Youth Attitudes Towards Assessment Tools in After-school Informal Learning and Employment Training Programs

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1. Introduction

"Making" is an umbrella term that refers to a wide range of activities including tinkering, customizing, designing, and fabricating small-batch artifacts that usually require technical skills in self-directed projects [1]. After-school programs focused on making introduce youth to engineering concepts and skills before college and provide opportunities to engage in hands-on projects that require creative problem solving, teamwork, and persistence [2], [3]. Additionally, these programs have been shown to strengthen job-readiness and can lead to careers in technical fields [2], [4], [5]. Given the diversity of the contexts in which these programs are being offered and the range of projects, technologies, and approaches that they utilize, there is a need to understand the potential of existing and new assessment tools that can provide insight into their impact on youth participants. Additionally, as interest in after-school programs grow, and they expand to include hundreds of youth participants, it is important to identify appropriate assessment tools that can be deployed at scale and provide useful insights into programs' impact to educators. A promising approach to evaluating the quality of these programs is conducting assessments that capture program impact both in terms of *technical skills*, such as the ability to program or 3D model a desired object, and *non-cognitive skills* which are defined as "attitudes, behaviors and strategies that facilitate success in school or workplace" [6]. In this context, a key factor that impacts the acceptance and relevance of assessment tools is youths' attitudes towards them. For quantitative assessment tools, youth attitudes can impact the tool's *face validity*, the degree to which an assessment tool appears subjectively to participants as measuring what it aims to measure [7].

We investigated the assessment practices of program outcomes at an after-school informal youth learning and employment center. We were particularly interested in youth's attitudes towards different forms of quantitative and qualitative assessments in this context and their interaction with the values practiced at the center with the goal of using these findings to inform the design of better tailored tools and procedures for these settings. Specifically, we studied youth attitudes towards both quantitative assessment tools, including *Grit-S* and *Alternative Uses Test* (AUT), and qualitative assessment tools, including open portfolios and showcase presentations. We analyzed three years of survey data from 159 youth who participated in after-school learning programs at our research site. We also conducted interviews with three adult program staff members who administered the different assessments and collected their observations and reflections about youth's attitudes towards them. Through participant observation and a focus group with 8 youth employees, we studied attitudes towards self- and peer-reviews in a professional training program housed at the center. Studying assessment procedures and youth's attitudes towards them in these different contexts (learning programs and professional training), provides us with a holistic picture of the center's different approaches to assessment and areas for improvement.

Our results show that youth attitudes towards different kinds of assessments significantly impact completion rates and, in the case of quantitative tools, face validity. Overall, youth in the learning programs exhibited negative attitudes towards quantitative survey tools that resulted in low participation and resistance towards completing them. We found that youth exhibited more

positive attitudes towards open portfolio and showcase assessments, although the performative aspects of these activities failed to engage all. During interviews, staff members identified several factors that contributed to the youths' negative attitudes and provided recommendations on how to improve future assessments in this context by making them more relevant and appealing to youth participants. Youth in the professional training program explained that they preferred a variety of assessment tools, including engaging assessments for re-enforcing technical skills and personally meaningful assessments for self-reflection. In addition to these results, we present a set of lessons learned that can be applied to the selection and development of assessment tools and procedures for youth in similar programs in the future.

2. Related Work

Many researchers have underlined key elements in maker courses for success, such as self-directed learning, collaboration with others on group projects and the acceptance of failure as important for supporting learning, especially as related to Science, Technology, Engineering and Mathematics (STEM) topics [2], [3]. The importance of project-based extracurricular activities, including after-school programs, workshops, and summer camps in introducing and engaging youth participants to a variety of technical and non-technical topics is well-recognized and studied [2], [8] - [15]. Papavlasopoulou et al. found that the number of empirical studies of learning outcomes of maker workshops and programs has significantly increased in the last few years [13]. Studies have shown that participating in making and digital fabrication activities can positively impact self-efficacy [16], [17], technological awareness and confidence [18], as well as, general and declarative knowledge of technical systems [13], [19].

A recent literature review found that the majority of the empirical studies of the outcomes of maker activities (57%) employed qualitative methods [13]. Additionally, the review observed that most of the quantitative data was collected in relation to school concepts and the impact of participating in maker programs on academic school performance. There was a lack of assessment tools to study non-cognitive skills in informal learning settings.

In line with the above results, researchers in this area often recommend the use of qualitative measures such as open portfolios [12] and peer- and self-assessments [8] to assess the outcomes of making activities and projects. In the past, a strong argument has been made for the lack of nuance in quantitative tools to measure the performance of youth makers in creative and expressive activities [8]. However, there is little empirical evidence that provides insight into the shortcomings of quantitative tools in this context and the challenges of assessing the outcomes of maker activities in general [13].

We agree that assigning grades and comparing youth makers' performance with each other might be detrimental to the intrinsically motivated learning activities that maker programs aim for. However, these are not the only ways that quantitative assessments can be used: they can provide insight into the differences between programs and courses (rather than individuals) and help with an overview of the differences and similarities between groups of individuals.

Research is emerging that is examining the potential of quantitative tools for measuring the outcome of maker activities on youth. In a recent project, Chu et al. developed a series of survey instruments to measure youth's interest, self-efficacy and self-identity with respect to making

and science [2]. The survey tools measured maker identity, self-efficacy and interest, as well as, science self-efficacy and interest. Additionally, the researchers measured the students' STEM-career possible selves and interest. In a year-long study with 121 middle-school students (ages 8-11) who participated in weekly maker activities, they found that participating in maker activities had significant impact on students' science self-efficacy and identity, as well as, making self-efficacy and interest [2].

Emerging research is finding that participating in maker activities and projects impacts STEM career identity and awareness [2] and making can become a pathway to engineering jobs for youth [20]. Previous research has shown that many youth who participate in maker activities, identify as "Makers", an identity that incorporates positive attitudes towards learning and creativity [21], [22]. Previous research has also identified links between the maker movement and the innovation sector, including information technology startups and small-scale high-tech manufacturing [21], [23], leading to the notion that making might be a factor in industrial democratization [1], [24]. However, while much of this research focuses on skills acquisition, questions remain about how well skills acquired during these making experiences translate to technical work experiences which are often collaborative in nature.

The majority of previous research focused on using qualitative tools to assess the impact of making activities. There is a need to study the possibility of combining these tools with existing and new quantitative tools. To our knowledge, no research exists that studies youth attitudes towards different forms of assessments in maker settings. Given that "maker culture" aims to engage youth using practices that are different from ones utilized in traditional formal learning settings, it is important to study what kinds of assessment tools and procedures can better match this approach. We aim to investigate these questions by analyzing results from surveys used in this context, as well as, taking into account observations and reflections from both youth who participated in them and practitioners who administered the assessments.

3. Research Setting

Digital Harbor Foundation (DHF) is a non-profit organization that provides after-school informal learning and training programs focused on making for children and youth (grades 3-12). DHF is located in Baltimore, a large American city, and serves participants from a wide range of socio-economic backgrounds. One of the main goals of DHF is to use technology and hands-on projects to engage inner-city youth in learning and creative activities. To this end, DHF offers a range of STEM-based courses and workshops, including programs that focus on 3D printing and game design, on a pay-what-you-can basis. Additionally, DHF offers a unique employment training program for youth in which youth who have completed a set of required learning programs gain real world technical work experience in a professional setting. In the following subsections, we describe both of these components.

3.1.DHF Learning Programs

Learning programs at DHF take the form of courses and workshops. Workshops are shorter than courses in duration (1-day, 2-day or 3-day) and are focused on specific topics. Courses take longer (about 7-14 weeks), with classes meeting twice a week, and cover a variety of topics and activities. Courses are structured to resemble a series of workshops rather than a traditional classroom setting. There is a strong emphasis on self-directed learning, with youth participants

being encouraged to explore online resources at home and continue work beyond face-to-face time. Once course material is covered through presentations by course instructors, participants work on team projects with creative freedom to choose from a set of suggested projects or to work on an entirely new idea of their own. During design and fabrication times, senior staff are present in the classrooms, but mainly help the youth with questions and finding resources rather than telling them what to do. Teamwork is highly encouraged at DHF and projects are often completed and presented by small teams (3-5 members).

Figure 1: Typical setting for DHF's courses: The classes are held in one of several large spaces where participants work on shared tables and are surrounded by equipment such as 3D printers and laser cutters. They typically use their laptops or other digital or electrical tools when participating in the activities.

DHF requires all incoming youth to take an introductory course, *Maker Foundations*, that takes 14 weeks. This course introduces the youth to a wide variety of maker-related topics, including 3D printing, programming, game design and physical computing. The youth who successfully complete the course, referred to as *DHF Members*, can then choose from a variety of more advanced courses and workshops. Figure 1 shows a typical DHF course setting.

A key component of many courses at DHF, including Maker Foundations, is digital fabrication. These include the 3D modeling and printing of customized objects. In addition to 3D modeling and printing, courses often include laser cutting exercises and the use of a variety of materials including metal and wood. Often, the resulting objects are combined with electronic components, such as sensors and microcontrollers to implement various digital functionality. A typical project can involve the design and 3D printing of a custom game controller that is then attached to a microcontroller or computer (e.g., using a Makey Makey module) and used to control an existing game or one that the participants have developed using an entry level programming platform, such as Scratch.

DHF was founded in 2012 and has experienced a surge in interest in its programs in the last few years. Given the organization's expansion, a key priority has been finding more sustainable and

efficient ways to assess program outcomes at scale. This need has motivated the organization to assess the relevance of existing surveys and other assessment tools for their programs. In addition to quantitative assessment tools, DHF uses qualitative tools such as open portfolios and final public presentation assessments to evaluate program outcomes. Recognizing the importance of documentation and technical writing, the youth at DHF are highly encouraged to create and update an online open portfolio in the form of a small website with descriptions of their final course projects (referred to as capstone projects). In their portfolios the youth include descriptions of their design processes, as well as, the failures and challenges they faced. The websites are usually media-rich and include images and videos. Instructors often view these websites during the courses and afterwards and provide the youth with feedback. As recommended by previous research [17], this usage of open portfolios is a form of qualitative assessment that incorporate learning, self-reflection and self-expression as part of the assessment.

Another key activity at DHF that supports the youth's self-reflection and self-expression is the organization of a showcase at the end of each semester. At the showcase, the youth present their projects to visitors. These events are advertised in advance and often attract a mix of parents, relatives, technology enthusiasts and other community members. At these events, the youth set up their projects on tables and present them to visitors. These presentations often include descriptions of design processes and challenges that they faced and how they were overcome. Figure 2 shows a typical setup at an DHF showcase.

Figure 2: At the DHF showcase youth show their final projects to visitors and explain their design and implementation process.

3.2.DHF Youth Employment Training

DHF offers technical employment training opportunities for youth in the form of internships at a youth-staffed 3D print shop. The print shop opened in early 2017 as a "living laboratory" to provide technical jobs to youth who completed Maker Foundations and are DHF Members. The print shop employs youth who are eligible to work through a state government minor work permit and have completed the 14-week Maker Foundations program. Since opening, the print shop has employed 8 youth (4 female, 5 underrepresented minorities in STEM) between the ages of 15-18. The print shop offers 3D printing, 3D scanning, and 3D modeling services to clients. Six months after opening, the print shop youth employees have over 60 jobs and produced over

4,000 objects. Example projects that youth completed include developing assistive devices for older adults, printing art assignments from younger youth, printing chess sets for local parks, and designing a case for scientific sensing equipment that will go in a volcano. Employee hours vary by individual based on availability. Youth typically work in 2 hour shifts during the academic year and 5 hour shifts during the summer. Figure 3 shows the print shop and some of its employees.

Figure 3: The 3D print shop is located in the corner of a large room where DHF's learning courses take place (Left); Youth employees receive training in a professional setting at the print shop (Right).

Even though the print shop is situated within the same physical space as DHF's other after-school programs, several key factors set the print shop apart. First, is the period of time in which youth are engaged. As opposed to spending 7-weeks enrolled in a course, youth have the opportunity to spend over one year working in the print shop. Second, are the motivating factors driving participation in each program. Maker Foundations and other DHF courses encourage youth to find and pursue projects that are personally meaningful and engaging. However, projects in the print shop are undertaken at the request of clients and likely have no personal meaning to youth. While there are opportunities to be creative in this setting, responsibility and financial compensation are key external motivators. Third, during their time as employees, youth are given more responsibility and autonomy over their work. This differs from the learning programs at DHF that are guided by adult instructors and staff. In the following sections we provide an overview of the print shop's current assessment tools and youth attitudes towards them in this unique professional training environment.

4. Data Collection Methods

4.1. Participants

In order to evaluate the effectiveness of multiple assessment techniques of youth programs, we analyzed data from four diverse groups of participants at DHF using multiple data gathering activities. These four groups included new youth participants who were taking their first Maker Foundations course, participants who had already taken this introductory course and were taking more advanced courses, youth employees who had already completed the introductory course and were working in the print shop, and adult DHF staff. Table 1 shows an overview of participants and data collection procedures.

Participants	Number	Age	Procedures
Incoming Youth	92	11-15	Surveys
Member Youth	67	11-18	Surveys
Youth Employees	8	15-18	Participant Observations/Focus group
Staff	3	Adults (20-25)	Interviews

Table 1. Participants and Data Collection Procedures

Through this sampling technique, we gathered data from 167 youth participants. 98 participants completed the Grit-S survey, 61 participants completed AUT, and 8 participants who worked at the print shop took part in a focus group and were regularly observed during work shifts. The participants who completed the surveys were between 11-18 years old (grades 6-12) and the youth employees who took part in the focus group were between 15-18 years old (grades 9-12). We interviewed 3 DHF adult staff members who had directly administered the tests during after-school courses. The staff members had worked at DHF between two to four years.

4.2. Procedures

4.2.1. Surveys

We analyzed results from two quantitative assessment tools used at the center, *Grit-S* and *Alternative Uses Test* (AUT) and collected over the last three years. The *Grit-S* survey is designed to measure *grittiness*, which is defined as "trait-level perseverance and passion for long-term goals" [25]. Grittiness is believed to be correlated with academic success and there is some evidence that it can be indicative of higher career aspirations [25]. The Grit-S (i.e., Grit-Short) survey is a shorter version of a longer Grit survey that is designed to measure the same concept with a smaller number of items [26]. It consists of 8 self-reported Likert style items (Table 2). Each item has to be rated on 5 levels ranging from "not like me at all" to "very much like me". The measure was collected from three classes both pre- and post-course. The original paper survey was converted to a digital online survey that was completed by youth in DHF.

1. New ideas and projects sometimes distract me from previous ones.
2. Delays and obstacles don't discourage me.
3. I have been obsessed with a certain idea or project for a short time but later lost interest.
4. I am a hard worker.
5. I often set a goal but later choose to follow a different one.
6. I have difficulty maintaining my focus on projects that take more than a few months to ! complete. !
7. I finish whatever I begin.
8. I am hard working and careful.

Table 2. Items in the Simplified Grit-S Survey

The *Alternative Uses Test* (AUT) is a tool to measure *Divergent Thinking*, a type of thinking process, usually used in problem solving, that involves coming up and considering many related but distinct concepts or solutions [15], [27] . Divergent Thinking is believed to be highly correlated with creativity and problem-solving [15]. For AUT, participants are provided with a series of common object names (e.g., pencil, tire, …) and are instructed to come up with as many different but practical uses as possible for each object. For each object, a common or primary use

is provided and the participants are instructed to "list as many as six other uses for which the object or parts of the object could serve." For example, for a newspaper that is commonly used for reading, alternative uses can include, starting a fire, wrapping garbage, swatting flies, etc. These responses are then given a score based on a set of criteria including *originality*, *fluency*, *flexibility* and *elaboration* [15]. The AUT was completed by youth in four classes using pen and paper: two classes for incoming youth and two for youth who had completed courses before. DHF staff followed instructions standardized and distributed by the Mind Garden organization [28] for deploying the tool and scoring the results. Youth answers were scored by three adult judges who worked independently from each other.

4.2.2. Participant Observation and Focus Group with Youth Employees

The 3D print shop has implemented a mix of quantitative and qualitative assessments which evaluate youth mastery of skills/knowledge through engaging quizzes on Kahoot!, and promote reflection through personally meaningful self- and peer-reviews. The selection and design of these assessments were largely informed by participant observations by the research team over one year. During this study, one member of our research team was regularly present (approx. three days per week) at the print shop to observe and take notes during employee work shifts. To stay abreast of ongoing workplace dynamics, members of our research team also participated in monthly group meetings with all print shop employees.

We conducted one 40-minute focus group with youth employees that was initially focused on approaches to problem solving and troubleshooting. During this discussion, youth opinions and preferences towards assessment types surfaced and these themes were further explored. This focus group session was audio recorded and transcribed. We then analyzed the transcripts, focusing on quotes relating to assessments. For the purposes of this study, we report only findings related to youth attitudes towards assessments rather results.

4.2.3. Interviews with DHF Staff

We conducted semi-structured interviews (between 30-60 minutes) with 3 DHF staff members who had administered the AUT and Grit-S surveys. In the interviews, we asked the staff about their observations when administering the tests and also their observations with respect to the use of online portfolios and the showcase. We took detailed notes during the interviews that we subsequently analyzed.

5. Findings

5.1. Results from Grit-S and AUT Surveys

An increasingly low completion rate in post-course Grit-S surveys reflects youth's reluctance to participate in these assessments: while the first class had a completion rate of 100%, the two subsequent classes had completion rates of 47.5% and 42%. A decrease was also present in pre-course completion rates (100%, 90% and 74%, respectively) but not as dramatic as the one observed in the post-course completion rates. These results, combined with staff observations reported below, reflect youth's negative attitudes towards Grit-S and its compromised face validity. Due to these low completion rates, we were only able to compare results from one out of three classes that we had collected data from. An ANOVA test to compare the pre- and post-course results for the first class did not show a significant difference between the pre- and post-course Grit-S scores ($F_{1,35} = 0.02$, ns).

With respect to AUT, the low completion rates were not present in the pre- or post-course data and the completion rates for both pre- and post- were 100%. The average score for youth who had been at DHF was 9.5% higher than the youth who were entering the program. An ANOVA test showed a statistically significant difference between the two groups ($F_{1,59} = 3.94$, $p < 0.05$).

5.2. Results from Staff Interviews

All staff members described observing negative attitudes from youth towards quantitative assessments: *"They [the youth] don't like sitting down and filling out surveys. When we gave it to them, they would often say 'Oh no, we now got to fill out surveys' and had an attitude of 'let's get it out of the way', not paying attention to how they filled them out."* Two staff members observed that the youth seemed especially bored and impatient when completing the Grit-S surveys. The staff often had to track individual surveys to make sure they were completed or submitted. With respect to the AUT, while the staff mentioned that some youth commented that items on the assessment were old-fashioned, most of the youth seemed to enjoy the task of coming up with multiple uses for objects.

The staff identified several factors that could have caused the youths' negative attitudes towards the assessments. First, they stated that the assessments (especially Grit-S) were perceived as "test-like". An important part of DHF's approach is that it aims to be different from formal teaching settings by providing opportunities for youth to follow their own interests and work at their own pace. To this end, the number of formal rules is kept to a minimum and the youth are encouraged to freely express themselves and not be in competition with others. One of the staff stated that the assessments posed a contradiction because usually at the center, youth were discouraged from competing with each other and were instead invited to collaborate with each other and get inspired by more senior youth or staff members. Additionally, they mentioned that the culture of the center values creativity or problem-solving over "bragging" about the ability to do so. The staff believed that this contrasted sharply with the idea of assessments that were perceived as being used to compare youth with each other using self-reporting of skills and in form resembled school tests. To counter this sentiment, the staff often told that youth that they were not taking a test and that they cannot pass or fail the assessment. However, these statements did not motivate the youth. The staff contrasted the quantitative assessments with open portfolios and the showcase which could also be viewed as assessments but were not perceived of as negatively because they had the purpose of sharing projects with others, which is an important maker value [1], [29]. However, the staff mentioned that the youth also were often not enthusiastic about creating portfolios and viewed it as "doing work."

The staff also stated that the youth might have had difficulty finding personal meaning in completing the assessments. The staff stated that the youth were told that the assessments were important to understand the outcome of maker programs. However, the youth often seemed to not see the importance of these tests and viewed them as a formality. Furthermore, these negative attitudes were amplified when the assessments were repeated at the end of the programs. One of the staff members stated that this might be because the youth do not see the results of the assessments over time and their effort seems to "disappear into the ether." On a positive note, sometimes the youth were surprised by their own reactions to the same survey items at the end of a course and how their perception of their own abilities had changed. All of the staff members

stated that having similar mechanisms to support self-reflection can be a promising way to make the assessments more meaningful for the youth. To illustrate, one of the staff members described his observations about a Minecraft course that required considerable team work. They stated that many of the youth participants had scored themselves lower on collaboration and teamwork skills in the post-course assessment. When they talked with them about this difference with the pre-course scores, the youth had described that the course had given them an opportunity to test their teamwork skills in a realistic scenario and made them aware that they needed to work on them more. The staff member explained that while the numerical scores were lower in the post-course assessment, they believed that completing it before and after the course and discussing the results with the staff member had given the youth an opportunity to explicitly reflect on their skills.

Another observation was that the static and linear format of the assessments (i.e., pen and paper for AUT and static computer forms for Grit-S) contrasted with the many technological tools that the youth used on a regular basis at DHF. The staff stated that they had experimented with new digital tools such as Kahoot! [30], which is an online interactive platform for group participation in quizzes and uses gamification and engaging music to create a positive experience for participants. While Kahoot! And other similar platforms such as Quizizz [31] were very popular with the youth, the staff found them more suitable for testing skills or knowledge in a competitive way rather than questions involving self-reflection. The staff mentioned that an important value at the center is to support youth work at their own pace. Many of the activities completed by youth are self-directed by design and so if someone needs to take more or less time they can do that. According to one of the staff, a common moto at DHF is that "we can all learn from each other." This value contrasted with the format of the assessments that required everyone to complete the activities at roughly the same time.

Finally, the staff identified logistical challenges that impacted the post-course assessments. DHF courses are often planned such that the youth receive instruction in the technical materials early on and spend the latter part of the courses working on self-driven projects. Towards the end of the courses, time becomes very constrained and the youth become focused on finishing their projects to include them in the showcase. The staff observed that when assessments were deployed at this time, the youth were often more interested in working on their projects rather than participating in something completely different. The staff also mentioned that sometimes the assessments conflicted with activity schedules and the youth seemed to think of them as a waste of time that took away from other important tasks, such as getting ready to present their projects for the final showcase. The staff commented that it might be useful to find ways that assessments could be built into the courses such that they do not conflict with the final projects.

Despite the difficulties the staff members believed that quantitative tools could be useful and complement qualitative assessments. They stated that sometimes it is difficult for youth to express themselves through online writing. Additionally, some youth are not as expressive during public events such as the showcase. While anecdotal information from the youth parents and peers showed positive outcomes, capturing these using structured, detailed methods would be useful. Thus, the staff expressed that with better assessment tools and procedures, surveys or questionnaires could still be useful in this context.

5.3. Results from Participant Observation and the Focus Group with Youth Employees

As a professional work experience, responsibility and financial incentives are external motivators for youth. During our focus group however, we learned of several factors that served as internal sources of motivation for youth. These include the desire to make others proud (e.g., parents, siblings), and the desire to acquire and share knowledge. We found that youth generally viewed assessments in the print shop as valuable to personal development and as a necessary means towards achieving desired outcomes.

"I'm just in it moreso for the knowledge and the investment. I mean the money is nice, but money is money. But I think with knowing 3D printing... because when people ask me 'where do you work' and I tell them where I work in a print shop… and I finally get the chance to teach somebody something. I guess teaching people things is kind of what I like to do"

Much like the youth in the learning programs, the youth employees reacted positively to interactive platforms which incorporate game elements to create engaging experiences. In response to this finding, the print shop has adopted Kahoot! quizzes as a tool to supplement training through assessing youth knowledge of job-relevant facts (Figure 4). To date, Kahoot! has only been used to assess youth employees' ability to identify and diagnose common printing problems such as over or under extrusion. However, after introducing this tool, youth have shown continued engagement with the platform, even requesting quizzes on additional topics including printer and material facts and interacting with customers.

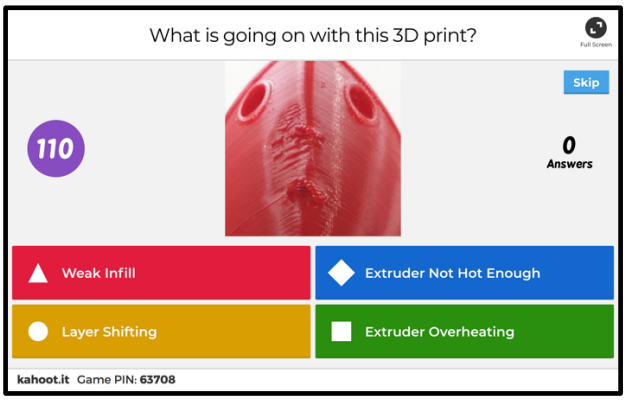

Figure 4: An example Kahoot! question used in the print shop: The image shows a failed 3D printed object (due to an overheating extruder) and asks the youth about the reason behind the print failure. The youth can select one of the four options displayed below by voting online.

While Kahoot! has proven to be an engaging way to assess youth on their ability to learn and retain facts, a lack of customizability limits the use of this tool for other applications. Despite some apprehension over adopting "test-like" assessments, youth employees recognized the limitations of Kahoot! advocated for more appropriate assessment tools which could be used to reflect on progress and development in meaningful ways.

"Kahoots aren't really specific enough. The Kahoots are more of "this is a question, did you answer the question" and half the answers in Kahoot might be random."

Informed by this feedback on Kahoot!, the print shop implemented self- and peer-reviews. The structure of these assessments was modeled after the reviews completed annually by full time DHF staff. Self-reviews feature a mix of self-efficacy questions focused on important tasks that are critical to performing work on a daily basis (e.g., operating the scanner, or printers, documenting work, communicating with others), and open-ended questions (e.g., set professional goals, reflect on personal progress towards the development of technical, social, and organizational skills, and identify ways in which they can improve over the coming year). Peer-reviews ask youth to reflect on the performance of the shift that regularly comes in before them and to identify areas for improvement (e.g., including as high-level collaborative skills, such as leaving the workspace clean, and communicating effectively).

Because of limitations with Kahoot!, youth employees viewed reviews as a necessary part of tracking personal progress and identifying areas for improvement. Some youth also felt that these assessments would lead to increased awareness of the distribution of employee skills, which in turn, would contribute to more knowledge sharing amongst peers.

"Yeah, that way we can see what needs to be addressed. What does nobody know about? What does nobody know how to do? And what do a lot of people know how to do? And what do certain people know how to do? Maybe nobody knows how to use Fusion [a 3D modeling software] and everybody knows how to use Meshmixer [a 3D modeling software]. Nobody can use the [3D] scanner."

6. Discussion and Lessons Learned

The findings presented in the previous section show that youth attitudes can be an important factor in the successful deployment of assessment tools. In the learning programs, the youth's negative attitudes towards the quantitative tools, especially Grit-S, resulted in resistance to completing them which in turn made it impossible to compare pre- and post-course results. Staff interviews revealed that these attitudes might have been related to the contrast between the maker values practiced at the center, such as playfulness, creativity and humility, and the format and content of the quantitative assessment tools, which were perceived as rigid and disconnected from the activities that the youth were engaging in during the courses and workshops.

Findings from the professional training setting show that youth employees had astute observations about the usefulness of different types of assessments. Further, they commented on how each assessment strategy can be suitable for achieving a different purpose. For example, the interactive Kahoot! exercises were suitable for assessing technical skills, while self- and peer-reviews were tools for self-reflection. Finally, the youth have different motivations for participating in learning and professional training programs and these might also impact the way they perceive assessments. Taking these into account can help educators develop assessments that contribute to the overall learning and training experience of youth. Following, we present a set of lessons learned for the future deployment of assessments in similar settings by the community of practice active in similar spaces.

Make Engaging Assessment Tools. Staff members believed it is important to develop and use tools that are engaging and reflect the technical and artistic space in which the youth are working in. Platforms like Kahoot!, while not yet appropriate for individual assessments that require self-

reflection include engaging elements. These engaging elements included gamification, interaction through smartphones and laptops (instead of paper), and appealing graphics and music.

Develop Efficient Assessment Procedures. The staff recommended allocating dedicated time in the learning program schedules for evaluations, so they do not interfere with other activities, and take time from final projects and presentations. They also suggested dedicating personnel to conduct assessments at specified times so that the importance of the procedures is underlined for the youth. These recommendations can result in more efficient and consistent assessments.

Select Meaningful Assessments. A key recommendation from the staff was to find ways to make assessments personally meaningful to the youth, a recommendation that was especially emphasized with respect to quantitative assessment. They suggested explaining to the youth how these results can improve future courses and also including more items in the assessments themselves that support self-reflection and learning. Working on personally meaningful projects is known to be an important part of the maker culture [1], [16] and extending this value to program assessments makes sense.

Utilize Multiple Assessment Tools. Despite the challenges with deploying quantitative assessments, the staff believed that the results could be useful and complement input from qualitative approaches such as analyzing profiles. They recommended using a variety of assessment methods that could complement each other and provide a well-rounded picture of the outcomes of maker programs. This recommendation is in line with previous research that has recommended the use of mixed-method approaches for assessing maker program outcomes [13].

Include Youth in the Development of Context-Sensitive Assessments. Input from youth employees showed that constructive feedback from youth can help the selection and development of appropriate assessments tools and procedures. We recommend the use of participatory approaches in which youth feedback considered when developing assessment tools.

7. Conclusion and Future Work

As after-school informal learning and training programs focused on making for youth grow in scale, so does the need for assessment tools that can accurately and efficiently measure program impacts. Among the factors that can significantly impact the successful deployment of these tools is youth's attitudes towards them. We investigated youth attitudes toward multiple assessments at an informal learning center. To gain a holistic view of youth attitudes, we studied survey results collected from youth attending learning programs and data from observations and a focus group with youth employees in a professional training program at the center. We found that youth in learning programs had negative attitudes towards quantitative written assessments, as their form and content contrasted with the culture of the center that valued creativity and failure-positiveness. These attitudes negatively impacted youth participation and the completion rates of the assessments. We also found that youth employees viewed different assessment tools as having different functions, with interactive tools used for skill practice and self- and peer-reviews used for self-reflection. These results show that even with validated and highly-regarded assessment tools, the specific context in which they are deployed and the youth's attitudes towards them remain determining factors as to their efficacy. We use these results to inform a

series of lessons learned for the selection and development of assessment tools and procedures that are better aligned with maker culture as practiced in the center and in similar after-school informal learning and training programs. This research underlines the importance of matching assessments to the culture of learning centers in which they are deployed.

In the future, we plan to apply the lessons learned to develop new assessment strategies and tools that are better suited to the context of after-school informal learning centers focused on making. Currently, we are working with DHF staff to incorporate our findings into the next iteration of assessments and will plan to compare youth attitudes towards new assessments in the future. Additionally, we plan to use a participatory design method to include more input from youth on the content and format of future assessments. Finally, we will continue to study youth employee attitudes towards different assessment in the print shop in a longitudinal study.

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