community centers (e.g., churches, libraries) and other programs (e.g., YMCA, Y.O.U) can help not only to promote DYD but also support youth's learning ecosystem, and even solve the problem of conflicting schedules. By having a presence in these communal areas, programs can better target the populations they are looking to recruit and make it easier for youth to attend because they are already spending time in those spaces.

B. Limitations and Future Research

This study has some limitations that will help inform future research. First, the sample size used is very small and not representative of the entire population of DYD. It will be beneficial to interview more people for a better understanding of this topic. Also, parent interviewees were from the same group of people who attended the parent workshop. We believe that parents who were not able to attend the workshop will be able to provide more insight as to the barriers that parents face, as they have more difficulty attending DYD events. In addition, interviewees, all of whom were either Hispanic, African American, or Asian were all from one neighborhood, so it will be helpful to talk to people in other demographic groups, communities, or cities.

The parents in this study have at least one child that was already in a STEM program. While they have expressed that they experienced difficulties and barriers when trying to engage their children in out-of-school programming, they were able to overcome some of the barriers in this instance. Conducting interviews with those who have been trying to but have not been able to enroll their children in OST STEM programs or have never thought about engaging their children in those programs will be useful in providing a more comprehensive view regarding this matter.

In this study, we interviewed only parents and staff members. According to the Activity Theory, perspectives of other stakeholders such as youth, siblings, mentors, and program leaders should also be taken into consideration for a more comprehensive understanding of barriers to participation.

We were not fully prepared for interviewing participants whose native language is not English. Fortunately, we had a native Mandarin speaker on the team who was able to conduct the interview with the parent who only speaks Mandarin. In the future, we should ask interviewees' preferred language for their interview and prepare for a translated protocol as needed.

Lastly, we did not have any photo or video documentation from the workshop. In the future, we will take photos or even record audio, especially during events like workshops, which may reveal unnoticed findings later on and provide context to others who may not be familiar with the program.

VI. CONCLUSION

This work identified barriers that parents face when they consider enrolling their children in OST STEM programs, such as high fees, inaccessible locations, conflicting schedules with other activities, an overwhelming amount of emails about programs, and difficulty in understanding the term "STEM" or program activities. Additional insights were identified surrounding aspects of programs that parents value, including having subject matter or activities that are interesting to their child, affiliation with highly regarded educational institutions, and an emphasis on curriculum. To

better recruit and retain youth from populations that are underrepresented in STEM fields, designers and researchers of these types of programs must consider and address these challenges and aspects in their recruitment strategies and programs design.

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