

Enacting Identities: Participatory Design as a Context for Youth to Reflect, Project, and Apply their Emerging Identities

Merijke Coenraad
College of Education
University of Maryland
College Park, MD, USA
mcoenraa@umd.edu

Jen Palmer
UChicago STEM Education
The University of Chicago
Chicago, IL, USA
hellige@uchicago.edu

Diana Franklin
UChicago STEM Education
The University of Chicago
Chicago, IL, USA
dmfranklin@uchicago.edu

David Weintrop
College of Education
College of Information Studies
University of Maryland
College Park, MD, USA
weintrop@umd.edu

ABSTRACT

Participatory design is an essential design strategy for creating artifacts and experiences that reflect the voices of the population being designed for and with. The participatory design process can serve not only to research resulting artifacts but also as an empowering activity for those who participate. This paper explores how participatory design can serve as a context for young participants to enact and voice their emerging identities and reveals how different participatory design activities have unique affordances for supporting this identity enactment. Focusing on a group of 12 and 13-year-old African American girls, this paper presents a case study showing how participatory design activities served as venues for the girls to reflect characteristics of their current identities, project future identities, and apply aspects of their identities to shape materials for others. In doing so, we contribute a case study showing how participatory design allows participants to enact their identities, helping researchers gain insight into characteristics of those they are designing with and for. This paper advances our understanding of participatory design as a design approach for youth, especially as it relates to issues of broadening participation, identity, and equity.

CCS CONCEPTS

• Human-centered computing ~ Participatory design

KEYWORDS

Participatory Design, STEM Education, Feminism, Identity, Equity

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1 Introduction

Broadening participation in STEM (Science, Technology, Engineering, and Math) fields is a perennial challenge that designers and educators have been working to overcome for decades [2]. Historically, women and individuals of color have been disproportionality underrepresented in STEM-related fields [58], especially in fields considered to be more scientific and technical [2]. With their intersectional identities as both women and minorities [16], women of color are especially underrepresented in STEM fields despite showing relatively high levels of interest in STEM careers at an early age [50]. Research suggests that women of color are absent from STEM fields not because they are uninterested but rather because they are systematically excluded due to social and structural challenges in formal educational institutions [34, 51].

The underrepresentation of women and minorities in STEM can in part be linked to instructional issues and a lack of diversity and culturally-relevant curricula in formal educational contexts [39]. In response to this, new initiatives are underway to welcome everyone into STEM fields starting in primary school and continuing through high school and beyond. Many of these initiatives share the common goal of seeking to help learners develop an identity as one who can succeed in STEM and see STEM as having a role in their futures, either professionally or personally [14].

In working towards increasing participation of women and minorities in STEM, we are in the process of designing a culturally-responsive computing curriculum for upper elementary students (ages 10-13) with the explicit goal of helping learners historically underrepresented in computing develop a sense of belonging in the computer science community. To aid in the design of the curriculum, we conducted a series of participatory design sessions. The results from one of the sessions were rather extraordinary as compared to the other sessions. This particular participatory design

session included a group of nine African American girls whose ideas and contributions during the design sessions focused on their developing feminist STEM identities, topics that did not surface in the other sessions. The girls spoke of being STEM leaders and shared their desire to succeed in STEM contexts without compromising their identities as African American girls.

This paper explores this identity representation and investigates how participatory design as an approach gave the participants an opportunity to present dimensions of their emerging identities and voice their values. More specifically, we present the activities that comprised the participatory design workshop and look at how each provided a different way for learners to enact aspects of their identities, including:

- **reflecting** their current identity
- **projecting** future identities
- **applying** ideas about their own identities through design

For each enactment of identity, we present data showing what it looked like for young designers to voice identity within the activity, discuss how the activity supported what was observed, and show how identity is reflected in the resulting design artifacts. To further understand the context surrounding this session, data from an interview with the girls' teacher is presented. This interview helps situate what was observed and provides insight into other significant factors shaping the girls emerging identities.

With this case study, we seek to develop a better understanding of how the participatory design setting fostered the enactment of student identity and the potential implications for these observations as researchers plan design activities. We treat this case study as Flyvbjerg encourages [22], examining this case to provide a depth of knowledge about an exemplary case. This builds on recent work looking at ways to conceptualize participatory design through a Learning Sciences lens as a means to understand how the practice shapes and impacts learners [8, 17, 18]. Further, it confirms and extends work on participatory design that shifts focus from participant empowerment and the act of democratizing design towards how the experience of engaging in participatory design can shape participants, their emerging view of themselves, and their identities and relationship to their world [5, 7, 29, 33].

2 Prior Work

2.1 Participatory Design

Emerging from a Scandinavian movement for worker participation in decision making, participatory design focuses on including the voices of users and stakeholders in the decision-making process and in the design of products [47] as a means of equalizing the power structure between workers and managers [5, 7, 36]. The early focus on giving workers influence over their work environments was designed to empower workers and promote democracy through developing institutional regulations [5]. This idea of participatory design as a mechanism of empowerment features prominently in the work presented below.

In the last four decades, the focus of participatory design has grown beyond the workplace to include the general public and everyday activities while maintaining the goals of participation and

democratizing spaces [6, 35] and is used as a design strategy counter to the conventional top-down design of technologies absent of end users [52]. The result is a technology design approach that gives voice to users [61].

The inclusion of users in the design process through co-design and participatory design has become increasingly popular within the creation of educational technologies [e.g. 5, 28, 44, 52]. Technologies such as computers, handhelds, interactive toys, and online communities are leading to student learning in many subjects including computer science, healthy lifestyles, literacy, and storytelling [31]. Within the educational setting, projects have focused on the empowerment of participants through the design process. According to some researchers, simply including youth in the design process is a form of empowerment [33]. In youth design teams, kids are able to share with adults their opinions, critiques, and new ideas [20]. Youth share "what excites and bores them, what helps them learn, and what can be used in their homes and schools" [20], which can all be used to better align technologies to their needs. Gathering accurate ideas from youth acts as an emancipatory action for youth who are often designed for rather than designed with [35].

From its inception, participatory design has been rooted in changing political structures and democratizing design [36], with early projects having explicit political bias and a goal of increasing democracy [5]. More recently, designers have begun to focus on how design, broadly, and participatory design, specifically, can be used to promote social justice and equity agendas. Scholars note the growing social justice agenda of design projects and the need for projects to take into account social and political forces in order to succeed, especially for community-scale projects [19]. Using participatory design, designers and researchers are accessing the ideas and opinions of those who often have their voices taken away including individuals with disabilities [23–25, 31]. Additionally, co-design techniques are being developed to allow for greater socioeconomic and racial diversity [60].

Participatory design research focuses not only on the resulting designed artifacts, whether physical, digital, or otherwise, but examines the effects of participatory design on youth designers [31, 32]. Previously, researchers have cited participatory design as an opportunity for students to see themselves as more than technology consumers and be empowered by adults listening to them and their ideas [20]. Over time, participation in cooperative design teams allows youth to transform their perception of themselves into one of innovators and partners rather than users [7]. This shift in perception evokes feelings of empowerment and challenge, growing their confidence with regards to academic and social situations [7]. Studies have found that participation in a long-term design team impacts students' collaboration, communication, design process knowledge, and confidence [42]. Further, engaging in participatory design sessions allows student designers to gain knowledge pertaining to the design process [9, 54]. This participation and design knowledge can empower students to design and reflect upon technology [33]. "Participation is not only a political and emancipatory category, it is also a basic

epistemological (knowledge theoretical) principle... a fundamental process, not only for democracy, but also for learning” [7].

2.2 Identity Development and Representation

Identity is a construct that is fluid over both time and place. For this work, we draw on Gee’s notion of identity as the perceptions of an individual, both self-perceptions and the perceptions of others, within a certain context [26]. This context-based identity is built off of a core-identity that remains static across contexts, but, generally, the type of person an individual is considered to be is determined by being in a certain time and place [26]. Identity is constructed throughout a person’s life with adolescence being a particularly important time as self-reflection develops and individuals begin to think about their futures, ideologies, and relationships [38]. Developed across a number of factors, identities are often viewed in relation to organizations or groups that the person is a part of [1, 26] and although identity is a personal trait, it is something that is built through socialization and social contexts [11].

Identity is not unitary but rather individuals hold multiple identities which co-exist and become more or less salient based on the context. At times, this results in tensions and potential intersectional effects [16]. Gender identity represents a social construct, rather than a biological one, and is extremely important because it dictates many aspects of the lives of individuals and is built upon opinions of gender developed based on what youth and adolescents see in the world around them [12]. Similarly, racial identity is constructed within society and links perceived differences to physical traits and a socially perceived hierarchy [55]. Living within this reality, minority youth develop their own ethnic identity which develops as they age. This is particularly true for minority youth in the United States, where research has found that as kids grow up, they become more aware of their ethnic identity and realities of such an identity in a white-dominant society taking the form of a constructed racial identity [53]. The identity development of girls of color is especially complex given the contexts in which they find themselves and the intersections of race, class, gender, and sexuality that they face [9]. Intersectionality highlights the multiple avenues of discrimination faced due to a person’s identities and how intersectional discrimination is greater than the sum of discrimination based on identities individually, this is especially true for Black women [16]. In order to contend with their unique combination of identities, Black women often develop resistance and resilience [15].

Other forms of identities relate to education, occupation, and causes central to an individual. One cause for the gender gap in STEM fields is related to identity and perceptions of women’s roles in STEM fields, especially those considered to be more scientific and technical. STEM fields have a masculine culture creating lack of belonging for women [14]. Significant overlaps exist between perceived traits associated with adult men and scientists, but not between adult women and scientists [13]. These stereotypes are cited as being represented by youth as young as age six when girls begin to believe that they are less brilliant than boys, and the stereotypes affect their aspirations and interests [4]. Academic

identities, including STEM identities, are learned beginning at an early age and are reinforced in both familial and school environments, serving students in the long term, even after they finish school [49]. Academic identities are influential for students because they represent student perceptions of belonging to a specific field, such as STEM, and if they are the type of person who would be a part of that field [11]. Academic identities can be problematic for some students, leading to different identity enactments depending on location. Many times, especially for minority students, home personalities and academic personalities are managed as separate allowing them to develop strong academic identities without losing their ethnic identity [43].

Another final aspect of identity that is pertinent to this work is the notion of *possible selves*. Possible selves describe an individual’s self-perception of their future and conceptualizations of who they might become [41]. These possible selves are often idealized, can be either positive or negative, and can relate to careers, personality traits, physical traits, and accomplishments. Although they can be tied to current identity attributes, how individuals view their possible selves need not be related to how they currently view themselves, but they can act as “cognitive bridges” between present and future selves for individuals to visualize who they hope to become [41]. Aspirational future selves act as motivation towards future careers and lead to individuals being more proactive in their career related behaviors and focus on long-term consequences of actions [57]. Perceptions of possible selves also affect students academically with students who have more elaborate and positive possible selves being more successful in school [40].

3. Methods

In this section, we introduce the participatory design sessions, characteristics of the participants, and discuss the data collected and analytic approach used before continuing on to our findings.

3.1 Design Context, Goals, and Session Structure

The participatory design sessions were conducted as part of a larger project to create a culturally responsive computer science curriculum to address issues of equity and underrepresentation in the field. As part of the curricular design process, we conducted participatory design sessions at different locations and times with various stakeholders, including students, parents, teachers, and school and district administrators. These design sessions were motivated by the desire to determine what “culturally relevant” meant to our target population and what topics would be of interest and resonate with them.

We conducted four participatory design sessions, each with different participants. Each design session was four hours in total, either split into two two-hour blocks on consecutive weekdays or a single four-hour block on a weekend (Figure 1). This scheduling was to accommodate potential participant scheduling constraints. Throughout the sessions, participants were encouraged to share their own ideas and experiences, bringing their identities, interests, and values to the designs. Over the four-hour design session, participants completed four distinct design activities. Three of these

design activities included opportunities for the participants to create new artifacts: Likely Learner, Bags-of-Stuff, and Module Design. These three activities are the focus of this paper. Each of the activities is described in more detail later in the Findings section.

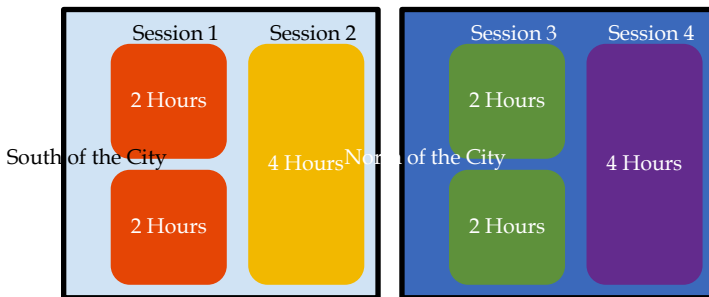


Figure 1. Schedule of the design sessions and design session locations. Each session includes a different group of participants.

3.2 Participants

The design sessions occurred in a large Midwestern city and were held at two distant community locations strategically chosen to attract differing populations. To recruit for the sessions, flyers were distributed at schools serving large populations of historically-underrepresented groups in computing where teachers were participating in the larger research project or with whom researchers had personal or professional connections. We invited the teachers and their administrators to participate in the study as well as asked them to pass out the flyers to their students. Participants were accepted on a first-come-first-serve basis, meaning participation in the design sessions was based on self-selection.

In total, 57 individuals participated in one of the four design sessions. The participants included 5 teachers, 34 students, 15 parents, and 3 administrators. The average student age was 11.35 years old (SD 1.65) across all sessions. The gender and racial information of participants are presented in Table 1. We purposefully included not only students, but also teachers, parents, and school and district administrators to get the voices of multiple stakeholders to the curriculum. In our design sessions, each individual, regardless of whether he or she was a student, teacher, administrator, or parent participated equally and was given equal voice, but to combat power imbalance between adults and students, sessions purposefully included 2-3 times as many youth as adults and groups never included more adults than students. While the mixed-age and mixed-role composition of the sessions undoubtedly shaped the resulting outcomes, this paper focuses specifically on the way the students who participated voiced aspects of their identities.

The focal design session was comprised of 20 participants (3 teachers, 13 students, 3 parents, and 1 administrator). Two of the teachers, the administrator, and 9 of the students came from the same school. It is this group of nine students that are the focus of this study due to their extraordinary contributions. All of the focal students identify as female and Black or African American and are in 7th grade (ages 12-13). The school is a public, neighborhood

school that is 97% Black, 2% Hispanic. About 67% of the students are from low-income households. Because the original goal of the design session was to gather ideas from a variety of different users of the curriculum, the focal girls were spread throughout groups in the design session. Although the co-design nature of our activities limits our ability to tease apart their ideas from ideas of other students entirely, the fact that the focal girls constituted a majority of the students in the session and the differences between the designs in this session as compared to the other three sessions led to this research and the decision to focus on this group in particular.

Table 1. Participant Demographics

	All Sessions (Adult/Student)	Focal Session (Adult/Student)
Gender		
Male	14 (4/10)	3 (1/2)
Female	40 (17/23)	16 (5/11)
Other/Unspecified	3 (2/1)	1 (1/0)
Race		
Hispanic	22 (8/14)	4 (1/3)
American Indian or Alaska Native	2 (1/1)	2 (1/1)
Asian	1 (0/1)	0 (0/0)
Black / African American	29 (10/19)	15 (4/11)
Native Hawaiian or Other Pacific Islander	1 (0/1)	0 (0/0)
White	20 (10/10)	1 (1/0)
Mixed Race	2 (0/2)	1 (0/1)

Note: Two participants did not respond to the demographics survey and are only counted by age category (adult or student).

3.3 Teacher Interview

After identifying the exceptional nature of the focal design session, we reached out to the teacher of this group of girls who had recruited them and was credited as having been influential in the development of the feminist STEM identities on display throughout the design session. While our preference would have been to interview the youth directly, due to the consenting process, we were unable to contact them for further data collection.

We conducted a semi-structured interview with this teacher, Ms. Matthews (pseudonym). Ms. Matthews is an African American woman aged 35-44. She has been teaching in her school district for ten years and at her current school for six years. Ms. Matthews primarily teaches science to students in grades 5-8 (ages 10-14). For the last three years, Ms. Matthews has run the school's Girl's Coding club.

The interview with Ms. Matthews followed a semi-structured protocol which included questions related to the design themes that emerged from the analysis of the design session videos. The protocol includes general questions about her approach to teaching and mentoring as well as specific questions drawn from observations made in the analysis of the participatory design sessions. The interview lasted 35 minutes and was conducted and recorded over a video conference. The interview was transcribed and the transcript was inductively open-coded for recurring themes related to the behaviors and emerging themes identified in the

participatory design session as well as newly emergent themes [56]. Ms. Matthews was offered the opportunity to member check the transcript and coding of her interview but declined the opportunity due to her available time.

3.4 Data Collection and Analysis

The design sessions were led by two researchers acting as facilitators for the sessions with a third researcher observing and taking field notes. All three researchers participated in some designing with participants as is typical when conducting participatory design research. The sessions were audio and video recorded and the researchers involved took field notes during and after the sessions. Further, all design artifacts created over the course of the sessions were collected for analysis. In total, 538 photographs and 70 hours of video were collected, including images of 23 Bags-of-Stuff artifacts, 12 Big Paper designs, 14 Storyboard designs, and 31 Likely Learners.

Video and audio recordings from the sessions were transcribed and design artifacts created during the participatory design sessions were cataloged. Data analysis was performed mainly by the first author with all emerging themes and noteworthy in-session events discussed and evaluated by the entire research team. First, the videos of the design sessions were reviewed and inductively open-coded, specifically looking for design ideas and themes generated by the participants [56]. Seven potential themes emerged: focus on STEM and education, leadership and helping others, future-oriented thinking, adult/school influence and lessons learned, confronting social challenges, understandings others, and pride in work. The emerging findings from the design sessions involving the nine focal girls were used to inform the protocol for the interview with Ms. Matthews. Similarly, the interview with Ms. Matthews was transcribed and open-coded for emergent themes. Four major themes arose from the interview analysis: a pro-girl attitude, the importance of STEM identities, teacher influence and support, and student agency/leadership. The themes and ideas that emerged from the interview and the artifacts created by our focal girls were compared with those from the other sessions in order to generate a fuller picture of the exceptionality of this group and help put their ideas and design recommendations in the context of peers their age. From this analysis came the emergence of themes related to pro-girl attitudes, STEM identities, and student agency/leadership, which ultimately lead to our decision to focus on how the structure of the participatory design session enabled these unexpected results from the focal group.

4. Enacting Identity during Participatory Design

In this section, we present data showing how a group of 12 and 13-year-old African American girls enacted feminist STEM identities over a series of participatory design activities, including **reflecting** their current identity, **projecting** future identities, and **applying** their identities to the design of learning activities for others. We do this by presenting the three main design activities that were the focus of the participatory design sessions: Likely Learner, Bags-of-Stuff, and Module Design. For each activity, we describe the rationale of the activity, document what the focal girls

created, and discuss how the activity itself provided a context for the girls to voice their feminist STEM identities. We also provide data from our other design sessions to serve as a comparison, highlighting the exceptionality of what was observed. In doing so, this section is presented as a case study for how participatory design can serve as a context for participants to enact currently held as well as aspirational identities and how when given a voice to shape their own education, desired future selves can be revealed.

Before presenting the activities, we start by sharing a short excerpt from the opening discussion, which set the stage for the activities to come. To begin the session, participants were asked to introduce themselves and a community of which they consider themselves to be a member. While typical responses included sports teams or gaming communities, six of the nine focal girls reported being part of educational communities with three of them specifically mentioning math, science, and coding. One of the other girls promoted her ability to lead as a member of the community of educators, saying: “my teachers educate me and I go around and help the other students.” This type of response was often heard from teachers and administrators, but rarely students. Later in the session, another of the focal girls who did not offer a STEM-related community mentioned how she was also going to identify with the coding community, but since another student had already done so, she chose to identify as part of the cooking community. This orienting conversation provides an initial glimpse of the girls’ identities as STEM learners, which was in contrast with the communities voiced by other participants.

4.1 Reflection via Likely Learner

The Likely Learner activity served as an opportunity for participants to envision a possible learner for their curriculum. In doing so, the person they designed became a reflection of who the girls see themselves as, with the resulting design reflecting important and salient aspects of their own identities.

4.1.1 The Likely Learner Activity

In the first design activity of the sessions, participants were asked to create a Likely Learner for the curriculum being designed. This activity was based on the User-Centered Design concept of a Persona [44]. Participants were instructed to design the typical upper elementary and middle school student who would be a learner using this curriculum. In the activity, adults and youth were grouped together, but each age group created their own learner. First, the adults interviewed students using a guiding protocol as the students drew and wrote about their learner. Then, students interviewed adults as the adults drew an image of their likely learner with a list of his or her characteristics. This activity was chosen to both gather information about how the participants saw themselves and others in their classrooms and to act as an activity that would provide some power balancing between adults and students. By having the youth create and use their voice first and then giving them authority as the interviewer, this first activity was meant to break down barriers between adults and youth. Note we asked the participants to design a “typical” learner but did not

specifically ask participants to create a learner different from themselves as is often the case when working with personas.

4.1.2 Enacting Identities during Likely Learner

All four of the mixed-age groups in the session contained at least one of the nine focal girls. While the personas were not to be direct representations of the girls, they reflected their identities and the characteristics that they deem to be the most important in a learner as they created their typical users of the curriculum. The girls' feminist STEM identities were on display from the beginning, starting with the fact that all four groups chose to create a female student. As seen in Figure 2, the girls' groups designed learners that had a feminine gender presentation with earrings, large eyelashes, and big hair. The groups gave their learners feminine names such as Emily and Soliloquy. The choice of gender was explicit for these groups. When an adult asked whether the learner should be a boy or a girl, one of the girls simply replied, "*Girl, girl power.*" These learner descriptions contrast to those of other sessions where the created Likely Learners were evenly split between being girls and boys. When one group was asked by their adult design partners about whether or not the learner likes computer science, the student replied that the learner likes computer science and coding, following up her response by saying "*I like it at least.*"

Beyond identifying as female interested in STEM, further positive identity characteristics were reflected in the Likely Learners the focal girls created. Three of the four student-generated learners were specifically listed as leaders and the fourth aspired to work in youth advocacy. As they were creating the learners, one student described her learners as a "*leader and a very strong person. She is not a follower. She follows her own mind.*" She even noted that "*followers don't get nowhere,*" speaking to the drive and aspirations of the focal girls. When asked about what motivates the learners, one group replied that their learner is motivated by "*being able to give back to future students.*" Another learner dreams of helping people and the fourth learner uses her leadership to "*set the example for others by reaching out to where others is*" and "*if you always following what somebody else doing, it's going to determine how you live your life; you can't live your life following other people.*" Furthermore, when describing why

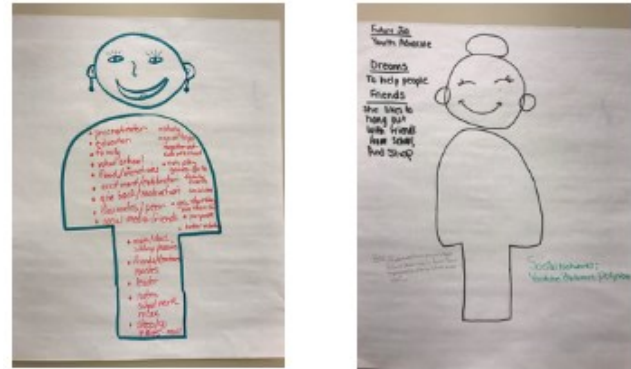


Figure 2. Two Likely Learners designed by the student groups. their learner likes computer science, one group discussed the ability to use computer science to help people with the work that they do

stating that computers, "*can help you with the work that you do without computers.*"

The Likely Learners created by the focal girls were described at times as liking math and science, but also emphasized other interests such as the arts, sports, friends, and video games. In other sessions, groups varied in their mentioning of the learners' leadership, but when it was mentioned, not all of the groups designated their learners as leaders, instead, listing them as followers or givers. When other groups referenced technology with respect to their Likely Learner, the focus was on social media and communication (e.g. texting). Groups from other sessions focused on other traits of their learners such as their clumsiness or social awkwardness and some groups outwardly stated that some of their learners did not like school or computer science (Table 2).

4.1.3 Likely Learner Discussion

The Likely Learner activity serves as a first demonstration of how participatory design can serve as a context for learners to voice aspects of their identities. The nature of the activity gives participants an opportunity to incorporate their own identities into the character they are creating, as can be seen above. This was particularly apparent as the focal girls aligned their own interests

Table 2. Likely Learner identity characteristics and interests compared across participatory design sessions.

Language/ themes	Focal design session	Session 2	Session 3	Session 4
Identity	"Leader" Strong Gives back Own mind Spiritual	Follower Clumsy Doesn't finish homework Hates school Leader The best he can be	Awkward Hates school Leader Learner More of a follower Analytical	Very smart Athletic Hispanic/Latina Giver Follower Leader Hard worker
Interests	Education/Studying Eating/food Dance Volleyball Math/Science Arts/Fashion Video games Social Media	Singing Student council Hair Art Phone games Math Working out Dogs	Sports Skipping school Roblox Books Writing Drawing Movies	Drawing Sports School Technology Going to the park, pool, and museums Video games

and values with those of the Likely Learner they were creating, such as when one girl said she likes computer science, just like her Likely Learner. In this way the Likely Learner activity can serve as a mirror where participants can incorporate their values into their design, producing a reflection of aspects of their identities.

As shown in Table 2, participants' identities often reflect relatively contemporary trends (e.g. video games, and social media) or immediate desires (e.g. motivations related to food or money). This shows how participatory design can serve as a venue for participants to draw on their existing interests and funds of knowledge [3, 27, 46]. In the case of the focal girls in this study, they chose to incorporate a blend of a number of features of their interests and values including being leaders and helping others while also being feminine and participating in a STEM community. This demonstrates a belief that girls can retain their feminine identities while being STEM-focused. This idea is reflected in the Likely Learners they created: female leaders interest in STEM. This activity served as a first opportunity for enacting identity: creating artifacts that **reflect** aspects of their current identity.

4.2 Projection via Bags-of-Stuff

Designing with Bags-of-Stuff gave participants the opportunity to explore potential future identities. In doing so, the girls **project** forward aspects of their current identity to create future, potentially aspirational, identities.

4.2.1 Designing with Bags-of-Stuff

The second activity in the design session was called Bags-of-Stuff and is a common, crafts-based activity used in participatory design [21]. Bags-of-Stuff is a low-tech prototyping design technique where participants are given access to crafting materials like felt, pipe cleaners, ribbon, and popsicle sticks and are asked to create a physical artifact based on a given prompt. For this activity, the students and adults were separated. The prompt for the student groups was to create something that was of interest to them. They were further prompted to think about things that they liked to learn about, talk about, or do. The motivation for this activity and prompt was to gain further insight into the values and interests of learners in our target demographic and then use these to inform the later design of curricular materials. Bags-of-Stuff was specifically chosen for this activity because it allows for deep discussions

between group members that can be analyzed in addition to the final products created as well as a chance for the students to collaborate and elaborate on the design. It is also a good technique for breaking the ice between designers [21].

4.2.2 Enacting Identities during Bags-of-Stuff

During this low-tech prototyping activity, one group comprised of the girls designed a girl (Figure 3) who they described as having "a little community group



Figure 3. Low-tech Prototype of a Fashion Loving Feminist.

that gets together, talk about things that they see in their country...their community with like dealing with women and stuff. And then on the other side, you know, she's a beauty girl. So, she has her own beauty line, so that on the other side she got a little red carpet dealing with it, you know her lights and her friends in the background and stuff." The character they created wants "to make a better world like to make the world better in the future. All of the stuff we are dealing with how, you know, women rank is mostly men above women so, she is trying to show, 'uh uh, men, women can come out on top of things too.'" In creating this artifact, the girls designed someone who acted as a leader for her community and used her interests to make her world a better place. While designing, the girls specifically found brown markers to color the figure, which was originally made out of white paper. As African American girls, it was very important to them to represent not only a strong female in their design but one of color.

This design is exceptional on its own but is especially unique when compared to designs developed by other participants (Table 3). Other youth designers created a puppet of a man being eaten by a shark, a name brand purse with all of its contents including money, phone, and make-up kit, and six distinct artifacts relating to video games created at multiple sessions. While each of these designs represents the ideas of the designers and allows them to project their values and interests, the differences in these values and interests are evident between the sessions. The focal girls used this design opportunity to project not only an interest in fashion but also a strong tie to female empowerment and community leadership.

Table 3. Bags-of-Stuff artifact comparison across sessions

Focal design session	Session 2	Session 3	Session 4
Social activist fashionista	Graveyard & zombies	Uni Kitty (Unicorn/Cat mix)	Fortnite artifacts
Offset proposing to Cardi B	Fisherman eaten by a shark	Legend of Zelda artifacts	Gucci purse with make-up, wallet, and phone
Girl dancing in a videogame	Arcade game	Ferris Bueller's Day Off DVD	
Jesus on a cross	Musician with maracas		
Male best friends "hanging out"			

4.2.3 Bags-of-Stuff Discussion

During the Bags-of-Stuff activity, the focal girls once again voiced their feminist STEM identities as well as showed how they value leadership and agency. However, whereas the Likely Learner activity served as an opportunity to create a reflection of their current identities, this activity served as an opportunity for them to project aspects of their identity into the future.

A few things stand out about the Fashion Loving Feminist. The prompt was intentionally broad, as can be seen in the wide array of topics in Table 3. The fact that the girls chose to use this as another opportunity to create an external representation of the feminist STEM identity speaks to the importance the girls place on this idea. A second interesting feature of this activity and the resulting artifact

is how well it captures the intersectional identities these girls hold. The character they created reflects both stereotypical gender characteristics (e.g. interest in fashion) while also having a clear racial identity and position of leadership within her community. The specific choice of fashion is poignant here as fashion is recognized as a particularly complex locus for intersectionality in African American girls [30]. In this way, we see the girls projecting multiple identity characteristics onto their artifact.

When comparing this activity with the Likely Learner activity that preceded it, we see similarities but also differences. The most noticeable difference is that while the Likely Learner activity was designing a learner, the girls used the Bags-of-Stuff activity to **project** their feminist STEM identity forward into the future, creating a community leader who is working to make the world a better place.

4.3 Application via Module Design

The Module Design activity gave participants an opportunity to apply aspects of their identities to the creation of artifacts for others. In doing so, the consideration of identity goes beyond the self to influencing others.

4.3.1 Designing a Module

The final activity of the session asked participants to design a new module for the curriculum being created. Working again in mixed-role groups, the participants were provided with the disciplinary content for a set of short lessons and were asked to develop a new theme through which the content could be taught. The groups used big paper and storyboarding [21] to represent their learning modules graphically and give an overview of what would occur. These two methods were used in conjunction in order to support “blue sky” ideas to be generated and presented. After designing their modules each group presented their ideas to the other groups. The nine focal girls for this paper were split between the four design teams, with the majority of the girls in two groups. Both of these groups situated their activities in STEM-based contexts whereas neither of the other two groups did.

4.3.2 Enacting Identities during Module Design

The first group of focal girls designed a multi-level video game in which a robot encounters a series of challenges as it tries to get back to the cockpit of its spaceship and return to its home planet. Bodi, a spherical robot that stars in the game is like the ones the students used in school for science, math, and coding. One of the challenges Bodi encounters is an obstacle course that it must finish “without running out of code.” Thus, this activity focuses on controlling a robot by giving it instructions, i.e. coding. Additionally, in discussing the consequences of running out of code, the girls talked about the robot being sucked into space, raising issues of gravitational pull, introducing another series of scientific concepts to their game.

The second group of focal girls designed a game that encourages students to graph points on a coordinate plane based on a train running down rainbow tracks (Figure 4). The students describe the game as “*like the four quadrant graphs. And so like every time you click a color it could be like you get a dot on the*

graph and once you make like a certain amount of dots it makes up a picture.” Players are assigned a point on the graph based on where the train stops and then need to correctly graph a series of points to make a picture. The students

considered the resulting picture to be the reward and motivation for playing the game. This activity has clear connections to classroom STEM content, specifically mathematics and concepts related to graphing. Further, while designing the game, the girls discussed linking the activity to the learning management system used by their school as a way to share outcomes with their peers, showing both an eagerness to showcase what they were designing as well as agency in distributing the lesson to a wider audience, positioning themselves as leaders.

In both of the modules designed by groups comprised of the focal girls, STEM content is placed front and center. This was unexpected and distinct from what we saw in other groups (Table 4). For comparison, other groups designed a track and field game where the player races against other players or the computer, a game where a snake tries to eat apples while at the same time avoiding obstacles, and an animated scene between siblings where the brother is the cause of the sister’s phone being broken.

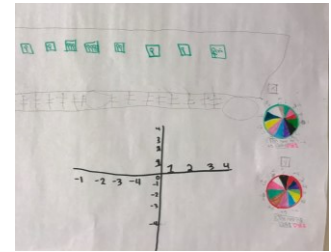


Figure 4. Big Paper design of Rainbow Train graphing.

Table 4. Module design comparison across sessions

Focal design session	Session 2	Session 3	Session 4
Track & field race	Dancing the Whip & Nae Nae	Choose your own adventure	Zombie killing game
Sibling Interactions	Snake game	Cat chasing mouse game	Animation of a rocket
Robot in space game	Bus ride Animation	Hungry dog game	Island survival
Coordinate graphing game	Basketball game		Soccer game

4.3.3 Module Design Discussion

Placed alongside the two designs described above, we can see a third enactment of identity in the Module Design: application. While not as explicit as the first two activities, with the module design activity, the STEM identity foregrounded over the previous few hours is now applied to the creation of STEM-based activities intended to be used by peers. As such, the decision to use a STEM theme reflects the girls own priorities and how they view themselves as STEM leaders and reflects a desire to foster interest and engagement with STEM among their peers.

What is truly remarkable about this is not that STEM-based activities were chosen, or that the blank-palette of the participatory design activities elicited such ideas, but that despite the

underrepresentation of women and minorities in STEM, these ideas came from a group of 12 and 13-year-old African American girls who attend an urban school where two-thirds of attendees come from economically disadvantaged households.

5 External Context via Teacher Interview

To better understand how this came about and more fully understand the context from which these feminist STEM identities emerged, we interviewed the teacher responsible for recruiting the girls to our design sessions. The interview with their teacher, Ms. Matthews, provides additional insight both into the girls' identities but also a way to link observations and artifacts from the participatory design session with the girls' daily lives. As literature predicts [28, 48], Ms. Matthews' actions both inside and outside of the classroom and the relationships that she builds with her students affected the girls' developed STEM identities and achievement, thereby influencing their actions within the design sessions.

5.1 Cultivating a Feminist STEM Identity

Ms. Matthews revealed that she works hard to cultivate pro-STEM dispositions in her students without asking them to forfeit who they are or what they are interested in, especially as it relates to potential future careers. *"Just because you like to have long hair and get your nails done doesn't mean that you can't...get in there and do some STEM-related career things and make choices for your career based around STEM-related issues."* Ms. Matthews made clear that she does not strive to replace students' current career aspirations with STEM ones but rather help them to see how they can *"take the STEM title and, like, move it into a career that's interesting to them."* As an example, Ms. Matthews cites *"a couple girls who are dancers and...so, they've often talked about taking STEM and building like better dance uniforms. You know, like, moisture wicking."* In these quotes, we see Ms. Matthews explicitly speaking to issues of identity intersectionality between discrimination within STEM fields and society based on gender and race. This same intersectionality was on display throughout the design sessions, where the girls designed a fashion-loving, feminist, entrepreneur and community leader as well as a learner with big earrings who loves coding.

5.2 Fostering Community

Along with teaching the girls in her class, Ms. Matthews opens up her classroom during lunch period and invites the girls to join her. *"I let them come up for lunch and we can sit and have like a round table discussion...we'll just sit and just kind of talk about girl things."* As part of these discussions, Ms. Matthews engages her girls in conversations *"about images that girls look up to...I'll let them bring in their phones and they'll pull up these Instagram pages of girls that they follow and then we talk about the girls' images."*

The recognition by the girls of the importance of community can be seen throughout the session. For example, in the Bags-of-Stuff activity, when the girls describe their fashion-loving leader as convening *"a little community group that gets together, talk about things that they see in their country...their community."* Here

again, we see traces of the identity being cultivated by Ms. Matthews emerging as part of the participatory design sessions.

5.3 Empowering Learners as Leaders

Along with cultivating a feminist STEM identity and fostering a sense of community, Ms. Matthews encourages her girls to be leaders and develops their agency. Ms. Matthews runs an after-school Coding Club for girls and has structured it to be completely student-run. She describes, *"I'm just kind of there with them and they do all of the work. They do the setup, they do the breakdown, they order their own kits...They have worked out their own problems. They went online, they've done research...I'm just their 'coach' but I'm not really teaching them the robotics part, they are teaching themselves."* In providing a space for self-directed STEM exploration, Ms. Matthews relinquishes control and shows that she trusts her students to direct their own STEM learning.

This sense of leadership is present throughout the participatory design sessions but is most clearly on display in the way the girls choose to apply their feminist STEM identities during the module design activity. Taking on leadership roles in STEM contexts is an important, but often overlooked, aspect of becoming a more full-participant member of a STEM community [3]. Both in the choice of topic and their justification for why they chose STEM-themed projects, the girls position themselves as leaders among peers.

5.4 External Context Discussion

Hearing Ms. Matthews explain what she hopes to instill in her girls provides a critical element to our investigation into how participatory design can serve as a venue for young people to enact aspects of their emerging identities. By better understanding some of the forces at play outside of the sessions, we can link the utterances and constructions from inside the design session with who these girls are in the classroom. This external data source, and the connection between how Ms. Matthews describes her students with what the girls created as part of the design session provides a base level of external validity to the interpretation of how participatory design can serve as a venue for enacting dimensions of one's identity. Further, across the three activities, we can see how the different aspects of identity and intersectionality encouraged by Ms. Matthews are supported.

Ms. Matthews' students are at a crucial time in their development where their identities are being developed and molded not only by individual biological and psychological factors but also by the people and things around them and the experiences that they have. Without Ms. Matthews as their teacher, these girls might never have been exposed to a pervasive feminist STEM identity. She acts as the teacher Milgram [45] calls for by *"plant[ing] the seed of 'You Can Do It!' and water[ing] it daily."* This message gives Ms. Matthews' students the countercultural ideal of being a woman in STEM. This is particularly important as it relates to reconciling challenges of intersectionality [62]. Collectively, these efforts by Ms. Matthews have helped create a group of exceptional young women who hold strong STEM identities while retaining their own set of interests, an identity that they were able to demonstrate during the design sessions.

6 Discussion

Through their experiences in the participatory design session, the focal girls in this study had the opportunity to enact feminist STEM identities and voice their ideas and values. In effect, the session provided opportunities for the girls to enact their chosen identity and represent their self-perceived current or future selves. Designing Likely Learners and depicting the topics that are interesting to them and their peers provided the girls a chance to enact their emerging identities and reflect their aspirational selves onto the learners they designed. These aspects of their identities were then projected forward onto future selves through low-tech prototyping in the Bags-of-Stuff activity. For the focal girls, this took the form of a community leader and entrepreneur who embodies both leadership and feminist characteristics. Finally, the girls channeled these dimensions of their identity and applied them to inform the creation of a new theme for a computer science learning module. By moving through the reflection, projection, application progression, the girls were able to use the participatory design session to voice different aspects of their identities.

While long-term design teams are able to promote students' collaboration, communication, design process knowledge, and confidence [42], the analysis presented in this work shows that even a relatively short session can provide rich opportunity to empower students to enact aspects of their identities and work within design contexts to collaborate and design according to who they are. Ms. Matthews viewed the sessions as *"beneficial because [the girls] got to express themselves outside of the classroom and then [the sessions] gave them a sense of confidence because they felt like they were part of something that was bigger than just, you know, your day to day classroom conversations."*

Although this group of girls is unique due to the support that they receive from their teacher, their ability to take on the full extent of their STEM identity is not necessarily unique to them. Participants within design sessions have the opportunity to show not only their interests but also who they believe they are, whether that is enacting a feminist STEM identity or one of a video gamer or animal lover. We focus on this specific example due to its exceptionality and alignment to the larger goals of our project, but the ability to reflect, project, and apply identity through participatory design extends beyond the specifics of these sessions.

For adolescent students, identity is constantly developing and being explored [38]. It is not a fixed feature of the students' lives. Through these design activities, our focal girls were able to "try on" a feminist STEM identity; publicly voicing different facets of what makes them who they are and who they desire to be. The activity also provided an opportunity for the girls to reflect on the nature of identity and recognize the developing nature of their selves. While interviewing an adult who was creating his Likely Learner, one girl asked him, *"Okay, so for your person, would you like a big question mark as the drawing because they're still trying to find their inner self?"* With this student's suggestion, she demonstrates a recognition of how identities can change over time and that part of adolescence includes wrestling with one's own identity by attending to diverse pieces of your identity at different times and experimenting with which portions of identity to the foreground.

Given the opportunity for young designers to reflect, project, and apply their unique identities within the context of participatory design, it is essential that design teams are constructed of diverse populations of students in order to represent the breadth of ideas and opinions of the larger student and youth population. While the voice of the individual is important on a design team, that voice acts to represent larger groups of stakeholders related to the thing being designed. Diverse voices on a design team enable the foregrounding of many values and identities. Researchers should also be cognizant of the opportunities for design techniques to allow for identity enactment and for participants to "try on" various identities, especially within projects seeking to broaden participation. These opportunities could allow for identity enactment aligning to the project goals.

7 Conclusion

Given the goal of the participatory design sessions was to create culturally-responsive computer science curricula, particularly for learners from historically underrepresented populations in computer science, we hardly expected to have nine African American girls arrive and create STEM-based designs and speak about the importance of being a strong female leader. As these events unfolded, we observed a form of identity-reflexivity that helped us better understand the potential for participatory design to serve as a venue for participants to enact various aspects of their identity. The actions and designs of the focal girls emphasized the need for our curriculum to include options for students to express different parts of their identity and personal knowledge within their learning and cultivate existing positive attitudes towards STEM within some students while introducing them to others.

This case study shows how through participatory design we gain knowledge both about the artifacts being design as well as those doing the designing. Throughout the design session, the girls talked about themselves, and learners like them, through a feminist STEM perspective that emphasized leadership and agency. The girls enacted these beliefs in their designs and conversations and also demonstrated their STEM identities through the artifacts they created. While these findings cannot be expected in every participatory design session, this case study demonstrates the potential for participatory design to serve as a context to elicit and support emerging identities of young participants. Further, this work demonstrates how a range of activities can provide different ways for learners to enact and voice aspects of their identity, shedding further light on how participants see themselves and how they affect their values. Collectively, this work shows yet another important facet of participatory design and its ability to help us learn about the designers, their interests, who they are, and who they hope to become.

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Selection and Participation of Children

As the inclusion of youth voices was central to this work, care was taken to ensure our young participants felt comfortable, were treated respectfully, and all ethical research standards were followed. The primary method of recruitment was through flyers given to teachers associated with our project to be distributed in their schools. Schools with demographics matching those of our target audience were specifically targeted. The parents of interested participants completed an online survey to register for the session. The parents of minors completed consent forms on their behalf and the students completed student assent forms. Participants were given a meal and snacks during the time that they were participating as well as a gift card for participating.

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