Girls as Experts, Helpers, Organizers, and Leaders: Designing for Equitable Access and Participation in CSCL Environments

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Abstract: Within the CSCL community and in computing and computational making more broadly, issues of equity continue to be under-researched and undertheorized. Here, we examine how FUSE Studios – a set of in-school, choice-based, STEAM learning environments, based around a set of digital and tangible making challenges – supports equitable access to and participation in making and computing. Drawing on web-log data and video-ethnographic data, we argue that four characteristics of FUSE support equity: the design of the challenges; the diverse ways of knowing and doing supported by the activity system; the specific interactions encouraged by the activity system; and the program's placement inside school. We focus, here, on gender equity, but also discuss implications and planned research on other aspects of equity.

Introduction

Within the CSCL community, issues of equity continue to be under-researched and undertheorized. Of the articles published in the *International Journal of Computer-Supported Collaborative Learning* since it started in 2006, only one title references anything related to women or gender. Further, despite the theme of the 2017 conference, "Making a Difference: Prioritizing Equity and Access in CSCL", of the over 200 contributions to the conference proceedings, only six listed "equity and gender" as a keyword. Only 61 mentioned either "gender" or "equity" *at all* in the text, and far fewer dealt with either issue substantively, with many mentions of "gender" appearing only in a description of participants or groupings and many mentions of "equity" appearing only as authors quoted the conference theme. This lack of attention to equity is reflective of larger inequities in participation in computing and computational making (e.g., Funk & Parker, 2018; Lewis, 2015; Margolis & Fisher, 2002; Vossoughi & Bevan, 2014). Despite well-documented equity problems in these fields, efforts to engage women and minorities are still far too few and have been only minimally successful at involving a diverse audience in equitable ways.

Background

Research that has addressed equity in computing and computational making has done so in two ways. The first is by attempting to create *equitable access* to these activities and spaces by removing barriers to entry for women, minorities, and less affluent individuals (e.g., AAUW, 2000; Lewis, 2015). For example, Lewis (2015) found that many women avoid makerspaces, because they don't have prior computing experience or struggle with the absence of clear goals in making activities. However, multiple studies suggest that if we can get females in the door and get them engaged, they are more likely to express increased confidence and empowerment related to the tools and skills involved (e.g., Barniskis, 2014; Bowler, 2014; Fields & King, 2014). As a result, some recent efforts have focused on bringing making and computing into schools, where there is greater access (e.g., Atit et al., in press).

However, efforts to diversify access to making or computing have not necessarily resulted in *equitable participation* (e.g., Scott, et al., 2015; Vossoughi & Bevan, 2014; Vossoughi et al., 2013). Thus, other studies (e.g., Vossoughi et al., 2013) have focused on understanding what types of knowledge and interactions are valued in a learning space and used this as a lens to see how the space does or doesn't create opportunities for young people of different backgrounds to experience themselves as knowledgeable contributors. For example, Lachney, et al. (2016) argued that the technologies that designers claim are value-free may actually be implicitly exclusionary. Vossoughi and Bevan (2014) also argued that makerspaces have the potential to challenge deficit views and support more inclusive learning *if* they support interactions such as novices and experts working side-by-side, assisting each other, and continually shifting roles. However, *if not*, making and computing activities also have the potential to reproduce existing inequities. For example, Volman and van Eck (2001) documented a number of studies of learning through computer games where boys took over the computer, sidelining girls.

A handful of approaches have recently emerged that seek to engage females and underrepresented minorities in making and computing. One successful example of this is e-textiles (e.g., Barniskis, 2014; Buchholz, et. al, 2014; Buechley, et al., 2008; Fields & King, 2014; Kafai, Fields & Searle, 2014). This approach integrates craft skills (textile work) with electronic circuitry and computer programming. Researchers have found that females prefer to learn new technology skills by incorporating them into such craft work (Barniskis, 2014; Kafai, et al., 2014). Others have found that e-textiles disrupt preconceptions about gendered ability, access, and authority in making (Buchholz, et. al, 2014). Still others have used e-textiles to create cultural connections between Native American indigenous practices and computational thinking (Kafai, Searle, Martinez & Brayboy, 2014). However, the specificity of this approach invites the questions, 'What about students who aren't interested in textiles?' and 'What about skills that can't be taught through this (or any) single activity?' This tool-centered approach also diverts focus away from the role that activity systems in which tools are embedded play in promoting equity.

Another intervention that focused more holistically on providing supportive infrastructure for equitable computational learning was "Digital Youth Divas" (DYD; Pinkard, et al., 2017). This out-of-school program used narrative stories to motivate the creation of digital artifacts and support non-dominant, middle-school girls' STEM interests and identities. In addition to the narrative-driven, project-based curriculum, DYD involved an online social network, supportive adult mentors, and support for the extension of interests beyond the DYD context.

Here, we explore a program, FUSE Studios (e.g., Stevens et al., 2016), which shares DYD's attention to the role of sociomaterial infrastructure in supporting equitable interest development and learning but takes a different approach to achieving these goals. FUSE is a set of in-school, choice-based, STEAM learning experiences, structured around a set of digital and tangible making challenges. Drawing on web-log data, video-ethnographic data, and interviews with students and teachers, we will show how FUSE supports equitable access to and participation in making. We will also show how it supports learning that is embodied, enactive, extended, and embedded, the conceptual themes of this year's conference. Elsewhere, we have written about the affordances of this activity system for supporting: (1) a variety of collaborative learning arrangements (Penney, 2016; Stevens et al., 2016); (2) the development and sharing of expertise (Penney, 2016; Stevens et al., 2016); (3) interest development (Ramey, 2017; Ramey & Stevens, submitted); and (4) learning (Ramey, 2017; Ramey, Stevens, & Uttal, submitted). Here, we examine whether and how these outcomes were equitably available. We focus the discussion of equity here on gender equity, because this is where we have the most complete data. However, in the Conclusion section, we also discuss implications for and future research about other dimensions of equity.

Methods

Research context

FUSE is structured around a set of almost 30 STEAM challenge sequences, housed on the FUSE website (fusestudio.net). These challenges level up like video games, with each challenge containing multiple levels of increasing difficulty and complexity. The challenges are designed to build on student interests (e.g., video games, jewelry or clothing design, music), as well as make connections to the tools and activities of STEAM professionals (e.g., CAD, 3D printing, programming, electronics). FUSE is structured to allow students choice in what challenges to do, how to approach challenges, and what resources (e.g., other students, physical and digital materials) to draw upon for help. In other words, FUSE is more choice-based, student-driven, and interdisciplinary than traditional learning in schools—or even learning in workshop-style making activities, where all students do the same project or use the same tools (e.g., Fields & King, 2014). However, it also provides more structure and support than many makerspaces, where learners are let loose to explore available tools without being provided clear goals (e.g., Brahms, 2014). Further, although FUSE started as an after-school program, it is now primarily being implemented in schools, as a standalone class. We argue that the following four characteristics of FUSE – (1) the design of the challenges; (2) the diverse ways of working and learning supported by the activity system; (3) the specific interactions encouraged by the activity system; and (4) the program's placement inside the school day—promote both equitable access to and equitable participation in this learning environment for girls and boys.

Data collection and analysis

The first way in which we examined gender equity in FUSE was to examine challenge activity data from the FUSE website. Every student who creates an account on the website is asked to indicate their gender. Once users set up accounts, they are met with a gallery of challenges to choose from. They are also able to watch trailer videos to invite interest in particular challenges. Once they identify a challenge of interest, they can choose to "start" level one of the challenge (an action that the website logs). In order to unlock subsequent levels (up to five), users must "complete" the previous level by uploading an image, video, or digital artifact that demonstrates they have completed that level (another action that the website logs). For our analyses here, we drew on these three data points (gender, level starts, and level completes) to look for equity in challenge interest and persistence.

The second way in which we analyzed equity in FUSE was by drawing on data from video-ethnographic observations of seven FUSE classrooms, from one large, suburban, racially- and socioeconomically-diverse school district, over the course of the 2015-16 school year. Each of these classes met twice per week for a total of 90 minutes, and a member of our team was present for all sessions, acting as a participant observer. During each visit, we took field notes and recorded whole-room video using a stationary camera and point-of-view video using visor-mounted cameras worn by six focal participants per class. At the end of the school year, we also conducted semi-structured interviews (Patton, 1990) with 60 focal students and seven facilitators to understand what they had learned or remembered from FUSE and what impact, if any, it had had on their interests or identities.

In analyzing this ethnographic data, we drew on interaction analysis (e.g., Goodwin, 2000; Hall & Stevens, 2015; Jordan & Henderson, 1995), because, in line with the conference theme, it allowed us to analyze ways in which knowledge was embodied, enactive, and embedded in this particular sociomaterial context. We also selected this method based upon work by Vossoughi et al. (2013) and DiGiacomo & Gutiérrez (2016), which proposes that equity is produced and reproduced (and therefore can be analyzed) interactionally.

Findings

Evidence from web-log data of equitable access and participation

We analyzed data from the FUSE website in three ways to examine whether equitable access and participation were achieved for girls in FUSE. First, an examination of the gender of all users on the FUSE website showed that over the lifetime of the program (2012-2018), more girls have participated in the FUSE than boys (22068 versus 21126). This indicates that we have been successful at getting girls in the door, or achieving equitable access. Second, an analysis of persistence shows that boys and girls persisted at similar rates. For example, 39% of girls and 40% of boys who started level one of a challenge went on to start level two. Similarly, 56% of girls and 57% of boys who started level two of a challenge went on to start level three. Finally, an analysis of challenge interest by gender—where "interest" was defined as starting level 1—showed that of the 26 challenges available at the end of 2018, 14 were preferred by boys, 9 were preferred by girls, and 3 were gender neutral (see Table 1). This indicates that we're doing relatively well developing challenges that appeal to both genders, but there is still room for improvement in developing more challenges that appeal to girls.

Table 1: Challenge preferences by gender

Gender Neutral Challenges (3)	**Challenges Girls Prefer (9)**	**Challenges Boys Prefer (14)**
Smart Castle	Jewelry Designer****	Print My Ride****
Dream Home 2: Gut Rehab	Just Bead It!****	Get in the Game****
Eye Candy	Selfie Sticker****	Game Designer****
	Cookie Customizer****	Laser Defender****
	Electric Apparel****	Solar Roller****
	Spaghetti Structures****	Music Amplifier****
	Keychain Customizer****	Wind Commander****
	Dream Home****	Ringtones****
	LED Color Lights**	Coaster Boss****
		Minime Animation****
		How to Train Your Robot****
		VR Escape Room****
		Mini Jumbotron****
		3D You***
*p < .05, **p < .01, ***p < .001, ****p < .0001. Results are from a chi-square test of level 1 starts from a sample of 43194 users (22068 girls, 21126 girls) between the start of FUSE in July 2012 and December 2018. The more statistically significant a p value, the more 'gendered' a challenge is.		

The good news is that this web data analysis also helps us understand where specific improvements can be made. For example, from an analysis similar to the one presented above, conducted on data from 2012-2015, we noticed that our only robotics challenge (*Robot Obstacle Course*) skewed heavily male. So, we redesigned it to use a different robot with different appearance and a different programming language. We also changed the challenge name, trailer video, and goals to reference different cultural imagery (*How to Train Your Robot*). As a result, girls' participation in the challenge increased by 12% (see Table 2).

Table 2: Redesigning a robotics challenge to make it more interesting to girls

	Robot Obstacle Course (ROC)	**How to Train Your Robot (HTYR)**	**Change**
Robot			+Pre-built +References different cultural imagery (training a pet vs. a tactical mission)

			+transferable programming
% Level 1 Starts by Girls	33.7%	45.4%	12% increase in level 1 starts by girls

Ethnographic evidence for equitable participation

Analysis of video-ethnographic data also provided evidence that girls participated equitably in learning and developing interests in FUSE. Here, we present three cases highlighting key features of FUSE that promoted equitable participation. These cases are representative of both the ways in which girls participated in FUSE and the positive experiences they reported having in their end-of-year interviews. For example, of the 32 girls we interviewed, none reported negative experiences in FUSE and 30 reported highly positive experiences.

Johanna, Victoria, and Andrea: Girls organizing their own learning

Our first case involves a group of fifth grade girls, Johanna, Victoria, and Andrea, who spent their entire school year in FUSE working together on challenges. They began with the *Dream Home* challenge, each creating their own home using the CAD program, Sketchup, but sitting together, helping each other, and showing each other things they'd made. After finishing all three levels of *Dream Home*, they worked through a follow-up challenge, *Dream Home 2: Gut Rehab* and a vinyl cutting challenge called *Selfie Sticker*, again making their own, individual products but sitting side-by-side and helping and consulting with each other. The episode in Table 3 shows how Johanna sought help from Andrea and Victoria when she encountered a problem in *Dream Home*. Here, she was trying to see inside her CAD model. Victoria had just figured this out moments before. When Andrea saw her make this discovery, she asked Victoria, "How are you doing that? How'd you get it to that view?", and Victoria showed her. So when Johanna asked Victoria the same question (line 1), Andrea was able to show Johanna.

Table 3: Andrea shows Johanna how to get "inside" her CAD model home

Line	Person	Talk	Actions
1	Johanna:	Victoria, how do you get inside?	
2	Andrea:	Got it! I got it, I got it, I got it!	
3	Johanna:	How do you? How do you do it? Can you tell me.	
4	Andrea:	Ok, so you're going to go to like the feet.	
5	Johanna:	I am at the feet.	
6	Andrea:	Uh huh.	
7	Johanna:	Mmm hmm	
8	Andrea:	And then[1]	[1]*Takes Johanna's mouse, scrolls forward.*
9	Johanna:	And just zoom in or?	
10	Andrea:		*Scrolls forward until inside is visible.*

This interaction shows how the girls shared knowledge to accomplish challenge goals. For example, Johanna sought help from Andrea and Victoria (lines 1 and 3), and Andrea provided help by explaining, then showing Johanna how to use the tools in Sketchup to achieve her goal (lines 4, 8, and 10). It also shows how Johanna actively participated in her own learning (lines 5, 7, 9), rather than passively letting Andrea do things for her. Finally, the fact that what Andrea was showing Johanna here was a skill she had just learned from Victoria shows how fluidly the girls were able to shift roles from novice to expert. This interaction not only shows how learning in FUSE was enactive but also how knowledge was embodied. For example, by asking "Victoria, how do you *get* inside?" Johanna was drawing on the embodied metaphor of walking around inside of the virtual CAD world and physically entering her model. This metaphor was supported by the tools in Sketchup, such as "the feet" (lines 4 and 5), a tool with an icon that looks like footprints and allows users to "walk" through virtual space. Andrea also shared her knowledge with Johanna in an embodied way, taking her mouse (line 8) and showing her, through embodied action, how to manipulate the hardware and software tools to achieve her goal.

As a result of many interactions like this one, not only were all three girls able to proceed through challenge levels of increasing complexity and master a set of technical tools and skills, but they also developed STEAM interests and identities related to their challenge work. For example, by her end-of-year interview, Johanna explained why she hoped she would be able to do FUSE again the next year, by saying, "*…this kind of helped me decide that I wanted to be an architect*, after my mom said it, because it's fun to make your own things."

We argue that Johanna, Victoria, and Andrea's collaborative learning arrangement and the learning and interest development that stemmed from it were possible in FUSE, because they were allowed to choose who to work with, what to work on, and how to approach the work. In other words, they were able to organize their own learning in ways that were productive for them. Their all-girl learning arrangement represents a significant departure from male-dominated computing and making spaces, in which not only is the culture dictated by males, but there may be so few females that girls are forced to seek help from males to achieve goals and/or be sidelined while boys take over control (Volman & van Eck, 2001). The fact that the girls were able to choose what to work on also allowed them to choose challenges which are broadly favored by girls but which are still technically challenging. Finally, the fact that they could work on challenges with prescribed goals allowed them to overcome one of the barriers to entry for females in makerspaces – the lack of clear goals (Lewis, 2015)

Erin: Girls leading others' learning

Our second case is Erin. Like Johanna, Victoria, and Andrea, Erin worked on challenges with other students. However, unlike Johanna, Victoria, and Andrea, she worked with a variety of, mostly male, students. Unlike girls making their way into male-dominated spaces, in Erin's interactions with boys during FUSE, she was consistently the leader. The episode in Table 4 is from Erin's work with two boys, Ajay and Aiden, as they did the *Solar Roller* challenge together. The goal of this challenge is to build a solar car capable of travelling a fixed distance along a track. In this interaction, the students were trying to add a capacitor to their car so that it could travel through a 50-inch tunnel. In this interaction, Erin directed her group's work (line 1, 12, 14), acquired problem-solving resources (lines 2, 10, 14, 16), and explained to Ajay what a capacitor was (line 18). Meanwhile, the boys messed around (lines 3-8), contributed minimally (lines 9, 11, 13, 15) and deferred to Erin's expertise (line 17).

Table 4: Erin leads her group in wiring a capacitor into their solar car

Line	Person	Talk	Actions
1	Erin:	[1]Okay, okay, Aiden, we're going to have to set up the capacitators.	[1]*Goes back and looks at the directions.*
2	Erin:	Where's the bread board?[1] Oh here it is.[2] Which one? The big one. The big one. This one's the positive side.	[1]*Looks in supply box.* [2]*Looks at directions and diagram.*
3	Boys:		*Laughing.*
4	Erin:	What?[1]	[1]*Turns toward boys.*
5	Ajay:		*Laughing.*
6	Erin:	What?	
7	Ajay:	He put his finger on the super glue thing.[1]	[1]*Holds up a plastic bag.*
8	Aiden:	I just picked it up, and it just gacked glue I guess.	
9	Ajay:		[1]*Rummages through box.*
10	Erin:	Oh, I already got all the stuff.[1] Alrighty, so we need to...so the solar panel's right here.[2] The motor's right here.[3]	[1]*Looks at directions.* [2]*Puts panel in place.* [3]*Puts motor in place.*
11	Ajay:	Here, first…	
12	Erin:	No, stop stop stop stop!	
13	Ajay:	Start with the car. Then see what you can do with it.	
14	Erin:	No, don't:::oh then that, yeah.[1] Ok, so then we're going to have to put the negative side in one of these things[2] and the positive side[3]:::where the positive side:::and don't ask why I know which one's negative.	[1]*Looks at diagram.* [2]*Inserts negative leg of capacitor into breadboard.* [3]*Looks at diagram.*
15	Ajay:	We should do like more research at our houses.	
16	Erin:	If I could fit this thing in here.[1] There I go. I'm just gonna add it. Ok so this is the capacitator, and it would, [2]short leg on the capacitor. Move the setup on the bread board. Wait what?	[1]*Inserts positive leg of capacitor into breadboard.* [2]*Reads directions aloud.*
17	Ajay:	What's a capacitator?	
18	Erin:	Um, it like gives energy, a short burst of energy, once the light disappears, continues the loop, but I don't get what[1] this is.	[1]*Points to diagram on screen.*

In her role as group leader, Erin correctly installed the capacitor and came to an embodied understanding of electrical circuits and the role of capacitors in them. We see this in line 18, when Erin provided a definition of a capacitor that incorporated the spatial arrangement of the circuit she had just constructed and the capacitor's role in it ("continues the loop"). By providing this explanation, Erin showed how knowledge is enacted through embodied activity embedded in a particular sociomaterial context. Erin also showed how, in FUSE, girls were able to be leaders, rather than followers, in learning. Like Johanna, in Erin's end-of-year interview, she reported emerging STEAM interests related to FUSE. When asked "Have you thought about what you want to do when you grow up?", Erin responded, "Yeah, I want to, since I really like space and stuff like that, I would like to be an astrophysicist or chemist…I would like to also be a programmer or stuff like that." This is significant, because in addition to doing *Solar Roller* and a number of CAD challenges, Erin spent substantial time working on computer programming challenges, such as *Game Designer* (released midway through the 2015-16 school year).

In our end-of-year interview with Erin's teacher, she also emphasized Erin's leadership role, saying, "Erin also started out with the dream house, but she is so into the computers and into GEMS and that, that *she actually took a lot of her activities home…Her group*, when they did the activity with the cars to get them to move, it was just a lot of *fun to problem solve with them."* This quote suggests that Erin's teacher recognized her role as the group leader in the *Solar Roller* challenge ("her group"). It also shows that she recognized the extended nature of Erin's interest development and learning in FUSE, as she mentioned Erin working on activities at home (without being assigned to) and participating in extracurricular STEAM activities (GEMS – Girls Excelling in Math and Science). This quote also suggests of how this teacher saw her role in FUSE – as a facilitator or helper rather than instructor (e.g., "fun to problem solve *with* them"). This indicates one mechanism through which space was made for Erin or other students to step into leadership roles – because the teacher was not dominating them.

Carmen: Girls' expertise being valued

Our final case is a student, Carmen, who represents of a type of interest, identity development, and learning frequently observed in FUSE—students developing interests and *relative expertise* (Stevens et al., 2016) related to 3D printing, using that expertise to help others print, and becoming recognized as *relative experts.* For example, the transcript in Table 5 shows Carmen helping another student, Elena, print by fixing a problem with the printer.

Table 5: Carmen fixes a problem with the 3D printer and manages the print queue

Line	Person	Talk	Actions
1	Carmen:	Something must have went wrong with um, when it was pulling this in,[1] it must have gotten a little bit tangled.	[1]*Pulls on guide tube surrounding filament.*
2	Elena:	[1]Can I edit this?[2]	[1]*Sits down at computer connected to printer.* [2]*Looks at Carmen.*
3	Carmen:	What? No you can't, Elena. Sorry. Unless you want to do it on this computer, and then let Diego print today, and then you can print next week.	
4	Elena:	I'm not going to print next week[1], unless I'm going, unless I go after Diego?	[1]*Shakes head.*
5	Carmen:	You can go after Diego[1], right after Diego.	
6	Aaliyah:	This is probably going to take a little bit longer.	
7	Carmen:	So do you want to print after Diego or do you want to print now, with 'Focus'? Your choice.	
8	Aaliyah:	Just make it really big	
9	Researcher:	Is there something that you could do to fix it, so that it will print better next time, do you think?	
10	Elena:	Maybe like, I want to make it	
11	Carmen:	Something, it probably got tangled right here[1] in the string and it wasn't going in through it[2].	[1]*Reaches for filament, then points to it.* [2]*Points to extrusion nozzle.*

In lines 1 and 11 of the transcript, Carmen demonstrated her embodied technical knowledge and troubleshooting skills with the printer by presenting a possible solution to a problem both in words and embodied action. She then fixed the problem by untangling the filament. Elena positioned Carmen as an expert by seeking her guidance (line 2), letting her solve the problem, and deferring to her authority about the print queue (indicated by Elena's lack of response after line 5). Two weeks later, another student, Diego, also recognized Carmen's expertise, by awarding her the class's travelling "Engineer Award". He did so in recognition of both her technical expertise at

3D printing *and* her use of that expertise to help other students print, saying, “I nominate Carmen, because how she was working hard and how she was like helping us and like pushing herself and as soon as something was wrong, she would fix it.” Diego’s nomination was seconded by a number of students and the teacher.

Carmen’s teacher also showed recognition of her 3D printing expertise in his end-of-year interview, saying “Carmen, she became like our 3D printer guru. You know, she was the one that you would go to with any 3D printer issue. She could change it. She could do it”. He contrasted this with her confidence elsewhere, saying, “And you know, in class, she might not always show that confidence. Um, you know, she likes to participate, but you can tell with her answers sometimes, there’s not the confidence, whereas here at FUSE, when it came to 3D printing, Carmen could tell you with confidence.” This suggests that the forms of knowledge and interaction valued in FUSE allowed Carmen to build confidence and expertise in ways unavailable in a traditional classroom.

Carmen also recognized her own expertise. For example, one day, when the first author asked Carmen and Elena, “What are you ladies working on today?” Carmen replied, “Uh, actually, I'm helping her print, *because I'm like the master of the printer now*, and the computer.” In Carmen’s end-of-year interview, she explained her interest in the 3D printer, saying “I like working on the 3D printer, and I like helping other people, um, with the 3D printer so that they can print and they can have their prints and be happy with it.” In other words, her interest was both in the technical object but also in using her technical work with it to help others. Carmen also connected this work to her emerging identity and interests, saying “So I am kind of like a generous person helping…and when I grow up I wish to help cancer kids and become a doctor for them…So I'm starting now and helping people with the 3D printer…the 3D printer is like a cancer kid. I get to help it. If it's broken, I get to cure it and fix it.” Carmen’s words show how FUSE supported her in discovering interests and identities, developing social and technical skills, and being recognized for those skills by her peers and teacher. In other words, they show how the FUSE culture valued her ways of knowing and allowed her to experience herself as a knowledgeable contributor.

Conclusion

The analyses presented here show how CSCL environments can be designed, studied, and improved to promote equity. Using web-log data, we showed how the placement of FUSE in school allowed for *equitable access* and how challenges were designed (and redesigned) to appeal to both boys and girls. Using ethnographic data, we showed how FUSE promoted *equitable participation* in interest development and learning that was enactive, embodied, embedded, and extended. We showed how FUSE afforded opportunities for girls to organize their own learning, to become leaders of others’ learning, and to develop and become recognized for their expertise. We argue that these opportunities were afforded by three key features of the FUSE activity system. The first is the choice-based nature of FUSE, which allows learners to pursue projects of interest in ways that work for them. The second is the attention paid to designing and improving challenges so that they appeal to both girls and boys. The third is the way in which students are encouraged to help one another and seek help from peers, rather than relying on the teacher for support. These features suggest guidelines for the design of other equitable CSCL environments.

The analyses we’ve presented also provide guidelines for further investigations into other sorts of equity (or inequity) in the FUSE environment. For example, a similar analysis is needed to determine whether interest development and learning outcomes are equitably available to students of different racial, ethnic, and socioeconomic backgrounds. Our video-ethnographic observations suggest that they are. For example, three of the five girls represented here were Latinas, and one was Asian. However, a systematic examination of these forms of equity is needed. As FUSE is now scaling up to schools across the country, many of which serve majority low income and/or underrepresented minority populations, this has become an emerging focus of our research.

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