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Making at Home: Interest-Driven Practices and Supportive Relationships in Minoritized Homes

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Abstract: The maker movement advocates hands-on making with emerging technologies because of its value for promoting innovative and personally meaningful transdisciplinary learning. Educational research has focused on settings that primarily serve youth from dominant groups, yet we know surprisingly little about making among minoritized youth and the kinds of resources that support their making. This study sought to better understand the extent to which maker practices are present in the lives of minoritized youth and the network of resources that support their engagement. In this study, we analyzed survey responses of 52 youth from an urban, under-resourced community in Chicago and conducted an inductive thematic analysis of 20 interviews through a model of connected learning. Findings showed these youth participated in a diverse range of interest-driven, low-tech maker activities in their own homes more often than in school, after school programs, or through online resources and communities (i.e., YouTube, Internet, social media). Many youths displayed different levels of participation with intergenerational support, as parents and extended family members supported youth in their hands-on making. This work opens up pathways for fostering connected learning opportunities within minoritized communities by building on existing learning experiences within home settings and supportive relationships.

Keywords: making; family making; maker literacy; connected learning; interest-driven learning; intergenerational learning; family-based learning

1. Introduction

Over the last decade, the maker movement has reinvigorated widespread interest in do-it-yourself (DIY), hands-on craft production practices through a combined use of low- and high-tech materials and tools, such as textiles, woodcrafts, 3D printers, and microcontrollers [1]. The enthusiasm for the educational promise of the maker movement and its associated practices (commonly referred to as making) has centered on how making can be leveraged to support learning across contexts by bridging young people's passions to disciplinary content valued in schools [2]. In our work, we take as a starting point that learning is "life-long, life-wide, and life-deep" [3] (p. 12) and argue that more concentrated efforts ought to be made to explicitly connect learning across the multiple social and cultural communities of which young people are members.

Understanding how learning is shaped in out-of-school contexts such as communities and learners' homes, as well as how that learning might be translated to more formal learning contexts, has been part of an effort to improve learning experiences for children and young people for many years [3–6]. Investigating the intersection of personal interest, supportive relationships, and opportunities, the connected learning model has begun to characterize how learning has changed with new access to information and an abundance of social connections [7]. Furthermore, research on maker literacies has deepened the way that we view youth making, both in terms of the exploratory way that youth tinker with materials,

as well as the semiotic meaning-making that is engaged in the process [8]. Although much educational research focuses on how to support maker practices in the context of traditional formal and informal educational environments [9,10], we know surprisingly little about the kinds of making that are part of youths' everyday lives. This absence of research risks overlooking productive learning opportunities to meaningfully connect youth maker practices to real-world pathways.

The purpose of the present study was to better understand the extent to which maker practices are present in the lives of minoritized youth, and if they are present, to develop theories for how these practices might be leveraged to connect homes, schools, and communities. We addressed the following overarching question in our research for this paper: to what extent and under what conditions do minoritized youth engage in maker practices? Using quantitative and qualitative methods, we analyzed data from open-ended surveys (n = 52) and semi-structured interviews (n = 20), which respectively provided both high-level and in-depth understandings about youth and their maker practices and experiences. Overall, findings demonstrate that youth participated in a diverse range of interest-driven maker activities in their homes. Through thematic analysis of interview transcripts, we describe youth motivations for engaging with making, including that youth were inspired by artifacts and processes, and that they mainly made things for fun and/or to share with others. Importantly, findings show evidence of intergenerational support as parents and other family members—particularly grandparents, uncles, and aunts—provide access, co-create, collaborate, teach, and encourage youth to make, thus supporting youths' developing identities as makers of things. We suggest that this work opens up new pathways for fostering connected learning that builds from existing supportive relationships and maker practices at home. We discuss design implications for connecting existing maker practices and supportive relationships to future academic, civic, and economic learning opportunities, and finally, offer suggestions for future research.

2. The Maker Movement and 'Making'

The maker movement has renewed popular attention in interest-driven, hands-on production practices with a focus on learning-through-doing [11,12]. The emphasis on making things includes both longstanding, low-tech maker practices, from sewing, knitting, and wood carving, to the integration of newer, high-tech practices and tools through 3D printing and programming microcontroller boards [1]. Through the use of these various low- and high-tech tools, practices, and materials that speak to a range of interests and cultural practices, making can foster STEM learning experiences for diverse youth populations by providing various entry points for participation [13–15]. Additionally, making can be leveraged as a resource to connect schools with out-of-school contexts by bridging youths' passions and interests to disciplinary content valued in schools and communities [2,16], as well as within the broader knowledge economy.

We acknowledge that the maker movement in education is a contested space and consider the present study one way of broadening what counts as making within current maker movement discourse. We locate our work in relation to equity-oriented education within making practices in that we sought to draw from family histories and cultures building from the assumption that making practices are already deeply embedded in minoritized communities [17]. To a large extent, the entrepreneurial aspects of the maker movement, where the honing of skills in the home are used to drive economic sustainability, drive the existing maker practices of many in America's working class. As Rose asserted, "working-class folk have not had the luxury of discovering making and tinkering; they've been doing it all their lives to survive—and creating exchange networks to facilitate it" [18] (p. xxv). We are interested in better understanding the sophisticated making practices of youth and their families and how to create bridges from these experiences to connected learning opportunities and pathways.

Relationships between family members can support the development of interest-driven projects connected to community resources [19,20]. These relationships may be characterized in different ways. For example, Brahms and Werner [19] found that family learning was dependent on the parents' and grandparents' involvement when young children were making in a museum makerspace. In Brahms

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makerspace. In Brahms and Werner's observations, adult family members actively engaged in activities with their children, learning and working with their children, coaching and encouraging them, and even sharing personal making-related stories from their family history. From Blum-Ross and Livingstone's study [21] of three different makerspaces, parents interacted in ways that the authors labeled: babysitting, supervising, cheerleading, collaborating, parallel-playing, and as connectors to prior experiences and other contexts. Importantly, we argue that regardless of the precise role family members play, supportive relationships are key to connecting youth interest-driven making to future opportunities and pathways for making.

3. A Model for Connected Learning

The connected learning model [7] is a productive theoretical framework for our study as it locates effective learning across contexts, consistent with sociocultural theories of learning [22,23]. This effective learning happens in the intersection of three elements: interests, relationships, and opportunities (Figure 1) acting as multiple entry points for the learner. For instance, educators can leverage youths' personal interests in today's "connected world" of online resources and online communities (i.e., YouTube, Internet, social media) to connect them with supportive relationships, such as mentors, and opportunities in the "real world" and across settings (e.g., home, schools, community). We know that connected learning experiences are inequitably distributed and that new technologies exacerbate inequities [24]. Given these historical and structural realities, like most current research on connected learning, we centered our work in this paper on supporting minoritized groups to pursue pathways to connected learning opportunities drawing from their already existing practices and forms of expertise [7]. Vossoughi and colleagues [17] acknowledged that centering equity in making environments can work in tandem with connecting young people toward meaningful academic, civic, and economic opportunities that support transformative outcomes. The connected learning model aligns with our equity-oriented approach to better understanding making practices of youth and how to connect those practices with mentorship and future opportunities to offer youth new learning pathways.

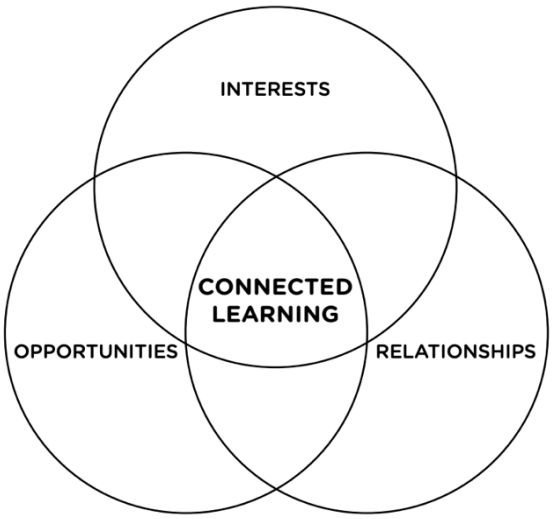

Figure 1. Elements of connected learning [7].

Here we explain each of the elements of the connected learning model. Personal interests motivate learners, help with focus and attention, support engagement, and are a source of determination to persist toward achieving a goal. For example, children and youth may spend their time on interest-driven activities, such as playing a sport or video games, practicing with a musical instrument, or communicating with friends on social media. Relationships between family members, friends, and the community can become meaningful supports that can connect children and youth to mentors, materials, or knowledge to nourish their interests and explore opportunities. Supportive relationships not only act as support systems for encouragement and motivating individuals with interest in the

learner, but they can act as "brokers", connecting the learner to resources, such as sources of mentoring and expertise, spaces, or materials. Finally, academic, economic, and/or civic opportunities may be available to children and youth as they pursue their interests. For example, some young people may be interested in digital media, as creators or users of video games, digital media production, social media, and text messaging [25]. Oftentimes these activities with technology are considered distractors and not recognized as productive, but as Ito et al. [25] have found, tech-savvy children and youth participate in new media literacy practices that afford their expression and participation in society through authoring and distribution of their work. Others develop technical skills such as programming or video editing that may provide a good foundation for future career pursuits. In brief, activities initiated from personal interests and supported and nurtured by relationships have the potential to connect to real-world opportunities due to the development of technical, creative, and analytical skills while working on these activities.

Importantly, connected learning builds from cultural and historical theories of learning that emphasize learners' social relationships as embedded within particular cultural and historical contexts [7]. This means that a connected learning model describes learning that happens between people as they interact in social contexts rather than as a solely individual or cognitive phenomenon. Therefore, part of connected learning is understanding the cultural and historical inequities that have prevented all youth from gaining access to opportunities and entering learning pathways since we know that minoritized youth have less access to new technologies than their economically advantaged peers [24]. Aligned with an agenda put forth by Reich and Ito [24] to design more equitable learning technologies, through our work in this paper we hope to support ideas for how to level the playing field to connected learning for youth by leveraging intergenerational connections. Our hope is that these family-centered connections may open up real-world opportunities for future learning pathways through making.

For the purpose of this study, we used connected learning as a theoretical framework, specifically by using the three elements of interests, relationships, and opportunities to frame the organization of our analysis and inform the interpretation of our findings. We were interested in finding the presence of existing low- and high-tech maker practices of minoritized youth that may be already nurtured, shared, and supported across the different contexts where these participants interact with others (i.e., homes, schools, and communities). Thus, we aimed to understand the kinds of interest-driven making activities with which youth engage and the conditions that nurture and support those activities. Lastly, we used the connected learning model to guide our analysis and interpretation of findings because it has been shown to support effective, equitable, and powerful learning during out-of-school time [26].

4. Method

Overall, our data collection methods and analysis approach supported our inquiry into youth making practices. We combined quantitative and qualitative data from a survey and semi-structured interviews with youth from minoritized communities and then applied inductive thematic analysis to survey responses and interview transcripts [27,28]. Through open-ended survey questions and semi-structured interviews, we hoped to access youths' "subjective understanding" [29] as participants reflected on and reconstructed [30] their making experiences.

4.1. Research Questions

Our overarching research question addressed in this paper was: to what extent and under what conditions do minoritized youth engage in maker practices? For the specific analyses included in this paper we broke down this overarching question into targeted questions we could answer with data. To investigate (1) the extent to which youth engaged in maker practices, we pursued the following detailed subquestions: (1a) What types of making are of interest to youth and to what extent they are engaged in making? (1b) Where does this making primarily take place? (1c) What resources do

minoritized youth draw upon to engage in making? To explore (2) the conditions under which these youth engaged in maker practices, we asked the subquestions: (2a) Why are they drawn to this type of making? (2b) How do relationships support and connect youth to making opportunities and future learning pathways? (2c) What opportunities and learning pathways are made possible for youth as a result of their making?

4.2. Study Context

This study was part of a larger collaborative initiative with the National Writing Project to produce curricula for classroom teachers through design-based research that investigated the development of systems of thinking while youth engaged with making toolkits. These efforts resulted in a four-volume series called *Interconnections: Understanding Systems through Digital Designs* [31–34], which investigates how designing digital stories, e-fashion, e-puppetry, and videogames in and out of school can help children learn core systems thinking concepts emphasized in the U.S. Common Core and Next Generation Science Standards. After pilot studies in after school programs and classrooms, we sponsored a summer camp to refine and test the curricula with 63 youth in the Chicago area. All youth came from schools and programs associated with a local partnership network that had researched digital media and learning for over five years. Youth were invited to participate in workshops, including computer programming with Scratch, game design, and e-textiles—the practice of merging electronic materials with low-tech textile materials. All participants and their parents (or legal guardians) gave their informed consent for inclusion before they participated in our study. The study was conducted in accordance with the Declaration of Helsinki, and the study protocol was approved by the institutional review board (also known as an independent ethics committee) at the time of the study. This particular study aimed to better understand how youth in minoritized communities conceived of their own making practices and the types of and extent to which making was taking place within this community.

4.3. Setting and Participants

Together with our research partners from a midwestern university, we sponsored a no-cost two-week summer camp for youth from surrounding low-income communities in the city of Chicago. Youth were purposefully recruited from low-income schools and long-standing after school communities in our established research networks that operated during the academic year but lacked summer programming. All youth who applied to the program were accepted. Out of 63 camp attendees, 52 participants (27 girls, 25 boys) agreed to respond to a survey about making and crafting. Table 1 provides a breakdown by gender, school grade level, age, and race/ethnicity. Importantly, 90% of participants ranged from nine to thirteen years old; 73% percent (n = 38) of participants self-identified either as Black, African American, Hispanic, multiracial Black, or multiracial African American.

4.4. Data Sources

Data sources included open-ended surveys and semi-structured interviews as described below (see Sections 4.4.1 and 4.4.2). In total, 52 youth participated in the survey and 20 youth participated in the interviews. Together, these data sources provided both high-level and in-depth information about participating youth and their maker practices and experiences. A benefit to using surveys and semi-structured interviews to answer our research questions was that these data sources offered us a window into youths' perspectives on their own maker practices. As a result of our focus on how interest-driven activities can connect youth to learning pathways, we were most interested in understanding how youth described and qualified their own participation and interactions with family members around making. Thus, surveys and interviews as data sources were aligned with our research aims. Of course, an implicit struggle of relying on people self-reporting on their own activity through means such as surveys or interviews is that results may be inadvertently biased toward youth showcasing how they hope to be portrayed. However, in our experience, we have most

often found in research of this nature that young people find participating in research to be a unique and worthwhile opportunity to talk to people who want to listen to what they have to say. Surveys and interviews thus offered youth a platform to talk about their interests and things that matter to them. Questions like those in our survey and interview protocols are rarely asked of students, especially in traditional learning settings, and so in the case of the present study, we found that interviews and surveys were a rare opportunity for young people to talk about things in which they and their families found value. Furthermore, surveys and interviews may have only scratched the surface in terms of the interesting making practices with which young people engaged. Overall, our data sources provided a compelling starting point for better understanding how young people and their families engage in making practices together.

Table 1. Survey and interview information by female/male participants, grade level, age, and race/ethnicity.

	All Participants *			Interviewed Participants *		
	Female $n = 27$	**Male** $n = 25$	**Total** 52	**Female** $n = 12$	**Male** $n = 8$	**Total** 20
Grade Level /Age						
4th / 9	-	1 (4%)	1 (2%)	-	-	-
5th / 10,11	1 (4%)	2 (8%)	3 (6%)	-	-	-
6th / 9–12	13 (48%)	13 (52%)	26 (50%)	7 (58%)	5 (63%)	12 (60%)
7th / 10–13	10 (37%)	5 (20%)	15 (28%)	4 (34%)	1 (13%)	5 (25%)
8th / 12,13	-	2 (8%)	2 (4%)	-	2 (25%)	2 (10%)
9th / 14	1 (4%)	-	1 (2%)	1 (8%)	-	1 (5%)
10th / 14	-	1 (4%)	1 (2%)	-	-	-
No response	2 (7%)	1 (4%)	3 (6%)	-	-	-
Race/Ethnicity						
Black/African American	16 (59%)	12 (48%)	28 (54%)	7 (58%)	4 (50%)	11 (55%)
Black/African American and another Race	1 (4%)	3 (12%)	4 (7%)	1 (8%)	3 (37%)	4 (20%)
Hispanic	4 (15%)	2 (8%)	6 (12%)	2 (17%)	-	2 (10%)
White	5 (18%)	3 (12%)	8 (15%)	2 (17%)	1 (13%)	3 (15%)
No response	1 (4%)	5 (20%)	6 (12%)	-	-	-

* Note. Data displaying number of participants (percentage of participants) by grade level (th) and age range (in years) from survey responses. The numbers highlighted in gray indicate largest percentages in the grade level/age and race/ethnicity categories.

4.4.1. Survey

We wrote an original ten-question survey about maker practices and experiences that was distributed during an e-textile workshop. Some sample questions included: Do you do any making/building or crafting? Where have you done these making and/or crafting activities? See Appendix A for full survey protocol. The objectives of the survey were to determine the extent and conditions of the youth's engagement with making prior to the summer camp. The survey had three sections: (a) demographic information (e.g., age, gender, school grade, race/ethnicity), (b) maker activities with which youth engaged from a list of eight items (e.g., woodworking, model building kits, knitting) with short answer fields, and (c) open-ended questions regarding the duration of making, location, future plans, and level of involvement in making. Youth filled out the surveys by hand and were given 20 min to complete the survey. These surveys provided high level insights into youth maker practices and supported interview selection.

4.4.2. Interviews

Semi-structured interviews supported our understanding of youth engagement with making and offered participants an opportunity to reflect on and reconstruct their experiences [30]. The main purpose of the video-recorded interviews was to learn more about the layers of individual experience in making activities. We purposefully selected 20 (12 girls, 8 boys) out of the 52 participants for semi-structured interviews (see Appendix B for demographic information of interviewed participants). We purposefully selected these youth based on the number and variety of crafts listed in their completed surveys and also because some were particularly compelling cases within our connected learning

framework. That is, some interviewed participants indicated engagement with making in ways that could connect to real-world opportunities (e.g., selling the artifacts they made). We also invited a few participants who indicated in their survey that they had not had any experience with making so we could understand how these youth understood making practice or potential for making practice.

The interviewer used each completed survey as a starting point for the semi-structured interview protocol, using responses to guide the interview discussion. A graduate student research assistant conducted each interview at the workshop location in a separate, quiet room. Video recordings ranged from 5 to 21 min (average = 11 min). We transcribed the talk verbatim (no gestures) to accompany the analysis while watching the video recording for thematic coding. All participants' names in this paper are pseudonyms.

4.5. Analytical Approach

Here, we report our analytical approach by treatment of each data source. First, we show how survey data helped us to construct descriptive statistics and get an overall feel for the extent to which youth engaged in making. Next, we describe how we used thematic analysis with our video transcript data. Importantly, our evolving understandings of surveys and interviews were used in relation to one another as we made sense of the entire data set.

4.5.1. Survey Data Overview

Working from a spreadsheet to organize survey data, we aggregated similar responses, counted frequencies, and summarized each of the survey questions, breaking down answers in percentages and including all divergent responses when appropriate. Table 2 shows how we mapped specific survey questions to our research subquestions. Surveys provided a starting point for understanding youths' self-reported making experiences, and interviews added texture to these experiences.

Table 2. Alignment of survey responses to address research question and subquestions.

Research Question	Data Source
1. To what extent do minoritized youth engage in maker practices?	
(1a) What types of making are of interest to youth and to what extent are they engaged in making?	To address question 1a, we used the responses to the survey questions: #1—Do you do any making/building or crafting? If so, what types of handcrafting or building/making do you do? #3—How long have you been doing these making/crafting activities?
(1b) Where does this making primarily take place?	To address question 1b, we used the responses to the survey question: #4—Where have you done these making and/or crafting activities?
(1c) What resources do minoritized youth draw upon to engage in making? *	To address question 1c, we used the responses to the survey question: #2—Who taught you about these activities? How did or do you learn about these activities?
2. Under what conditions do minoritized youth engage in maker practices?	
(2a) Why are they drawn to this type of making? *	To address question 2a, we used the responses to the survey question: #7a—Where did your interest come from? #7b—What made you want to get started?
(2b) How do relationships support and connect youth to making opportunities and future learning pathways? *	To address question 2b, we used the survey responses to the following questions: #5—Do any of your friends or family get involved in these activities? If so, who, and how do they get involved? #6 With whom and where do you share your work? #8—Who (else) crafts or makes/builds in your family and what do they make? #9—Which of your friends craft or make/build and what do they make?
(2c) What opportunities and learning pathways are made possible for youth as a result of their making? *	To address question 2c, we used the survey responses to the following question: #7c—Why do you keep doing it?

* We conducted thematic analysis of interview responses to address these questions in addition to triangulating and expanding on findings from surveys.

4.5.2. Interview Data Analysis

We analyzed each of the interview transcripts using inductive thematic analysis, as described by Braun and Clarke [27,28]. Thematic analysis (TA) is an iterative method that guides the researcher toward the identification of patterns (themes) within and across data to make sense of meanings and experiences relevant to the research questions [28]. We selected this approach for its flexibility to work with different theoretical frameworks as compared to other approaches that are attached to specific theories (e.g., interpretative phenomenological analysis). Thematic analysis allowed us to use an inductive or bottom-up approach to stay close to the content and participants' constructions of their experiences, instead of using a deductive or top-down approach with a set of pre-established concepts and codes. In other words, an inductive approach allowed us to highlight the nuances of participants' experiences in their own words. Informed by our theoretical framework of connected learning, we began the interview analysis by using an open coding approach with transcripts. After importing all transcripts into Atlas.ti (i.e., a computer-aided qualitative data analysis software), we started the thematic analysis process following the six phases described by Braun and Clarke [27]. The chosen unit of analysis was a "turn" or segment of the interview, including the question with its corresponding participant response.

First, we familiarized ourselves with the data (phase 1) by watching the videos multiple times while reading the corresponding transcript in Atlas.ti. During this phase, we marked excerpts of content unique to each participant about maker practices. For example, the following excerpt representing our unit of analysis (or turn) describes one participant's experience with making:

> Interviewer: Ok. Ok. Um . . . and bird houses. Who taught you how to make birdhouses?
>
> Anne: My dad... Um I wanted to do something with my hands and that was before I did weaving and sewing . . . So . . . um, I did [made] it for my uncle. 'Cause he loves birds...

Second, we generated initial codes (phase 2) or categories relevant to our research questions through all 20 interviews. For instance, in considering the above excerpt in relation to our inquiry as to how relationships connect youth to future opportunities and learning pathways, we thought about how to best characterize how Anne talked about making with a family member. While implicit in our interview question, Anne elaborated that her dad taught her how to make a birdhouse (which she did for her uncle), and so through our inductive approach we assigned the initial descriptive code "teach" to Anne's response. We figured that this was a relevant code because Anne could have negated the interviewer's assumption that someone taught her and replied something along the lines of, "I taught myself" or "I dunno." Instead, Anne took up the interviewer's question, characterizing her making relationship with her dad as one in which he taught her making practices so she could "do something with [her] hands." Our inductive work was guided by a deep engagement with our research questions, our assumptions about families as rich resources for learning, and our overarching model for connected learning. Third, after applying initial inductive codes, we searched for themes (phase 3) or patterns related to the research questions. Before finding patterns, we reviewed the coded data set and started merging similar codes that conveyed the same meaning, refining the names of the codes, or breaking up codes into two or more codes that seemed to explain different meanings. For example, we changed the code "teach" to "parent teaches crafting." As we continued to revise the initial codes multiple times across the data set, we noticed that a few codes clustered around common ideas. For example, we decided to construct the potential theme "family member teaching" with all of its related codes, including "parent teaches crafting," "uncle or aunt teaches crafting." We calculated the consistency of judgement, or intercoder reliability [35], of the final list of codes. One author and another trained researcher coded 30% of the transcripts using the developed coding scheme, reaching a high level of agreement of 85%.

Fourth, we reviewed all of the potential themes (phase 4), comparing repeatedly between each to ensure they did not overlap and that they related to the coded text of the complete set. Using Atlas.ti,

we created a table to cross-tabulate frequencies per code for each of the interviews to identify patterns and themes across cases and note particularly high frequencies. This cross-tabulations table allowed us to construct themes that described the data across cases. As the analysis continued, we began to work up a theory of how the theme such as "family member teaching" fit within a broader collection of themes that described supportive family relationships within youth making practice. Fifth, we defined and named the themes (phase 5) that would be representative of the data set (see Appendix C for coding scheme and full list of themes) so that we could achieve internal generalizability [36] as we crafted stories about data. Like much qualitative work, we consider this study to be illustrative of this community but do not make claims that it is necessarily generalizable to a broader population, as there may have been particular variables that made this population unique (e.g., all youth applied to be part of the summer camp). Through our careful qualitative work here we hope to illuminate the kinds of resources and supports to which young people might have access through relationships in the home. As researchers and educators, it is our responsibility to find ways to connect these rich qualitative findings to future opportunities and possibilities. As a last step in analysis, this journal article is part of what Braun and Clarke [28] call the production of the report (phase 6) to present findings.

5. Findings

We first present evidence on the extent to which youth engaged in maker practices by describing the types of interest-driven maker activities with which youth engaged, the locations where youth making primarily took place, and the resources youth drew upon to engage in making. Next, we describe the relevant conditions under which minoritized youth engaged in maker practices, including reasons for why these youth were drawn to making and how relationships supported their engagement with maker practices. Finally, we highlight the potential opportunities and learning pathways we identified as a result of their self-reported maker practices, explanation of resources, and description of how relationships shaped their making.

5.1. Extent of Interest-Driven Maker Practices

Guided by our first research question, we discuss findings related to the extent to which youth engaged in maker practices to offer a baseline for understanding the relationship between youth and their existing maker practices.

5.1.1. The Landscape of Youth Engagement with Maker Activities

We were interested to find out which maker activities participants self-identified as being part of their repertoires of practice [37]. Understanding the breadth of maker practices with which youth engage is central to helping us understand how to design learning experiences that build on these experiences since few prior studies have surveyed maker practices already in place among minoritized communities. Our survey indicated that the top five activities youth self-reported were model building kits (44%), sewing (37%), scrapbooking (33%), jewelry making and woodworking (29%), and friendship bracelets (25%) (see Table 3). We broke down survey responses by male and female youth to see if our data mirrored common historical assumptions about gendered making and crafting practices [38]. While some differences were found across our breakdown of male and female youth respondents, we found it most relevant for our study to note that taken together, all youth engaged in a wide range of maker activities.

Table 3. Types of maker activities from survey responses by male/female respondents.

	All Participants		
	Female $n = 27$	**Male** $n = 25$	**Total** 52
Type of maker activity			
Model Building Kits	8 (30%)	15 (60%)	23 (44%)
Sewing	13 (48%)	6 (24%)	19 (37%)
Scrapbooking	11 (41%)	6 (24%)	17 (33%)
Jewelry Making	11 (41%)	4 (16%)	15 (29%)
Woodworking	5 (19%)	10 (40%)	15 (29%)
Friendship Bracelets	12 (44%)	1 (4%)	13 (25%)
Knitting	9 (33%)	1 (4%)	10 (19%)
Crocheting	7 (26%)	3 (12%)	10 (19%)
Other: -Drawing	4 (15%)	3 (12%)	7 (13%)
-Paper Crafting	2 (7%)	3 (12%)	5 (10%)
-Lanyards	4 (15%)	-	4 (8%)
-Photography	2 (7%)	-	2 (4%)
-Comics	-	2 (8%)	2 (4%)
-Ceramics	-	2 (8%)	2 (4%)
-Miscellaneous *	7 (26%)	6 (24%)	13 (25%)
None	4 (15%)	3 (12%)	7 (13%)

* Other = animation, arts, balloon twisting, books, braiding, duct tape, everything, fiction, painting Converse tennis shoes, poppers fireworks, puppets, soap making, weaving, writing.

Through their write-in "other" responses, participants shared they engaged with a wide range of activities they considered to fall under the "maker" umbrella. These activities included: digital animation, arts, balloon twisting, books, braiding, duct tape, everything, fiction, painting Converse tennis shoes, poppers fireworks, soap making, weaving, and writing. Unexpectedly, just two out of the 52 survey responses explicitly mentioned some kind of digital making. One girl worked on digital animation in an after school club and another referenced involvement in making through Minecraft™ at home. Interestingly, the connected learning model would have had us guess that online communities and peers would play a stronger role in youth self-identified making; however, this was not the case with this particular group of minoritized youth.

On average, participants already had a little over 3 years' making experience, and most started making in early elementary grades, or about 6–7 years of age (87%). Additionally, on average, youth reported engaging regularly in three or more maker activities. This long-term interest and commitment to a variety of maker activities signaled youths' ongoing commitments to this work and potential for developing expertise in these areas.

Surprisingly, homes (as opposed to schools, community centers, libraries, or other out-of-school programs) were the principal location where these youth reported engaging with maker activities. When asked about where they engaged in making, student responses were distributed as follows: making only in the home (51%); in the home and school (28%); in the home and an after school program or community center (14%); only in school (5%); only in an after school program or community center (2%). We conjectured that schools and other community settings, such as libraries or city centers, would have been places where minoritized youth with limited resources would talk about engaging with making. Prior to conducting the survey, although we know that families carry valuable cultural, economic, and social resources, we would not have imagined that youth would specifically identify the home to be such a rich space for making activity. That is, through surveys and interviews, participants identified the home (in lieu of other more traditional learning settings) as a primary place for learning and making activities done in collaboration with family members. Additionally, at home, youth reported having access to materials, tools, their own free time, and help from family members and their wider family-based networks. Later, we describe in detail how key relationships with others to engage in making presented opportunities for youth to connect their interests and relationships to

the activities with which they engaged, thus supporting the connected learning model. Furthermore, this finding led us to consider that making activities happening in the home could potentially be tapped for other purposes, such as academic learning in traditional schooling (e.g., [39]).

5.1.2. Resources Youth Drew Upon When Engaged in Making at Home

There were different resources that youth drew upon to learn how to participate in different maker activities and to sustain their practices at home. Resources youth referenced as influencing their making included: expertise, time, transportation, and financial means to pay for making-related costs, such as after school program fees and materials and tools. It was important to us to uncover more about these resources to understand how to connect youth interests in making to their relationships and opportunities within a model of connected learning. A majority of surveyed youth (80%) noted that a family member taught them maker activities. The survey responses showed mothers (33%) as the main family member that did the teaching of the practice, followed by fathers, siblings, grandmothers, and other extended family members, such as their uncles, aunts, cousins, and grandfathers (in that order). Some youth (20%) shared that making was self-taught. While not all self-taught youth explained precisely how they taught themselves, a few shared that they used books, tinkered with available materials, and a couple of participants learned from YouTube videos.

In the examples below from Brady (13-year-old boy) and Ashley (12-year old girl), we illustrate how youth used their available resources to learn their maker activities and to sustain their practices. Brady shared in an interview that his grandfather shared his expertise in building model kits:

> Interviewer: I wanted to talk with you about your making and crafting. You talk about building models—and I just wanted to ask you how you learned about that?
>
> Brady: My grandfather taught me how to make that, anything I wanted to help him with. So my grandfather is the one that really taught me how to do it—he got me started. We made a model boat—a model ship—a ship inside a bottle—I helped him do that.

Brady seemed to have open access to his grandfather's expertise when he said he could work on "anything I wanted to help him with." This response indicated that Brady's interests drove their collaborative making, not his grandfather's predetermined agenda. Additionally, through this interview response, Brady's discursive orientation within the making activity shifted over time. That is, Brady moved from his grandfather teaching him how to "make that" to referencing their collaborative making (e.g., "*we* made a model boat") to asserting first-person ownership of making something (e.g., "*I* helped him do that"). This suggests that learning from his grandfather supported Brady's participation and evolving expertise within his making practice.

Ashley's interview below highlights how she accesses maker resources, such as expertise, time from her parent-turned-making-teacher, and making materials, in spite of facing "hard" circumstances, such as living "not walking distance" from stores:

> Interviewer: ...you said you learned [scrapbooking] from your mom and your grandmother about some of these activities.
>
> Ashley: My mom—she works for an advertising company so a lot of her stuff is creative and she knows how to draw and stuff—so like when I do projects—and scrapbooks and stuff, she helps me with designs and she usually gets me creative scissors and stuff—so I use that to like do the border of my scrapbook and stuff—and she goes and gets all the pictures and I know that is hard and stuff because we live not far, but not walking distance—so I know it is hard to go and get pictures developed and stuff—and she inspires me to do what I want and what I like to do because if I let restrictions hold me back, I'll never get done with anything.

Ashley's reflection on how she locates and uses resources included drawing from her mom's expertise in "designs" and material resources like "creative scissors." She also acknowledged that her

mom works to get her material resources she needs, despite it being "hard and stuff" to get "all the pictures" Ashley needs for her scrapbooks. Importantly, Ashley explained that her mom's willingness to do whatever it takes to help her engage in her chosen maker activity (i.e., scrapbooking) "inspires" Ashley to persevere with her interest despite challenges to acquiring necessary resources. This final reflection from Ashley is evidence of how despite facing "restrictions," she has internalized the message of not letting anything hold her back from pursuing her interests and passions. Ashley's positive relationship with her mom is a pivotal element of how she understands and holds herself accountable within her own making and perhaps across other activities.

Across cases, youth explained that their family members provided them with resources for their making in a variety of ways, including: parents offering instruction aligned with their careers (e.g., graphic design, auto repair, electrician) or other forms of expertise; buying or somehow acquiring construction kits, materials, and/or tools; and connecting youth with other family members or family friends that could teach them a particular making activity (e.g., knitting, crocheting). The interviews commonly revealed that most minoritized youth involved in making gained skills and knowledge from immediate and extended family members. These findings from our data, which showed the ways family relationships supported youth acquire necessary resources, suggest that relationships within the home are a rich and central support structure for fostering youth engagement with making. We detail how these relationships shaped youth making activity later in the findings, after diving into youth motivations for making.

5.2. Conditions under Which Youth Engage in Maker Practices

Guided by our second research question, we discuss findings related to the conditions under which youth engaged in maker practices to highlight youth motivations for making and describe how relationships impacted interest-driven making. We then use these findings, coupled with our earlier description of the landscape of youth making, to suggest potential opportunities and pathways that are possible as a result of youth maker activities.

5.2.1. Reasons for Making

Our analysis of interview transcripts allowed us to dig deeper into understanding each of the key reasons why youth engaged in maker activities, while the survey responses presented an overview of reasons youth engaged in making. Overall, our thematic analysis corroborated responses from surveys, indicating that participants were motivated to engage in making for four key reasons that were salient across the data: (a) drawing inspiration from artifacts; (b) drawing inspiration from making processes; (c) making for fun; and (d) making to share with others. Below, we describe each of these themes that were constructed from the data. Importantly, these themes were not mutually exclusive, as youth often described multiple reasons for making within their interviews.

Drawing inspiration from artifacts. Sixteen interviewed youth (80%) explicitly mentioned that they got inspired to start making projects or to learn the "how-to" of the practice (e.g., sewing) by the artifact itself. In the example below, Claire, a 12-year old girl, explained how objects that are part of her everyday cultural life motivated her to want to understand how to make particular things.

> Claire: If I see something I really want to do—then I tell my mom about it and then we start looking for stuff about it.
>
> Interviewer: Have you ever..., uh, while you are out seeing something that somebody is wearing.
>
> Claire: Yeah, I see a lot of girls are wearing these necklaces—and I ask them what they make them from and they say shirts, so I really want to try to do that someday.
>
> Interviewer: So, what does the necklace look like—it's made out of shirts?

Claire: Well actually it's like a scarf—they cut the scarf up and then tie it around and make it look like a scarf.

Interviewer: And who else in your family crafts or makes things.

Claire: No one else really does that.

In her interview response above, Claire revealed that her inspiration was drawn from both the artifact itself and the social meaning tied to the artifact she could imagine making for herself. Similarly, in the following example, Anne, an 11-year old girl, explained that she built a wooden birdhouse for her uncle, showing how artifacts can be deeply connected to the people for whom they are made.

Interviewer: Nice...So, um. And how did you ... like, decide you wanted to do a birdhouse?

Anne: Well, the first time I remember going to my uncle's house. I remember him having the purple martin houses and I knew that he liked birds. 'Cause I didn't know what they were so I asked him what they were, and he said they were birds. And so, for his birthday, which was just yesterday, so, for his birthday that the next year I made him a birdhouse, so and I knew he liked birds, so I made him a birdhouse. That's why I made a birdhouse.

Artifacts that inspire positive emotional connections have been recognized as productive mediators in learning [40], and it seems that youths' reasons for making are tied to the personal, social, and emotional contexts in which artifacts are situated.

Drawing inspiration from making processes. Fourteen interviewed youth (70%) explained that watching someone making and creating an artifact (e.g., sewing, building, fixing) inspired them to learn how to either make that type of artifact or to learn the skill, following the specific process and use of tools. That is, witnessing the process of making, especially by people to whom the youth were personally connected, led to youth expressing the desire to engage in the process of making, too. The experience of Ashley shows her interest in the process and actions of others, as expressed by the use of the verbs in her talk (e.g., using, sewing, knitting, making) about her grandmother's making practice:

Interviewer: So how do you happen to get involved in this [sewing] are your mom and grandmother doing it—or do you ask about it—do you just-

Ashley: When I was little I saw my grandmother using a sewing machine and I thought it looked so cool—it's not like everyone can do it—it's like . . . .she's sewing a dress by herself—and like, not a lot of people can do that . . . .so when I got older I just wanted to be like one of those people that is like creative and doing well manually with her hands...and like that was really cool—and I like see other people's grandmothers and stuff—knitting—and I just wanted to learn how to do it—that's it—that's the main thing with knitting—um—people making these really pretty sweaters and these really pretty ah scarves and I just wanted to make one. So that's why I got into knitting.

Ashley's judgment of the combined action–tool–artifact construct as "not a lot of people can do that" denotes an interesting and powerful perspective that prompted her to reflect on possibilities for her own future practice. When Ashley explained that "to be like one of those people that is like creative and doing well manually with her hands", she was projecting an imagined identity of her future self, who she may become if she learns the making process. Taken together, being inspired by artifacts and processes in making were bound to the people and social contexts in which the maker practices were situated.

Making for fun. In addition to being inspired by artifacts and the making process, making for fun or leisure was another theme that emerged in our analysis of youth making motivations. Across interviews, eighteen youth (90%) explained that they participated in making because it was enjoyable, "fun", or "cool." Marlene, an 11-year-old girl, explained how knitting was fun:

Interviewer: Do you enjoy knitting?

Marlene: Yeah, it's kind of fun, it's kind of relaxing type. Where if I'm like in stress it helps me calm down and it's fun because I get to talk to my friends [in an after school class] and stuff. And then I can make my own fashions because one day I made a scarf—out of rainbow string. So, then I gave it to my grandma—and she liked it—but making my stuff was kind of fun so I would just calm down sometimes. And I always teach my mom how to knit—but never got the hang of it yet. So, I would make my own stuff—and that is awesome because I like got to use different type of yarn and stuff made of color I like. And since I learned how to finish off a scarf instead of having pieces left, it seemed kind of fun—because every time you did it—you could put your own imagination and stuff.

While this theme emphasizes how making is a form of leisure and something that youth enjoy doing in their free time, Marlene's response still highlights how the artifacts she makes are connected to a person about whom she cares a great deal (in this case, her grandma). This theme again emphasizes the value of how personal relationships are embedded within the interest-driven artifacts youth make.

Making to share with others. Giving personal artifacts as gifts is another reason youth engage in making, as evidenced through Anne giving her uncle a birdhouse for his birthday and Marlene knitting a scarf for her grandma in the excerpts above. Fifteen interviewed youth (75%) indicated sharing the artifacts they made with their families. This sharing consisted of either showing or giving away their artifacts as gifts to others. Josephine, an 11-year-old girl, explained that she enjoys giving away her projects to family members:

Interviewer: And who do you share your work with?

Josephine: I like giving people things that I make.

Interviewer: Who do you give things to?

Josephine: Just family for their birthdays and stuff like that.

Interviewer: Does that affect what you are going to make—so you have an idea of who you are going to give it to before you even start making it?

Josephine: Yes, it kind of motivates me to make it better if I am making it for someone besides myself.

Family members provided validation for making practices of youth by showing their support. Furthermore, we found that youth were motivated to "make [a project] better" if it was intended as a gift for a member of their family or social circle. In all, making was motivated by the interests youth had in making artifacts, engaging in making processes, for fun, and to share with others. As the other themes highlight, this theme of sharing with others is also contextually and socially bound to people that connected youth with maker practices and artifacts.

5.2.2. Different Ways Families Support Youth Making at Home

Immediate and extended family members were often central resource brokers (i.e., through sharing expertise, time, and acquiring materials) for engaging youth with making. Here we disentangle the ways family members interacted with youth to support their maker practices. We pivot our focus from resources to how relationships and interactions supported making. Our thematic analysis of interviews led us to break down these types of supportive interactions in the following ways: (a) family members involved in their own maker activities; (b) family members connecting youth to resources; (c) family members explicitly teaching youth; and (d) family members making alongside youth.

Similar to how we reported the reasons for making above, these different types of supportive interactions were not mutually exclusive from participant to participant, and several could coexist

within the same case. That is, the participants discussed a diverse range of ways in which they interacted with family members in relation to making and so multiple thematic codes could be applied within the same interview. For example, a participant may have discussed how a family member bought materials for making activities like knitting, and then also explicitly taught them how to engage in a different kind of making (e.g., sewing) in which that family member had greater expertise. The four themes we report and describe with examples below represent the most salient categories across data and highlight how youth described supportive interactions with family members around making.

Family members involved in their own maker activities. In total, 77% of the youth reported in survey responses that their immediate or extended family members engaged in forms of making, building, or crafting due to their own occupations, including: mechanics, electricians, architects, construction workers, painters, carpenters, writers, costume creators, and graphic designers. All of these occupations require hands-on practices with an emphasis on creating artifacts or products. Participants knew about these occupations of their family members and often those activities occurred in their own home. These facts suggest that those hands-on, maker activities were visible to participants. This theme emerged across interviews as well, as nineteen of the interviewed youth (95%) discussed a family member's hands-on making. For example, Joseph, an 11-year-old-boy, shared that his father drew from his occupation as a carpenter to actively make use of his making expertise in the home:

> Interviewer: What does your dad build?
>
> Joseph: He builds stuff for the house. Like, he bought a house and he repaired it all by himself. He built stuff he wanted inside. And he's a carpenter so he does roofs also.

Our interviews with Joseph and others highlight how youth identify their family members as engaging with hands-on activities as part of their careers and within the home. They expressed the magnitude and relevance of maker practices. Notably, Joseph did not mention actively participating in making with his father; when a parent is active in maker activities in the home, even if they are just acting as a model, those practices may be visible to the youth and leave open potential opportunities for the development of interest, pointing toward "observation with intent" [41]. This observation may be a first step toward leading youth to engage in legitimate peripheral participation and full participation within a community of practice [22].

Family members connect youth to resources for making. Across cases, youth mentioned the diverse ways their family members connected them to physical resources, such as construction kits, materials, and tools, as well as social resources like clubs or other people who could help them learn a making activity. The following example from Claire shows how her mom is an encouraging parent and resource connector, even though she does not practice any making herself:

> Interviewer: How did you learn about crocheting and friendship bracelets and keychains?
>
> Claire: Me and my mom went to this store—it's called [store name]—and it has a lot of stuff in it—oh that looks cool and she buys stuff for me. So, I get to start it.
>
> [later in the interview]
>
> Interviewer: So, who gets the idea of what you want to do—where does it start?
>
> Claire: It starts with me, but sometimes when things get really hard, I don't want to do it anymore—so my mom keeps pushing me to do it.
>
> Interviewer: Does your mom make things herself?
>
> Claire: Not really.
>
> Interviewer: No, so she doesn't knit or sew or crochet or anything like building—make birdhouses or anything?

Claire: No.

Across interviews, fourteen youths (70%) explicitly mentioned that they received resources from family members when their making interests did not map onto family members' expertise. This finding emphasizes that there are multiple ways that family members support youth even outside of their areas of interest and expertise. Many youths reported that even if family members did not engage in a particular making practice, they were supportive in other ways like providing access to material resources and encouraging their making. Although Claire noted that her mom does not have a making practice, she said that her mom "keeps pushing [her] to do it," indicating that though she does not model making herself, her mom is a source of supportive encouragement and finds value in Claire's making interests.

Family members teach making. Fifteen interviewed youth (75%) also mentioned that family members explicitly taught them how to make things. The following example from Marlene depicts a straightforward account of when her mother taught her how to sew:

Interviewer: ...does anyone else in your family and friends get involved like when you make things? I guess we didn't talk about your sewing and building models, too. So, what do you make in model making or what do you sew?

Marlene: My mom she taught me how to sew so on some days when I ask her if I can sew—she, um. Like today, I am going to sew my sister's shorts. We, um, I just wanted to learn how to sew because it seemed cool and it is kind of like knitting so I thought it would be easy, so I just got me interested in that

Although Marlene says her mom taught her how to sew, Marlene explains that she was going to sew her sister's shorts, indicating her active role within instruction. Marlene and other youth learned from their family members how to engage in a variety of maker activities, including sewing, building construction kits, and making birdhouses. In these supportive interactions, family members would not just provide access to resources but also spend time explicitly explaining making processes to youth. To illustrate, teaching sewing for the first time would require explaining how to use multiple tools and materials (e.g., needle, threader, pincushion), modeling technique, and practicing new skills (e.g., making knots, running stitches by hand, running a sewing machine). The level of participation here from the "teacher" (family member) and the "learner" (youth), is deeper in terms of time and effort than connecting youth to resources.

Family members and youth making together. Sixteen youths (80%) mentioned in interviews making something with a family member at home, an unexpected finding as we expected interactions with friends in schools or community centers to play a larger role. The example from Joseph below shows a simple interaction between him and his father while making together:

Interviewer: Have you ever worked with your dad?

Joseph: Yeah.

Interviewer: What kinds of things have you done with him?

Joseph: He was, uh, fixing a lamp for the outside and I was giving him tools and holding stuff for him. Like uh, holding stuff in place. So, he could screw stuff in.

Joseph's contributions to his father's actions were somewhat minimal as he was "holding stuff for him...so [his father] could screw stuff in." Nonetheless, Joseph still considered this to be working with his dad even if he was only helping so that his father could fix the lamp. In contrast, in the example below Nolan describes a more independent role when making with his father:

Interviewer: Tell me about what you are making.

Nolan: Well, one day I helped my dad build a bench for my football team and another time we made a chair...

Interviewer: ...and what is probably your favorite project that you worked with—either with your grandpa, your uncle,

Nolan: Well, my whole family pitched together at my great-grandma's house—she's still living—we pulled up the carpet and sanded the floor and uh—you see that edge over there—there were nails through the molding and we had to use a hammer to kind of pull all of the nails and pull the molding off—that was my favorite project.

In Nolan's descriptions of his maker activities, he seemed to take a central role while making with family members. His repeated references to a collective "*we*," noting that "*we* made a chair" and "*we* had to use a hammer," as well as referencing "my whole family pitched together" shows how he thought of making as a collective activity in which he was making alongside others. In contrast to Joseph's description of holding tools so that his dad could fix something, Nolan's reflection shows that he was a full participant [22], demonstrating potential for what Rogoff [42] called "participatory appropriation" since his participation changed through engagement in sociocultural activities with his family. Nolan's move toward participatory appropriation also suggests the potential for family making to shift how youth see themselves and imagine who they might become.

5.2.3. Missed Opportunities for Connections to Making

Thus far in this section, we have presented findings aligned with our second research question and subquestions to describe the conditions under which minoritized youth engage in maker practices, including uncovering motivations and describing how relationships support youth making. However, our data showed that there were some participants not engaged in any making at all who reported no interaction in making practices with others. 13% of the surveyed participants reported that they did not engage in any making activities. Digging deeper into the data, we found that about half of these participants reported that nobody in their family was involved with making and the rest mentioned that though someone in their immediate or extended family engaged in hands-on making activities, it did not impact their own making. For example, Karla and Megan were two participants we interviewed who did not have experiences they considered to be making. First, we highlight an interview exchange with Karla, who mentioned that her grandfather worked on hands-on projects:

Interviewer: So, you said [in the survey] that your grandfather makes, what does he make?

Karla: He makes birdhouses—he moved from where my parents are right now—he made a screen house and uh, he built like a bar in the downstairs—he um—what else did he build?—he built, um like a room inside um like downstairs, like his tool room he built the bathroom in the basement.

While Karla was aware of her grandfather's making practice, her experience was notably different from those who observed their own family members making because Karla's interactions with her grandfather did not impact how she oriented toward potential making activities for herself. That is, Karla did not meaningfully observe or interact with her grandfather around his making activity, and his making activity did not impact her interest in making. Though we tried to locate points of connection and supportive interactions for making in her interview, family relationships did not seem to enable possibilities for Karla's own making or learning. Similarly, in the case of Megan below, supportive interactions for making were not readily present because of the daily responsibilities and busy schedules of her family members:

Interviewer: So, one thing I wanted to ask is... it seems like you haven't done any making before or crafting. How come? Do you know why?

Megan: Uhm, no.

Interviewer: Does anyone in your family make things or craft?

Megan: [Shakes head no]

[A few minutes later]

Interviewer: What about your family? What do they do in their spare time?

Megan: My mom is always working. She works at a hospital. My grandma is always running somewhere, and grandpa works as a doorman downtown—so does my uncle, so.

Megan's interview brings to light the challenges youth may experience within the home that could prevent them from leveraging the supportive relationships they need to engage in interest-driven making activities and ultimately connect to real-world opportunities. Importantly, we do not believe it is fair to attribute the obstacles that Karla and Megan faced as the fault of their family members, and acknowledge that supportive relationships may have been present for these youth in other ways. However, we reveal these barriers to entry here to paint the full picture of youth experience in relation to making so that we can most productively figure out ways to support all youth to pursue interest-driven making activities, drawing from resources and relationships outside the home, if necessary.

The missed connections that the cases of Karla and Megan illuminate are necessary to holistically describe our data set. In bringing our major findings on making at home together, we now move to describe evidence for how supportive family relationships coupled with youth interests in making can connect youth to real-world making opportunities and future learning pathways. We have emphasized family relationships across our data set because they stay with youth as they grow and are often built on foundations of trust, encouragement, and support. The connected learning model emphasizes the connections between youth interests, supportive relationships, and opportunities, which may be academic, economic, or civic. In this study we focused mainly on how interests in making supported in the home might prepare youth for various learning pathways and other academic, economic, and civic opportunities. We describe possibilities for these opportunities through two cases in the section below.

5.2.4. Opportunities and Learning Pathways Connected to Making in the Home

According to the model of connected learning, interest-driven activities with supportive relationships afford real-world educational, civic, and career opportunities. The following stories of Brady (13-year-old boy) and Maria (12-year-old girl) illustrate their entry points to particular economic opportunities and learning pathways as a result of engaging in maker practices through supportive relationships in their homes.

Brady

Brady and two of his friends started to repair bikes together. Brady said that everything started when they "were just sitting around not doing nothing" and "saw people fixing bikes" on YouTube. They taught themselves and started to "build bikes." It is important to note that making is something that is valued in Brady's home. At one point in the interview, Brady expressed his desire to learn how to repair cars from his dad, who is a mechanic. Also, Brady's grandparents are makers. His grandfather works with Brady on aircraft and teaches him boat modeling and his grandmother engages in making through sewing, repairing clothing, and scrapbooking. Brady's maker practice of fixing bikes reaches beyond his personal interests and supportive relationships, however. In an interview, Brady explained that he and his two friends "get a little money like our little side business that we do." Bike repair work became an opportunity for him and his two friends to run a business. He described the details of his pricing model:

> We charge like $10 [USD] to fix bikes—but if a chain slips—we only charge like $5 because that's something simple that anybody can do. If it is something major—like bolts are all out of place—the wheel is like wobbly—we would help out and go buy pieces—put them on and charge like $15 for something like that, 'cause you know because of expenses, cause it's not that expensive to buy everything—and sometimes people bring in stuff that they think we need and help us out a bit—so we teach people how to do it so . . .

Interestingly, Brady did not only reflect on creating fair prices for the work they did, but he also explained that they became teachers to their customers so they could repair bikes themselves. Brady shared additional details of running their bike repair business, including advertising operations and their organizational structure:

> We set up flyers in our neighborhood. Sometimes we go out to different neighborhoods and we'll set up because we have some friends that live in those neighborhoods, they want some money and they want to help so we'll set up in front of their garage and help out and then give everyone their cut. And my friend [name] is the head of expenses and he knows, and he knows how to separate the money, so everyone gets the right amount. And the people on top—like me and [friend's name]—we get more money because we are the ones that kind of started it. So, he helps out with the money and he also helps out with the bikes, but not in a big way.

Through the bike repair business, Brady and his friends transformed their interest-driven making practice into a real-world economic opportunity. As they engaged in their interest-driven making, they simultaneously learned how to take on different roles to support the business, such as when Brady explained that his friend is the "head of expenses" and that he and his other friend are "on top" since they "started it." Overall, this opportunity presented by his making practice helped Brady and his friends gain a wide range of skills associated with running a successful business, including recruiting customers, setting fair prices, and engaging in ethical business practices.

Maria

The story of Maria also shows how an interest became an entrepreneurial opportunity. Maria's aunt from Puerto Rico had mailed a box full of handmade jewelry that Maria's family sold. Maria got inspired by the beautiful pieces and eventually had the opportunity to travel to Puerto Rico where she asked her aunt to teach her how to make the jewelry. When she came back home, she went to the store to get beads and started making and selling her own creations. When asked where she sells her jewelry, she said she sells them at her church or at her mom's job, "my mom will take it for me and she'll just ask the ladies if they would like to buy jewelry," Maria said. When Maria was later asked if she had tried something new, she said "I was going to try to start doing, um, instead of a different type of art, like, um, like doing people's nails, painting them and doing designs." Importantly, supportive relationships with family members helped Maria along her learning pathway toward the economic opportunity provided by her making.

The cases of Maria and Brady show the potential for how interest-driven making and supportive relationships could lead to real-world economic opportunities. In the entrepreneurial stories presented here, Maria and Brady started with interest-driven maker activities and were supported given appropriate conditions. These two youths were connected to real-world opportunities, expanded their networks, and successfully entered connected learning pathways. We think that entering these learning pathways may also support youth in constructing new visions of their future selves, as evidenced through how Brady self-identifies as a teacher through his making practice ("we teach people how to do it") and Maria talks about how her making might lead to another future interest-driven economic opportunity ("like doing people's nails, painting them and doing designs").

Beyond economic pursuits, within a connected learning model, youth making can also lead to academic or civic opportunities. The prior examples of Nolan working with his father to build a

bench for injured players for his football team and working with his family to fix the floor in his great-grandmother's home demonstrate how making might connect to civic and community outcomes. In both examples, Nolan's making opened up possibilities for improving other communities (in these cases, for a sports team and an elderly person), linking his making practice to specific instances of contributing to a larger civic good. These examples illustrate what has been observed in diverse connected learning environments where learners and mentors share purpose, values, and culture. Through engagement in activity, learners can cultivate a sense of belonging while contributing to their communities in meaningful ways [7].

6. Discussion

In this paper, we have presented findings addressing how maker practices and activities take shape in the lives of minoritized youth. We have described a rich landscape of youth engagement with making activities focused on the multiple resources and supportive relationships that youth draw from in their own maker activities. Our primary aim has been concerned with describing how making is supported in the homes of minoritized youth, as we showed how family members were central points of connection to making activities and opportunities. We described key motivations for youth engaging in making, including drawing inspiration from artifacts, drawing inspiration from making processes, making for fun, and making to share with others. We also showed how particular kinds of family relationships supported youth with making, such as making visible any produced artifacts and their production process, connecting youth to resources, explicitly teaching youth, and making alongside youth. Finally, we described particular cases to illustrate potential entry points to academic, civic, and economic opportunities and learning pathways as a result of engaging in interest-driven maker practices with the aid of supportive relationships in the home.

Analysis of interviews not only produced rich descriptions of the different ways that relationships supported youth making, but also uncovered possibilities for understanding learning in making. Here, we bring our findings in closer relation to the connected learning model to better theorize how participation and learning in making was shaped by youth interests and supportive relationships within the home. We use references to our data to discuss how supportive relationships within connected learning can create bridges to new opportunities and learning pathways. In particular, we address implications of our findings for how different types of supportive relationships impacted youth participation and learning in making.

6.1. Extending the Connected Model to Understand Levels of Learning in Making with a Focus on Supportive Relationships

Our theoretical framework of connected learning explains that learning happens in social communities at the intersection of interest-driven activities, relationships, and opportunities. Connected learning is dynamic [7] and interwoven with sociocultural theories that describe learning as shifting and changing participation as youth engage with cultural practices over time [7,43]. Acknowledging that learning happens between people within systems of relations, learning in sociocultural communities implies "becoming a different person with respect to the possibilities enabled by these systems of relations" [22] (p. 53). The key idea we want to underscore here is the enabling and active role of family relationships to shape how youth learn, thus impacting opportunities, pathways, and possibilities for shaping who they might become.

There is evidence from our data that supportive interactions with members of the immediate and extended family, as a system of relations, enabled learning possibilities to different degrees. Generally, we found that through interactions with family members, youth were taken deeper into their interests in making. That is, we found that family members were critical to developing youth interests, and therefore, contributing to their learning and development around making. Figure 2 shows this process visually. Each concentric circle represents a level of agentic participation for youth enabled by a type of supportive interaction with a family member. Participation or learning deepens as youth

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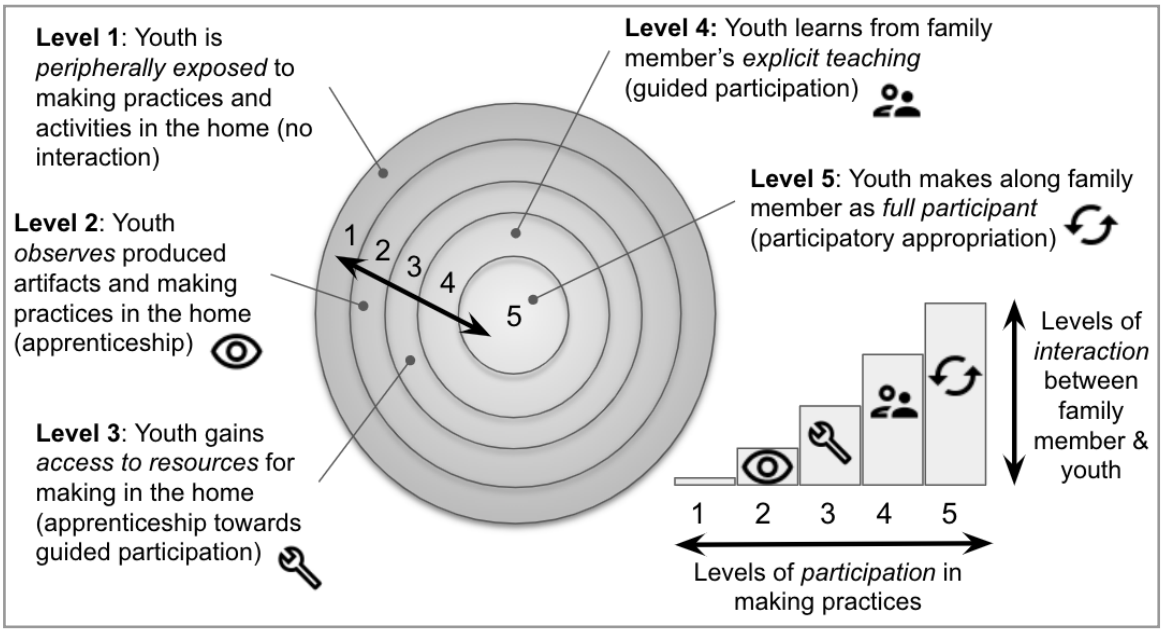

Figure 2. Representation of different participation levels enabled by levels of making interaction between family member(s) and youth.

Level 1: Youth is peripherally exposed to making practices and activities in the home (no interaction)

Level 1 is characterized by exposure to making practices or activities through family members; however at this level, youth do not engage with making in any form. In this level, we locate the youth in our data like Karla and Megan (Section 5.2.3 above), who did not participate in any making and reported no instances of family making, or if there were instances, no meaningful interactions were reported. For example, Karla and her grandfather did not interact around making activities. In the case of Megan, supportive interactions around making did not happen because of the daily responsibilities and busy family schedules she described. Possibilities for entry points to learning were limited on this level.

Level 2: Youth observes produced artifacts and making practices in the home (apprenticeship)

Level 2 includes youth who became interested in making after observing their family members work on their own projects or produced artifacts. Through observing her grandmother making a dress (Section 5.1.2), Ashley demonstrated her interest in learning a making practice. Ashley found particular made artifacts to be interesting and attractive, which inspired her to pursue those similar activities at home. This might be described as legitimate peripheral participation [22] and "learning by observing keenly" [41] (p. 75), through which Ashley might begin to be apprenticed into learning. The indirect interaction of the family members engaged in a making activity were instrumental for Ashley's learning possibility. Their implicit or explicit intent to be visible to the youth and not exclude them while making, afforded possibilities for learning by allowing participants to observe, thus leaving the possibility open to increase youth participation in an interest-driven making practice.

Level 3: Youth gains access to resources (e.g., expertise, materials, space, tools) for making in the home (apprenticeship towards guided participation)

Level 3 describes youth who participate in a making activity and interact with family members to access resources such as expertise, materials, space, and tools. On this level, participants describe family members as "resource providers" and "learning brokers" [44]. This level of limited direct interaction was illustrated by Claire's mother (Section 5.2.1), who provided access to materials but did not engage in any direct making activities herself. We want to underscore the level of interaction in this level, from no explicit direct interpersonal interaction of level 2 to direct interaction but no joint action in making practices. Still, this limited direct interaction does support possibilities for learning and fuller participation in making activities.

Level 4: Youth learns from family member's explicit teaching (guided participation)

Level 4 represents a different level of participation enabled by direct interaction with a family member. In this level we locate cases where the family member explicitly gets involved with the making practice, so both the newcomer and the more knowledgeable member make together, and the family member instructs the youth. This is a level of direct interaction and interpersonal engagement with joint action [42]. The examples above from Marlene (Section 5.2.1), Brady, and Maria (Section 5.2.4) tell the story of family members who explicitly taught youth making practices such as jewelry making, boat modeling, and sewing. We see a level of closer interaction between the members with expertise enabling possibilities for increased participation or learning for the youth.

Level 5: Youth makes along family member as full participant (participatory appropriation)

Level 5 represents "full participation" [22] in making. On this level, youth engage in a process of "participatory appropriation" [42], in which they become full participants in activity and may even shift how they see themselves in relation to the activities. Here, youth engage in making alongside family members now as a full participant where the youth makes independent of the family member. The example of Nolan (Section 5.2.2) discussing how he helped his dad make a bench for the football team shows how he became a full participant and producer, independent of the support of the relationship.

In summary, our data have shown how family relationships in the home support the youth in making practices through different levels of interaction, explicit or implicit within the social arrangement of their family community. Different levels of participation, as shown in our representation, range from the absence of any interaction, to visible making activities in the home, to providing access to resources, to explicitly teaching by making together, to full participation where youth see themselves as producers and people who have become makers of things in their own right. Our representation is about the trajectories of two parties, the youth moving to full participation in making and also the trajectory of the family member's levels of supportive interactions. We do not claim that more interaction from any family member support will make youth into full participants. However, our data show that participants who viewed themselves as experienced makers described various ways family members' interactions, particularly from parents, supported their interest-driven making. The implications of our findings extend theory on how connected learning is shaped by supportive interactions and how we might leverage the current surge of interest in making to better connect learning across the multiple social and cultural communities of which young people are members. Furthermore, these supportive relationships that mediate how youth engage with their interests in making might connect youth to future academic, civic, and economic opportunities and learning pathways.

The findings from this study suggest that the home environment and its embedded relationships has distinct affordances for learning that should not be overlooked in low-income, urban, and minoritized communities. A key challenge is that when we mine for things that look and sound like school learning in these homes, we may overlook other important ways learning takes shape—in this case,

around engagement with maker practices. A focus in work that seeks to uncover learning potential in the home is typically on how reading or math or science learning [3] takes shape, and less so on the kinds of maker activities youth and families enjoy working on together. Although the findings in this study may not be generalizable across the board, they illustrate the value of seeking to understand the maker cultures at play in these communities as we seek to broker new opportunities for youth toward future possibilities.

6.2. Limitations and Future Research

One of the main limitations of this work was that our interviews were performed outside the home, and therefore out of the context relevant to our central argument. In addition, participants did not have artifacts or even pictures to show their crafting knowledge and skills during the interview. Our main recommendation for future work is to include embedded ethnographic work in the homes of youth, although this would bring additional challenges methodologically speaking, such as privacy issues, logistics, and disturbance of the context with the presence of a stranger. However, the value of ethnographic work in context might contribute to deepening our understanding of maker activities and practices in the home.

In drawing from interest-driven making practices from the home and extending beyond the ecology of the family, we argue there are both opportunities and challenges in terms of how to connect youth to real-world pathways to support their academic, civic, and economic development through connected learning. This study highlights how personal relationships are vital to connecting youth to deeper engagement in making, yet leaves the question of how mentors and influential adults explicitly broker tangible pathways to practices valued by society at-large somewhat open [45]. We see opportunities in how connected learning opens up possibilities for who can connect youth to future learning pathways, and also challenges, if youth are not connected to real opportunities through potential brokers in the home. In future research we are interested in further exploring how these critically important relationships in the home can explicitly support connections to opportunities beyond youths' immediate environments.

6.3. Additional Implications

Our findings also have implications for how intergenerational relationships might be better tapped to further support learning. Generally, older family members have been the traditional purveyors of crafting and shop knowledge throughout history as evidenced by ethnographic work in indigenous communities [46]. The presence of intergenerational learning between adults, children, and youth might also offer empowering opportunities for young people to participate and be positioned as experts when teaching members of an older generation [47]. Nowadays, we see such instances of young people sharing expertise when they teach adults how to use high-tech devices such as smartphones or computers. These opportunities for cocreation and participation not only strengthen familial relationships by providing space for sharing family stories, values, and shared purposes, but also draw from both parties' funds of knowledge to support individual and collective learning trajectories [47–50].

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Making & Crafting Survey

Name ____________ D.O.B. ____/____/____ Gender: M F

School ____________ Grade ____________

Race/Ethnicity ____________

Address ____________

1. Do you do any making/building or crafting? If so, what types of handcrafting or building/making do you do? (Check the appropriate boxes below and describe your activity a little more on the line provided next to each box. You can add crafting/making/building activities that aren't listed here on the "Other" lines).

⩚ Scrapbooking ____	⩚ Woodworking ____
⩚ Sewing ____	⩚ Building models ____
⩚ Jewelry making ____	⩚ Knitting ____
⩚ Crocheting ____	⩚ Friendship bracelets ____
⩚ Other ____	⩚ Other ____
⩚ Other ____	⩚ Other ____
⩚ Other ____	⩚ Other ____

(If you don't do any crafting or building/maker activities, ***skip to question 7****)*

2. Who taught you about these activities? How did or do you learn about these activities?
3. How long have you been doing these making/crafting activities?
4. Where have you done these making and/or crafting activities?
5. Do any of your friends or family get involved in these activities? If so, who, and how do they get involved?
6. With whom and where do you share your work?
7. Where did your interest come from? What made you want to get started and why do you keep doing it?
8. Who (else) crafts or makes/builds in your family and what do they make?
9. Which of your friends craft or make/build and what do they make?
10. Is there anything you would like to learn how to do?

7. Where did your interest come from? What made you want to get started and why do you keep doing it?
8. Who (else) crafts or makes/builds in your family and what do they make?
9. Which of your friends craft or make/build and what do they make?
10. Is there anything you would like to learn how to do?

Appendix B

Appendix B

Demographic Information for the 20 Interviewed Participants and Making Activities They Engaged With

Pseudonym	Age	Gender	Race/Ethnicity (self-reported)	Grade Level	Types of Making Activities								
Alex	12	M	African American	7	Building Models	Drawing	Soap Carving						
Alicia	14	F	African American	9	Crocheting	Quilting	Scrapbooking	Sewing					
Anne	11	F	Hispanic	6	Crocheting	Knitting	Sewing	Weaving	Woodworking				
Ashley	12	F	Black	6	Drawing	Crocheting	Friendship Bracelets	Jewelry Making	Knitting	Lanyards	Scrapbooking	Sewing	Woodworking
Brady	13	M	African American	8	Bike repair	Building Models							
Claire	12	F	African American	7	Friendship Bracelets	Jewelry Making	Lanyards						
Damian	11	M	Black	6	Building Models	Paper Craft	Scrapbooking						
George	12	M	Black and Irish	8	Building Models	Duct Tape	Woodworking						
Jessica	11	F	African American/Hispanic	6	Lanyards								
John	10	M	American/White	6	Building Models	Paper Craft	Puppets						
Joseph	11	M	Black and Mexican	6	Building Models	Sewing	Woodworking						
Josephine	11	F	White	7	Animation (digital)	Building Models	Crocheting	'everything'	Friendship Bracelets	Jewelry Making	Knitting	Scrapbooking	Sewing	Woodworking
Juan	11	M	Columbian, Italian, Black	6	Building Models	Crocheting	Ceramics	Sewing	Woodworking				
Karla	11	F	African American	6	[None]								
Maria	12	F	Puerto Rican, Mexican, Texican	7	Crocheting	Jewelry Making	Scrapbooking	Sewing					
Marlene	11	F	African American	6	"Doing Art"	Building Models	Knitting	Sewing					
Megan	11	F	Black	6	[None]								
Nolan	11	M	Black	6	Building Models	Woodworking							
Rose	11	F	African American	6	Balloon twisting	Building Models	Friendship Bracelets	Jewelry Making	Knitting	Lanyards	Paint Converse tennis shoes	Paper Craft	Photography	Sewing
Sharon	12	F	White	7	Building Models	Drawing	Friendship Bracelets	Jewelry Making	Knitting	Paper Craft	Scrapbooking	Sewing	Write	

Figure A1. Demographic information for interviewed participants and making activities they engaged with.

Figure A1. Demographic information for interviewed participants and making activities they engaged with.

Appendix C

Appendix C

Table A1. Qualitative coding scheme and full list of themes.

Themes/Codes	Description	Definition	Examples
Theme: Types of supportive interactions between family members and youth			
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Work on own making activity	Family member's own making	Mention of family member's own making activities for leisure (e.g., knitting, jewelry making), business purpose (e.g., making lamps to sell), and any other hands-on activities including handiwork (e.g., fixing or constructing something at home or work)	-"My dad he repairs cars. Him and my grandfather are the only two that I know that do anything with crafting or building." -"And then my mom, she knits, crochets, weaves, and then sews. "
Teaching	Family member teaches making to youth	Youth's mention of family member that taught a crafting/hands-on activity or youth learned from family member	-"my mom is helping me 'cause and she and my sister letting me use their sewing machine. So, um, my mom has been teaching me how to sew and like the tricks of sewing"
Making together	Youth and family member create something together	Youth crafts or makes something together with a family member, including helping building or fixing something.	-"Interviewer: Tell me about what you are making. Nolan: Well, one day I helped my dad build a bench for my football team and another time we made a chair"

Table A1. *Cont.*

Themes/Codes	Description	Definition	Examples
Theme: Reasons for making			
Providing access	Family member gives access to classes, tools, and/or materials to youth	Mention of family member providing materials and/or tools to youth for crafting activity (including purchasing materials)	-"John: Well, on my birthday, my dad gave me one of those monster models, the creature from the black lagoon (which is my favorite movie), he gave me one of those . . . I did not know how to do it . . . . and he also gave me a set of paints, so I was guessing it was a model or something"
Inspired by artifact	Youth inspired by watching others' artifacts	Youth mentions how watching an artifact (e.g., dress) inspired them to either want to learn how to make that type of artifact (e.g., dress) or to learn the practice/how to (e.g., sewing)	-"Claire: Yeah, I see a lot of girls are wearing these necklaces- and I ask them what they make them from and they say shirts, so I really want to try to do that someday."
Inspired by making process	Youth inspired by watching others' making	Youth mentions how watching someone make and create an artifact (e.g., sewing, building, fixing) inspired them to learn how to either make that type of artifact or to learn the skill following the specific process and use of tools.	"Ashley: When I was little I saw my grandmother using a sewing machine and I thought it looked so cool—it's not like everyone can do it—it's like . . . .she's sewing a dress by herself—and like, not a lot of people can do that"
Fun	Making activity or artifact is fun, enjoyable, or relaxing	Youth refers to the making activity and/or artifact as fun and/or enjoyable.	-"So I would make my own stuff—and that is awesome because I like got to use different type of yarn and stuff made of color I like. And since I learned how to finish off a scarf instead of having pieces left, it seemed kind of fun—because every time you did it—you could put your own imagination and stuff. One time I checked how to do a hat. But I don't have circular needles so I can't do that yet. But making my own stuff is pretty fun "
Giving	Giving to others	Youth "share" their artifacts when making artifacts as gifts for others	-"Who do you share all your friendship bracelets, key chains, and necklaces with? Claire: Mostly my family—sometimes I give it to friends. but my family loves it the most, though"

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