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The Impact of participating in an Afterschool Professional Training Program on Youth Employees

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The Impact of Participating in an Afterschool Professional Training Program on Youth Employees (RTP)

1. Introduction

Afterschool STEM training programs for youth provide valuable opportunities to learn hands-on, real-world technical and social skills and develop STEM career interests [2,21]. However, many youths, especially in urban contexts, face financial pressures and may instead take afterschool jobs in non-technical fields such as food service or retail [5,30]. Paid out-of-schooltime (OST) professional training programs that can offer youth learning experiences while earning an income can meaningfully engage youth in STEM learning. However, understanding how to design, implement, and evaluate these programs can inform future innovative ways to engage youth in technology-rich learning and motivate them to pursue technical career pathways [2,13,21,31]. Furthermore, it is important to understand how youth experience these programs and reflect on their own learning. Research has long recognized the educational value of technology-rich making activities, such as 3D modeling and printing, physical computing, hobbyist robotics, among others, for engaging youth and adults in self-directed STEM learning activities [4,9,23,26]. Many aspects of making echo key principles in engineering education as recently articulated in the Framework for P-12 Engineering Learning [1], which recommends leveraging making as a form of active learning. Despite interest in this area, research still needs to investigate how to design and implement technology-rich training opportunities that motivate youth from diverse backgrounds to participate in meaningful technical work and what the impact of such experiences is.

In this study, we collaborated with a community partner that provides technology-rich learning experiences for youth to set up an afterschool professional training program involving running a 3D printshop for youth focused on digital modeling and fabrication. Over two years, two cohorts of youth (a total of 12 participants) participated in the project and worked at the 3D printshop at tasks that included interacting with clients from the local community, completing 3D modeling and 3D printing tasks, maintaining digital fabrication equipment, and representing the printshop at different outreach events. In this paper, we report on findings from qualitative exit interviews with the youth and focus on understanding the impact of participating in the program from their perspectives.

In this research, we pursued the following research questions: (RQ1) What are the motivations of youth for participating in an afterschool technology-rich professional learning program? (RQ2) What is the impact of participating in professional learning programs on youths' STEM career interests and long-term career plans? (RQ3) What are the youth's own reflections about their professional strengths and important experiences during training?

Our findings show a range of motivations for youth to interview for the experience, including family and peer support, interest in learning skills, affinity for the organization, and desire for income. Additionally, we found that the experience increased youths' confidence in their ability to pursue technical careers, including those in digital fabrication, engineering, and management, and demonstrated a career path that can be both technical and rewarding. Youth also described learning how to effectively troubleshoot different issues and collaborate with others to address problems as skills they gained during the program. Finally, youth described how their communication skills and ability to work in a team had significantly improved through the

program and described how specialized roles helped them stay motivated and engaged by learning new skills during their experience. We conclude with several recommendations for creating similar future professional development programs for youth.

Next, we present a literature review, before describing our methods, including the work training program, the site, participants, and data collection and analysis methods in detail. We then present our qualitative findings, followed by a discussion of the lesson learned and the study limitations, and future directions, before concluding.

2. Literature Review

Previous research has shown that participating in afterschool and out-of-schooltime (OST) learning programs result in increased self-reported STEM interest, engagement, motivation, persistence, and identity [8,11,33]. The results are significant as studies of college course enrollments, major selections, and long-term degree and career obtainments have repeatedly shown the importance of positive STEM attitudes as key success factors [20,22,24,27,28]. Additionally, supporting the growth of STEM attitudes can create new pathways to STEM careers for underrepresented populations, including girls, low-income youth, and youth of color [25]. Furthermore, STEM interest and engagement are closely linked to STEM identity [10], which itself is strongly linked to the depth of learning in STEM [3,29]. While assessing the impact of technology-rich maker programs in informal contexts at scale remains a challenge (e.g., [14,15]), previous qualitative research on these programs has shown their significant potential in engaging underrepresented youth and resulting in positive outcomes [6,8,11,16,17,33].

A significant and ongoing challenge in enabling youth participation in afterschool programs is the presence of financial pressures that can result in them deciding to instead take afterschool jobs in non-technical fields [5,30]. With increased recognition of the need for long-term investment in the technical workforce of the future and the ongoing cost of perpetuating inequitable access to high-quality STEM learning experiences, it is worthwhile to implement and study pay-to-learn programs that explicitly address these pressures on youth and their families. Additionally, while most research has focused on conducting maker activities in the context of informal learning programs (e.g., [4,9,23,26]), it is unclear how structuring these programs as paid job training experiences would impact youth's experiences. These experiences are distinct from non-work-related learning programs as, in addition to technical skills, they require youth to develop social skills related to employment, including being responsible for completing tasks necessary to complete client orders, reporting back to supervisors, and communicating with other co-workers, and managing time to ensure overall workplace efficiency.

3. Methods

3.1.Research Context: The 3D Printshop

Our research took place at a youth-staffed 3D print shop (Figure 1) housed at the Digital Harbor Foundation (DHF), a center for afterschool technology-rich learning and professional training. DHF is an educational non-profit and youth makerspace in a mid-sized East Coast American City. At the time of the study, DHF served over 1,400 youth from diverse socio-economic backgrounds through after-school and summer educational courses, hackathons, and field trips. In January 2017, the 3D print shop opened at DHF as a technical employment opportunity and workforce training program for local youth. The shop was in operation until the beginning of the COVID-19 pandemic, which resulted in its closure. During its operation (and the course of our

study) the 3D print shop offered a variety of services to clients, including 3D printing, 3D scanning, and 3D design. Youth employees were paid hourly to complete various tasks, ranging from printing giveaways for public events, to collaborating with physical therapy students to develop custom assistive devices for individuals with disabilities. Each job request can vary significantly in complexity (e.g., how many things need to be made, how much design work is needed) and difficulty (e.g., how hard something is to fabricate and assemble). Work was completed using a variety of consumer-grade technical resources, including 12 3D printers, and a 3D scanner -- most of these pieces of equipment required different specialized pieces of software to control.

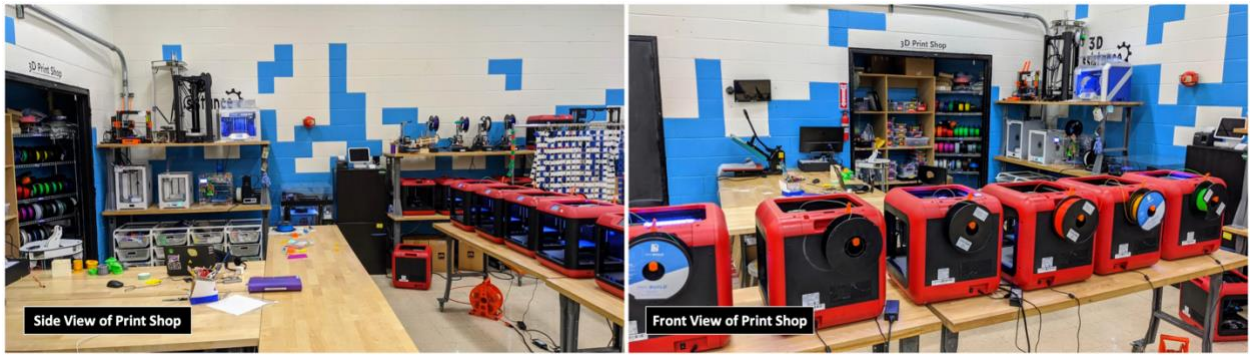

Figure 1. The youth 3D print shop was located next to a shared space where youth programming took place and housed a variety of 3D printers, 3D scanners, and other digital fabrication tools and materials.

The print shop offered a variety of services to community clients, including 3D printing, 3D scanning, and 3D design. Youth employees were paid hourly. Completed work ranged from printing giveaways for public events to collaborating with physical therapy students to develop custom assistive devices for individuals with disabilities.

3.2.Youth Participants

Over the course of its operation, the print shop employed 12 youth from diverse backgrounds across two cohorts (Table 1). To be hired, youth had to be at least 14 years of age (to obtain a work permit), complete a job application, and participate in a hiring interview. After approximately 16 months of employment, cohort one, with the exception of P2 and P6, were transitioned out of the print shop, and a new group of employees was hired. P2 and P6 were retained as senior employees who could help mentor their new co-workers. While most employees worked in the shop for at least one year, there was an expectation that some may transition out of their roles sooner to participate in other extracurricular activities or upon graduation from high school.

All youth hired to work in the print shop were informed about our research during their on-boarding process. It was explained to them that participation in our study was optional and that the choice to participate -- or not to participate -- would have no impact on their employment status at the center.

Table 1. This table provides information about the youth participants who were hired in two cohorts. P2 and P6 were hired in cohort 1 and remained in cohort 2 as senior employees.

ID	***Age***	***Gender***	***Months Worked***	***Cohort***
P1	18	Female	7	1
P2	17	Male	35	1
P3	17	Male	18	1
P4	16	Male	12	1
P5	16	Male	15	1
P6	15	Female	35	1
P7	15	Female	18	1
P8	15	Female	18	1
P9	16	Male	18	2
P10	15	Female	18	2
P11	15	Male	8	2
P12	14	Female	18	2

3.3.Data Collection and Analysis

We conducted exit interviews with each cohort, in which we asked them about a variety of topics, including asking them to reflect on their career interests, skills developed while working in the print shop, and challenges and experiences collaborating at work and using digital coordination tools. In this paper, we focus on findings on motivations and impact and discuss other findings about coordination and collaboration elsewhere. Two youth employees (P1 and P11) joined the cohorts later than others making their work experience shorter, but we decided to also interview them.

The second author conducted all interviews with participants, taking notes during the interviews and making audio recordings with the consent of each participant. Audio recordings from all interviews were fully transcribed. Transcripts were open and axially coded through an iterative process with two coders to identify common themes. To ensure consistency between both coders, one interview was independently analyzed by both coders. They then met to reconcile differences in their coding approach and develop a shared list of codes. Both coders then independently analyzed a second interview using the shared code list and met a second time to reconcile any remaining differences before independently analyzing the remaining interview transcripts.

4. Findings

In the following subsections, we present our findings along four overarching themes. We use extensive quotes from the youth to both illustrate their perspectives and also represent their voices as an important aspect of the research. We have tried to avoid drastically editing the participant quotes to preserve youth voices as much as possible. Table 2 provides a summary of our main findings.

Table 2. An overview of our findings from the study

Motivations: *Youth were motivated by family and peer support, interest in learning skills, an affinity for the organization, and desire for income.*
Career Interest: *Youth identified specific STEM careers to pursue in the future, including advanced manufacturing, mechanical engineering, electrical engineering, computer-aided design, mixed media, medical technology, and graphic design.*
Memorable Experiences: *Youth found technical and social achievements, sharing of experiences with others, appreciation of co-workers, and community building as the most memorable aspects of the experience.*
Comparison with other Employment: *Youth saw the technical skillset they acquired and practiced and the social connections they fostered in the training program as distinct from other available employment opportunities.*

4.1.Motivations for Pursuing Technical Jobs

Youth employees expressed having a range of motivations for pursuing the professional training opportunity, including family and peer support, interest in learning skills, an affinity for the organization, and desire for income.

Most of the participants had first heard about the professional training when taking courses at DHF and decided to apply because they enjoyed the material they were learning in these courses and the general atmosphere at DHF. For example, P2 said that they liked taking technical courses and training programs at DHF before joining the print shop and was always looking at what other new learning opportunities are offered at the center. They said, "I took a picture of the poster [at the center, advertising the professional training program] on my iPod, and I sent it to my mother. I was like, hey, I would love to do this. … I interviewed very early… I was very ecstatic when I got the job. I remember I got the email from it on my computer when I came down. I told my family… It was fantastic, yeah!" P2 further said they were "excited" to get the job, "because it's always a chance to learn new and different tools or tasks. I really liked the environment of DHF. It was very enjoyable every single time."

Similarly, P12 said, "I remember, I actually started DHF in a 3D printing summer course, and I remember just enjoying it so much. I loved it and was like, oh yes, I love studio modeling. It's so much fun. And then, the application came out for 3D print shop. It was like, oh yes, I want to learn more about this! Like, want to do this. This seems fun." P6 also mentioned how they learned about the opportunity in another learning program at the center.

Many of the youth employees knew each other from other learning programs at DHF and for some of them, working together was a motivation to apply. For example, P9 said, "I knew that someone that was in my course … would be a fellow employee, at the time, before he became the manager now. So that was really cool. I'd know somebody that was there, which is really cool." P6 also mentioned that, among other factors, they decided to apply for the job because they were encouraged to do so by another employee at the shop.

Some of the youth in the second cohort who had seen the print shop in action when taking courses at DHF, were motivated to work there to learn in new ways. For example, P10 said: "I think just knowing kind of my interest in 3D printing and seeing that the print shop does nothing but that, for me that was a big motivation. Because, just as an employee, you do a lot of stuff that

[youth in other learning programs] don't really get to do…I'm a bit of a visual learner, so I like to learn by touching and being hands-on, and the 3D print shop is really that."

As is already clear from the above quotes, the motivation to continue to learn about 3D modeling and printing was important to the youth. The participants expressed several other motivations, for example, P7 said about considering applying for the opportunity: "I need experiences. It will look good on my college resume, and also, I'll learn new skills which is always valuable, and all other stuff, and my mom wants me to do it too." Interestingly, P9 also identified their mother seeing the advertisement email and encouraging them to apply as an important factor, signaling the importance of family support as motivation.

Several youths identified the opportunity to make money while learning an important motivation. For example, P12 said, "I was like, all right. Get paid to learn. Sounds great." The following comment from P8 describes how getting paid was a motivation that was amplified by others: "Well, my mom found, like saw the email [advertisement] … then I was like, wait, money! And also, at the same time I was like, I kinda like 3d printing, and I do wanna know more about it, so…"

Several youths saw the job as a step forward in their career trajectory. For example, P6 said of the professional training, "I saw it as stepping up and growing up and stepping stone in each one. And I've seen how those stepping stones can lead to something great. So I was like, yeah, I'm on my way." In line with this view, the possibility of advancement at the print shop, which was built into the program, was invaluable to the youth. For example, P2 described how they progressed from an employee to a specialist and then to a manager in the program: "So print shop, in general, was me taking a 3D printing printer build course with a JellyBox, which ours was the only JellyBox which worked. I was very happy about that…. [Becoming] a design specialist was me working with different types of 3D design programs like Inkscape or MeshMixer or Fusion 360 and just getting better at designing and design work in 3D environments… [when the manager position was offered,] It was not a forced move up but a welcome forced move up. I was just recommended to be the print shop manager. I went ahead and did an interview for it. We discussed terms and everything for it and worked with, like I said before, the transition chart about the different tasks and stuff I needed to learn and yeah, I got it."

4.2.Impact on Career Interests and Long-term Career Plans

When asked about their career interests after the program, the youth employees described a range of STEM-related career paths, including pursuing degrees in advanced manufacturing, mechanical engineering, electrical engineering, computer-aided design, mixed media, medical technology, and graphic design. Several youths mentioned specific position titles or career paths they would like to pursue, including manufacturing manager, running their own additive manufacturing business, being a graphic design artist, a manufacturing specialist, a machine specialist, a tech instructor, or an IT and app developer.

While a lot of the career interests were focused on skills and tasks that the youth had learned in the print shop, some of them wanted to go deeper into certain skills. For example, P6 stated that they would like to run their own digital fabrication business and provide services, with "laser printer, vinyl. I want to do a lot more with vinyl and graphics. But vinyl and then some laser cutting and some 3D printing." P6 further described how they felt prepared and interested in teaching tech skills themselves: "Teaching at a school, teaching here, just because those are the

types of skills that I have now. And not a lot of people have those skills, so they're still looking for them."

The youth had different responses when asked if working in the print shop changed their interests in technical fields. For example, P9 mentioned that they already had an interest in engineering but that working in the print shop helped them identify specific skills, such as CAD, that they would like to focus on. Similarly, P10 mentioned that working in the print shop strengthened their previous interest in developing their skills further. P10 stated that they would consider a range of careers, including technical ones but also others such as politics or architecture. When asked to elaborate on these choices, they mentioned that the motivation behind a technical career would be to "kind of better our neighborhood and community. Kind of branching off of thinking about a political career is that I'm really all for youth advocacy and stuff. They're just a lot of different problems in our city, and I hope that I would be able to use [my career] to kind of just better the world around me." P12 stated that their "career interests have changed because I've learned a lot more, like a lot more about different fields that involve technology in 3D printing. I never knew that medical 3D printing was a thing! … I was really interested in being a veterinarian, so I was always interested in working with animals… I think there's probably careers out there that would involve like animals and technology."

When asked about where they would see themselves in five years, most youths described being or completing a college degree. For example, P9 stated that in five years, they'd probably be "in college for some kind of mechanical engineering degree or classes in computer-aided design and things like that." P6 saw themselves in five years, "hopefully, graduating [from college] with a degree in advanced manufacturing or something similar. Possibly a minor in graphic design or business. And with a beginning starting my own company by doing simple vinyl cutting work and possibly 3D prints." P2 hoped to still work at DHF or somewhere similar and, more importantly, wanted to be independent: "Hopefully, living by myself, being funded through my own job." This desire for independence was repeated by P3, who also mentioned wanting to "taking care of my parents, along with having a steady job."

P5 also shared their dreams and aspirations through a combination of independence, enjoyment, and continued learning: "finishing college hopefully, successful, happy, still doing something that I enjoy, something that I like doing and I'm having fun, still be able to support myself financially and stable…I kind of have a big fear of, I guess, living like a boring life where I have a job that I don't enjoy, and I'm just miserable, so I want to be able to, you know, live life doing something that I do enjoy. I think that's very important to me because I can do something I enjoy and still learn and grow as a person." They further elaborated that working in the print shop gave them hope that they can do something they enjoy in life and still make a living: "I wanted to do something that I enjoy, but then I kind of have doubts of how I'm going to get there, what am I doing to do. I didn't really know, so the print shop kind of gave me that idea of like this is something that I enjoy, and you know, gave me the realism to what I have in mind."

4.3.Reflections on Memorable Experiences and Biggest Strengths

When we asked the youth employees to reflect on the most memorable experiences during their training, they shared a number of instances that can be categorized as community building and feeling accomplished.

With respect to technical accomplishments, P2 stated that fixing a 3D printer for the first time: "Me fixing the Ultimaker II for the first time [was memorable]. Taking it apart, fixing the nozzle,

screwing it back on, doing level tested with it, and making it a fix of, actual fix as a 3D printer. My 3D printer fix." P10 mentioned an external innovation award they had received which motivated them and they connected to skills learned at the job and at DHF: "Winning the [anonymized award name]. It was a really big achievement for me because I don't know, it kind of showed me how far I've gotten in terms of like just being a part of DHF but also kind of motivated me to keep going."

These experiences often resulted in a sense of pride. For example, P5 said, "My time here was really amazing. I really did enjoy it. I learned a lot. I gained a lot of respect for this place and myself, and I'm just really excited to take everything I've gotten from here [with me to other places]."

P2 also identified an incident where a 3D printer caught on fire as memorable and "horrifying": "I would have to say still the Raise3D burning was still horrifying and probably the most memorable moment! Other than me getting promoted, of course, I would say that'd be memorable."

With respect to community building, P3 shared their experience of starting at the job: "Like that first Friday, it was actually us there, we were doing a big cleaning thing where we were going through inventory and everything. And everybody was able to talk and stuff like that, there too, so that was really good."

P6 saw every day as memorable, especially because of the sense of humor and camaraderie among the employees and management: "Because every day in the print shop, it's just funny. There's always something going on. it's either the printshop or in the space itself. There's always something going on. Well, somebody [told] me to tell our boss [himself, a youth employee] that he actually needs to make a meeting channel to share the memes that he makes instead of just showing everybody whenever!" P9 similarly shared appreciation for working with other employees: "Definitely a great thing has been the environment. The environment is very, very amazing. And forming friendships with my fellow employees … has been amazing, just absolutely wonderful. They're great people, and I wouldn't have anybody else to work with. I would not rather work with anybody else. They're awesome."

P12 specifically pointed to activities done together with other employees as memorable: "I know that one day we had like a staff hack day, which was pretty cool … all of 3D print shop [employees] … just got together and we took ... many hours … and we got a lot of stuff done, and that was really fun. We all had lunch together. Going to events with print shop too is also a blast, like going to the maker fairs."

An important aspect of what contributed to the environment was an appreciation of a sense of humor that the youth, including their manager, who himself was a youth employee, shared. For example, P8 shared a story about one of the days when he was working with another employee and the manager: "During winter break last year … We were here two days straight … The second day [another youth employee and the manager] got into like this joke argument, like. It wasn't an actual argument, like. It was literally just roasting each other back and forth, and so [the youth employee] got on a computer over there, and searched how to fire your own boss… and then we were all laughing about it, and then [the manager] was like, `You guys can't fire me, but I can fire you', and we were like, `oh crap'… everyone was laughing, and it was hilarious… and like also the audacity of like doing that while your boss is in the room… Yeah. Kind of like

the bonding like stuff and like what's stuck with me … everyone was kind of like joking around…"

P2 related another story: "I remember walking to work one day, and [two other employees] were absolutely terrified for some reason that I found out a few second ago before I walked in, a roach had fallen from the sky [i.e., ceiling] and startled them and they were still scared that they never wanted to pick it up from the trash and what, this thing?"

P6 described how this combination of a positive environment with serious work responsibilities created an ideal learning space for them: "It's kind of hard sometimes, but I figure out how to do it. Like you might have to be serious on this side of the table, and whatever on other side … Because it's a nice place to learn. You get a lot of soft corrections. They don't immediately go to hard correction like, `oh, you're fired. or oh, that's not how you do that. You get this for this, this and this.'" P7 also pointed out how a focus on helping each other in the print shop than being competitive supported learning: "It inspires more confidence, a lot less competitive, so it brought up my confidence. I don't tend to do well in competitive environments most of the time… [DHF is a better] environment for kids or for those who are beginning in the workforce and such because it's a lot friendlier than most."

From our findings, this combination of technical and social achievements, sharing of experiences, appreciation for co-workers, and community building are the main aspects of the experience that resulted in a sense of accomplishment and belonging.

4.4.Youth Reflections on Impact Compared to Other Jobs

Most of the youth saw their experience working at the print shop as distinct from other youth working opportunities. They articulated this difference as both in the technical skillset they acquired and practiced and the fulfilling social connections they fostered.

P2 described how working in the print shop impacted them: "I worked two jobs in the past couple of years. None of them can top [working in the] print shop. Most of them are hands-on, I was a gardening apprentice for one of them, and that was much less computer and more stuff… [the print shop is] basically a real-world experience…I talked to my dad a lot about...not his work exactly, like comparing things to the print shop. He was like, 'wow! it sounds like you are working in a real job while you're at the print shop.'"

P3 expressed that working at the print shop helped improve his professional skills: "I would say it has a better impact on me because I became a better, I would say, worker. Throughout [working in the] print shop, I consistently got better, and helped me improve, and I believe it would help everybody else [who would work there] improve too because you can see the improvement everyone is making … And compare to other jobs that youth usually have, you know, it's not like your McDonald's job where like everybody can get that, so it's really better. I would say, it's not like just your average job that actually allows you really get into like works, you know." They went on to emphasize how the managers' attitude to mentorship helped the youth: "Because [the youth manager] was there more as a mentor not as a boss …. I would say everything worked out really well for youth that really want to get into work field … [having mentors] makes it a little bit easier for us to make a transition from just like [us fooling around at] DHF and actually getting serious on working and the working attitude that we would have." P6, P10, and P12 also stressed similar points about how working in the print job offers valuable technical learning experiences that would be difficult to come by otherwise.

P5 echoed similar thoughts when comparing their experience with other youth jobs: “It's really like.. kind of like a life-changing experience because it's not like a regular job like McDonalds or, you know, a certain thing that a teenager, high schooler, my age at the time would be doing, so it's very, very proud moment… [other typical jobs for youth] could be [valuable]. I wouldn't say it wasn't.. but they're like for this, especially with my age, it was really valuable because you know it's not very common.” P6 also mentioned being proud of working in the print shop and that their family was also proud of them for it. P8 mentioned specific outcomes furthering their career plans as a result of the training, “I'm more confident. I'm more experienced in the workforce. Now on my resume, I can say that I actually have had a job, and also it looks good for college… It's actual work.”

Finally, P9 stated how working in the print shop helped them develop a sense of belonging: “Without having gone to Digital Harbor, I would be totally lost, completely lost… I wouldn't have any of the friends I have. I wouldn't have any of the knowledge I have… I'm really glad I'm here.”

5. Discussion

Previous research on engaging youth in technology-rich learning (e.g., [8,11,16,33]) and professional training programs (e.g., [12,18]) has identified that youth benefit from multiple motivators, such as engaging content, a supportive environment, and effective mentorship. Our findings extend these by illustrating additional factors related to monetary incentives and professional identity that motivate youth and contribute to their learning. Additionally, they provide insight into what elements contribute to youth’s continued engagement in the experiences and the impact of participation on their career interests, technical and social skills, and sense of belonging in STEM. In this section, we discuss several implications for future research and practice that result from this work.

Our findings show that monetary incentives can motivate youth, especially in the urban context in which our project was situated, to participate in informal professional training programs; but also, that these should be combined with others, including family encouragement, peer participation, existing familiarity with the learning context, and an interest in learning STEM skills, to be most effective. An implication of this finding is that situating professional training programs at the sites of informal learning, such as afterschool programs, libraries, museums, and other sites, can help expose and motivate youth who are already familiar with the social and technical ethos of a center to participate in them and view them as a natural extension of learning [19,32]. This would strengthen the already recognized link between early STEM experiences and professional Furthermore, it is important to inform families and peers with information about programs consistently and frequently so that groups of youth feel supported to participate in them together.

Similar to previous research [17], our findings show that a key factor in both motivating the youth to participate in the professional learning program and for ongoing engagement leading to deepened learning is creating a positive and supportive environment. The educators, administrators, managers, and youth at our site had successfully created a workplace and learning environment in which the youth felt relaxed, comfortable, and supported in completing professional technical tasks. This positive atmosphere supported not only learning but also a sense of belonging [7] in STEM careers and hope in the youth that their future professional careers can result in both independence and fulfillment. Among other things (e.g., the youths'

and adults' positive attitudes), humor, community building, and a balance between professionalism and mentorship contributed to the creation and sustainment of this atmosphere.

Finally, we find it important that when describing their career interests, the participants not only identify STEM careers but also detailed descriptions of the roles they would like to take on and what they would to do in them. This result correlates with the youth describing their experience as representative of "real-world" jobs and differs from other technology-rich learning programs that they had completed in the past. Interestingly, the youth were aware that the professional training opportunity was unusual compared to other youth employment opportunities, such as working in the food or recreation industries which they saw as making it more valuable and connected to careers they would ideally want to pursue in the future. We would also like to point out that the youth mentioning a desire to be independent financially in the future or even taking care of their families financially might have been a result of getting paid to learn, rather than other informal learning programs that don't have an employment aspect to them.

6. Limitations and Future Work

A limitation of the current paper is that we used youth self-reports about their experiences and did not analyze the perspectives of program administrators, clients, and educators who were also involved in the print shop to confirm findings. While we believe focusing on youth voices is important in answering our research questions, including other perspectives in the future can strengthen these findings. The specific characteristics of the context we studied, including the types of tasks and jobs that youth employees completed, the culture of the youth training center, and the urban context in which the center is located, might impact our findings and need to be considered in designing future studies.

In the future, we would like to replicate this study in other professional training contexts, for example, software development or youth-led community technology training programs, and compare and contrast findings. Future research can also study the organizational factors, for example, by including administrators, educators, and other stakeholders, that are important to the successful implementation of similar programs.

7. Conclusion

Youth professional training programs that combine technology-rich learning with paid work offer innovative and promising opportunities to engage youth in authentic and rewarding learning experiences. Despite their potential, research is needed to determine how youth, especially from diverse urban backgrounds, can be motivated to participate in these programs, and what is the impact of participation on their career interests and professional and technical skills. In this project, we studied the perspectives of twelve youth employees at an afterschool 3D print shop set up at a youth informal learning center. We found that the youth were motivated by multiple factors, including monetary incentives, family support, peer buy-in, an affinity for the center, and an interest in learning. We also found that youth valued both professionalism and but also community building and "gentle" support, as important factors in furthering their learning and motivation. Finally, our findings show that the youth perceived themselves as significantly more prepared to continue on STEM career trajectories as a result of participating in the program and envisioned being able to pursue meaningful and fulfilling careers in the future.

8. Acknowledgments

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