Analyzing Equity in Collaborative Learning Situations: A Comparative Case Study in Elementary Computer Science

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Abstract: This paper presents a comparative case study of the different ways that equity and inequity emerged as an elementary computer science student collaborated with two different classmates on programming tasks. Data collected include audio recordings of students' interactions, field notes, written assessments, and students' digital work. Using a mixed methods approach, quantitative patterns were identified in the distribution and content of student talk at multiple grain-sizes, which were analyzed in conjunction with pivotal sequences of interaction. Findings indicate that despite the existence of participation structures designed to foster equitable collaboration, inequities emerged in both dyads as students positioned themselves and their classmates with identities as more or less competent in computer science. While in the first dyad this positioning was often overt, in the second dyad positioning assumed a more passive form. Further, there is evidence that these positionings had an impact on students' opportunities to learn.

Introduction

Collaborative learning is a complex pedagogical undertaking that has the potential to foster both individual content learning and mutual respect between peers (O'Donnell & Hmelo-Silver, 2013; Webb & Farivar, 1994). However, when not carefully structured, collaborative learning can also inadvertently lead to inequitable learning situations where all students do not have access to the resources needed for learning (Cohen & Lotan, 1995; Esmonde, 2009; Sfard & Kieran, 2001). To better understand the interaction between collaborative learning and equity, this paper presents a comparative case study of how equity (and inequity) emerged as two dyads of elementary computer science students collaborated on joint programming tasks.

Learning environments are equitable when all students have access to the cognitive and social resources that foster learning given their particular histories and needs (Abrahamson & Wilensky, 2005; Boaler, 2008). From a sociocultural perspective, one resource that is critical to engagement in the learning process is a positive domain identity as a competent learner (Nasir & Hand, 2008). That is, if students are not afforded opportunities to develop such identities, or if they are actively positioned as having low intellectual status, then they may not participate in the kinds of practices (e.g., asking questions, sharing their ideas) that have been shown to facilitate content learning (Cohen & Lotan, 1995). Characterizing the equity dynamics of a collaborative learning situation, then, call for an analysis of the processes by which students position themselves and their peers as being certain types of learners, with varying potential to contribute to joint problem solving.

The findings presented in this paper are based on a mixed methods analysis of field notes, transcripts of audio data, written assessments, and digital student work collected during a three-week introductory computer science course for 10-11 year-old students in Northern California. The study focused on a student named Jason (pseudonym) as he collaborated with two classmates, Aaron and Samantha (pseudonyms), on separate days. Three strands of analysis were coordinated to progressively support or refute hypotheses related to the equitable nature of each dyad's interactions: 1) quantitative patterns were identified in how talk was *distributed* within each dyad across different phases of problem solving; 2) quantitative patterns were identified in the *content* of students' talk; and 3) qualitative analysis was conducted of key sequences of interaction in both dyads, which shed light on how students *positioned* each other (and themselves) with respect to identities as competent doers of computer science.

Findings indicate that inequities surfaced in both dyads' interactions through two different types of positioning: overt and passive. In the Jason-Aaron dyad, Aaron dominated the interaction by overtly positioning Jason as not capable of contributing to the problem solving process on multiple occasions. There is evidence that this inequity had a material impact on Jason's opportunities to learn. In contrast, data suggest that the Jason-Samantha dyad was more equitable. However, while overt forms of positioning were less prevalent in their interaction, analysis revealed instances where Samantha passively positioned Jason as less competent (e.g., by not asking for Jason's input on something she did not understand before asking a teacher for help).

These findings are significant because they illuminate aspects of the complex interaction between positioning, status, and content learning. Further, they demonstrate how even when collaborations seem equitable on the surface, students may be positioning each other in subtle ways that lead to inequitable conditions. Understanding some of the ways in which students come to be positioned as competent is critically important to designing learning environments where all students have access to identities as capable learners.

Equity, Identity, and Positioning in Social Interaction

In educational contexts, "equity" has primarily been conceptualized in terms of either institutional barriers or performance gaps on standardized tests. On the one hand, either a lack of material resources (e.g., computers, exemplary teachers) or a lack of access to the most rigorous coursework available (i.e., "tracking") can limit students' opportunities to learn (Margolis, et al., 2008; Oakes, 2005). On the other hand, even in the absence of such institutional barriers, inequities can still emerge at the classroom level as students engage with each other in the learning process.

One dimension of equity that is linked to learning concerns is students' access to the resources needed to construct identities as capable learners in a particular domain (Langer-Osuna, 2011; Nasir & Hand, 2008; Wortham, 2006). But what is meant by "identity"? According to Davie & Harré (1990), "an individual emerges through the processes of social interaction, not as a relatively fixed end product but as one who is constituted and reconstituted through the various discursive practices in which they participate" (p. 46). Thus, rather than a stable trait, "identity" can be thought of as the effect of an ongoing process of positioning embedded in social interaction (Davies & Harré, 1990; Hall, 1996).

Applying this conceptualization of identity to the context of learning puts issues of intellectual status firmly in view. That is, learning is not a neutral process. The ways in which students engage in the social practices of learning are related to the positions they occupy within the learning environment. Students that occupy positions of high intellectual status (i.e., those that signify domain competence) may take up (or be granted) opportunities to participate in the learning process more often than students that occupy positions of lower intellectual status (Cohen & Lotan, 1995). Conversely, the more students engage in the learning process (e.g., by offering ideas, answering questions), the more readily they come to occupy positions of high intellectual status. A key point is that students are not *inherently* "low" or "high" status. Rather, the types of learners that students become reflect what the learning environment makes available to them, how they are treated by their classmates and teachers, and how they understand their own capabilities.

Issues of identity formation and positioning are particularly salient in collaborative learning contexts because students are simultaneously confronted with both the cognitive challenges and social dynamics of joint problem solving (Esmonde, 2009). For this reason, the present study sought to investigate some of the ways students come to be positioned as competent (and less competent) learners in computer science while collaborating with a partner on a common set of programming tasks.

Methods

Data were collected in a university-sponsored, summer-enrichment program for academically high-achieving students entering the sixth grade. The course was titled "Creating Music, Movies, and Games with Computers" and taught introductory computer science concepts primarily using Scratch, a visual, drag-and-drop programming language. There were two sections of the course offered, which each met for 36 hours over 12 days during the same three-week period. Details about the research context and pedagogy are described in a previous paper (Shah, et al., 2013). Forty-five students were enrolled across the two sections, of which twenty-three students (51%) identified as female in enrollment records. After the first day of class, 12 students (6 per class) were selected as focal students in an effort to maximize the variation between focal students with respect to gender, race, and personality.

The course was designed and taught by the first two authors, who were supported by two teaching assistants. All instructional time was observed by at least one of three researchers who took fieldnotes focused on one or more focal students. During each 180-minute instructional day, each focal student was observed for at least 45 minutes and audio recorded for at least 90 minutes. A typical class included a 15-minute paper-based assessment (referred to here as "warm-ups"), lecture and whole-class discussion, and students working on programming tasks presented in an online curriculum. The majority of each class involved students working individually or in pairs on the computers. On odd-numbered days students worked individually, while on even-numbered days they worked in pairs on the same computer. When working in pairs, students shared a computer using a pedagogical structure common in computer science education called "pair programming" (Braught, Wahls & Marlin Eby, 2011). Pair programming utilizes roles to promote equitable collaboration (cf. Palinscar & Brown, 1984). Pair programming involves one student playing the role of "driver" while the other student plays the role of "navigator." Drivers use the keyboard and mouse, while navigators support the problem solving verbally without touching the keyboard and mouse. Further, students switched roles every five minutes so that each student has an equal opportunity to take up both roles.

Comparative Case Study Design

The full collection of 98 fieldnotes for the 12 focal students were systematically reviewed, discussed, and summarized by the research team. The summaries included perceptions of the focal students' trajectories in the class, interactions with partners and other students, and interactions with teachers. From a review of the fieldnotes and teaching experiences within the class, Jason was identified as a particularly interesting case because of the variation we observed in his pair programming relationships. That is, because at times he appeared to be engaged in a productive collaboration, and at other times he was not, it was thought that comparing Jason's learning experience across these different contexts might put into relief features of collaboration that might help explain this variation.

Audio recordings from two days when Jason was pair programming were selected because they included acceptable audio quality and variation in the quality of his partner interactions. On Day 4 of the twelve-day class, Jason pair programmed with Aaron. Jason's average scores on homework and warm-ups were some of the lowest in the class, while Aaron had the second-highest average performance on warm-ups among the 45 participants. The content students worked on during Day 4 included programming their character to make various geometric shapes (e.g., a square "spiral" that progressively increases in size; a four-leaf flower). These tasks built on basic knowledge students learned on Day 2 about programming basic shapes, such as a triangle and a circle.

On Day 6 Jason pair programmed with Samantha, who like Aaron was also a high performer in the class: she had the eighth highest average performance on warm-ups among the 45 participants. The content worked on during Day 6 involved making a game of "tag," which involved students learning to use conditional statements (e.g., "if" blocks).

Transcripts were created of all audible dialogue in the audio recordings. Each transcript was divided into turns, which were differentiated by either a new sentence or a distinctly new idea. Transcripts included few indications of tone, but documented phrases interpreted as questions using a question mark.

Analytical Approach

The present study characterized an equitable collaboration as one where all group members have an equal opportunity to participate in the interaction, as well as to be positioned as having high intellectual status (cf. Cohen & Lotan, 1995). Prior research has used student talk as a measure of engagement in collaborative settings (see Barron, 2003; Engle & Conant, 2002; Langer-Osuna, 2011). As some have argued, researchers should be careful not to over-privilege talk, particularly in light of research showing that nonverbal behavior (e.g., eye gaze) is also a meaningful indicator of engagement (Sawyer, 2013). However, the lack of high-quality video constrained the possibility of such an analysis. Still, much can be learned about the equity in an interaction through quantitative and qualitative analysis of verbal communication. Overall, our analytical approach was consistent with Barron's (2003) recommendation to emphasize the group itself as the unit of analysis.

Analysis using mixed methods was conducted at three levels. The first level focused on the *distribution* of talk within dyads in three areas of interaction: total overall talk, across the driver/navigator participation structure, and across certain classroom activities. In general, it was assumed that if the collaboration were equitable, then the number of turns would be near equally distributed (i.e., 50-50). In addition to determining the overall distribution of talk for the entire 90-minute interaction, transcripts were divided into six classroom "activities": a) whole class; b) interacting with teachers; c) coding; d) designing; e) managing logistics; and f) off-task. Each turn in the transcript was tagged with one of these six activities, and then talk-distribution was analyzed for each activity. The rationale for this part of the analysis was that only examining overall talk-distribution might obscure inequities at a finer grain-size in activities like "coding," which was particularly relevant to the problem solving process.

The exception to the 50-50 benchmark was the distribution of talk within the driver/navigator participation structure. That is, because navigators were expected to talk more given that this was the nature of the role, a 50-50 distribution of talk would not necessarily be desirable. Instead, the equity benchmark here was that the interaction would exhibit a "mirroring" effect, such that if talk distribution is 70-30 when Student A is navigating and Student B is driving, then when the students switch roles (i.e., Student A is driving and Student B is navigating) the distribution of talk should also switch (i.e., 30-70). This mirroring behavior could be interpreted as evidence that students are honoring the intent of the participation structure, which was to promote fairness in their social interaction.

The second level of analysis concerned the *content* of students' talk. Based on a review of coding schemes in the collaborative learning literature, as well as a process of open coding informed by our field notes that helped identify types of student talk that might be consequential for positioning vis-à-vis intellectual status, a coding scheme was developed that aimed to capture the quality of student talk. While the authors' cultural interpretations of students' statements informed the development of scheme, the codes were designed to describe the content of the talk rather than our perception of the likely effects. After multiple rounds of refinement on a subset of the transcripts, the codes stabilized and all of the turns were coded with the transcripts divided evenly between the first two authors. Each turn in the transcripts could be tagged with multiple codes.

While some of the codes occurred with high frequency (e.g., "asking a question," "issuing a command"), other codes occurred with lower frequency (e.g., "complementing a partner," "asking a teacher for help without consulting partner") but were still considered potentially consequential for positioning. High frequency codes were analyzed to determine how a given type of statement was distributed in a dyad. For example, if one of the two students issued disproportionately more commands, then it might suggest an inequity in the collaboration. Due to space constraints, the findings presented in this paper focus on the two highest frequency codes in the data: "student questions" and "commands" (subsequently described in greater detail).

The third level of analysis involved a qualitative analysis of key sequences of interaction that were both representative of the interaction and that seemed consequential for positioning and learning. Qualitative approaches are particularly useful in revealing the processes by which overall interactional trends emerge (Sawyer, 2013). In this case, the focus was on pivotal moments in each dyad where students were positioned either as competent doers of computer science or as having low intellectual status.

Findings

This section presents three levels of analysis: 1) distribution of talk; 2) content of talk; and 3) fine-grained processes of positioning. Each level involves multiple strands of analysis, which were coordinated to generate and then progressively refine hypotheses about how equitable both dyads were in various facets of their interactions.

Distribution of Talk within Dyads

An initial indicator of an equitable collaboration is whether the distribution of talk across the entire 90-minute interaction within dyads approached a 50-50 distribution. Figure 1 shows that while Jason engaged in fewer turns than Aaron overall (N=991; J:41%; A:59%), Jason and Samantha engaged in nearly the same number of turns (N=1000; J:51%; S:49%). In terms of an initial hypothesis, these data suggest that the Jason-Aaron dyad may have been less equitable than the Jason-Samantha dyad.

Total Talk (N=991):
(N=1000):

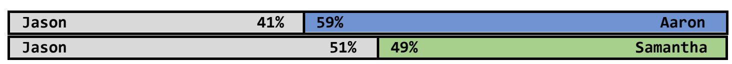

Figure 1. Distribution of talk within dyads.

Distribution of Talk within Pair Programming Participation Structure

A second indicator of an equitable collaboration in this context is whether dyads were respecting the norms of the driver/navigator participation structure. As described earlier, this would mean that: 1) navigators were talking more often than drivers, and 2) that the distribution of talk would exhibit the "mirroring" effect (i.e., when students switch roles the distribution of talk would also switch and be roughly equivalent).

Figure 2 shows how the distribution of talk within each dyad compared when each student was acting as the navigator. Data indicate that the Jason-Samantha dyad satisfied both criteria of an equitable collaboration within this participation structure: the navigator always talks more, and the distribution of talk exhibits the "mirroring" effect (see Figure 2). When Jason was the navigator, he engaged in 56% of the turns (N=415; J:56%; S:44%); when Samantha was the navigator, she also engaged in 56% of the turns (N=353; J:44%; S:56%). This finding supports the hypothesis that the Jason-Samantha dyad was equitable.

In contrast, the Jason-Aaron dyad did not satisfy either criterion. When Jason was navigating he actually spoke slightly *less* often than Aaron (N=341; J:49%; A:51%). And when Aaron was navigating, not only did he engage in a greater proportion of turns (N=574; J:34%; A:66%), but roughly 200 more turns occurred overall. Altogether, these data suggest that Aaron was dominating the interaction, and lend further evidence to support the hypothesis that the Jason-Aaron dyad was less than equitable.

Navigator - Jason (N=341):
Aaron (N=574):

Navigator - Jason (N=415):
Samantha (N=353):

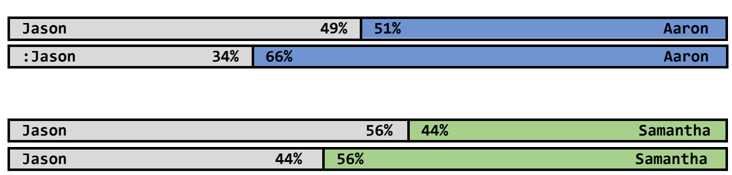

Figure 2. Distribution of talk within pair programming participation structure.

Distribution of Talk across Activity Contexts

A third indicator of an equitable collaboration is how talk was distributed within the finer grain-sizes of activity that students engaged in during the problem solving process. The analysis here focuses on two activity contexts: "coding" (e.g., generating new code, debugging) and "designing" (e.g., planning their project, making aesthetic choices about what their characters should look like). Not only were these two activities the most common during each dyad's interaction, it was assumed that "coding" and "designing" would be especially relevant for positioning and students' opportunities to learn.

Figure 3 shows the distribution of talk when each dyad was engaged in coding. In the Jason-Aaron dyad, the data show that Aaron dominated the interaction (N=492; J:34%; A:66%). Because "coding" was where much of the content of students' work was generated, the imbalance in this activity context may have been particularly impactful in positioning Aaron as high-status (i.e., the one who knows the answers) and Jason as low-status. In contrast, the distribution of talk in the Jason-Samantha dyad during coding was almost equal (N=485; J:48%; S:52%). Both data support the running hypotheses about the equity of each dyad's interactions.

Coding (N=492):
(N=485):

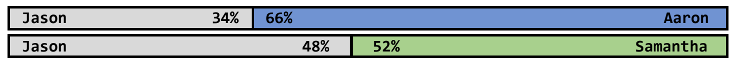

Figure 3. Distribution of talk when coding.

Figure 4 shows the distribution of talk when each dyad was engaged in project design. Interestingly, the analysis reveals that this is one context where Aaron did *not* dominate the interaction (N=328; J:48%; A:52%). This complexifies the current hypothesis about the Jason-Aaron dyad in that it shows that there was at least one part of the interaction that *did* appear equitable. In the Jason-Samantha dyad, the data show that Jason actually spoke more than Samantha during this phase of problem solving (N=163; J:55%; S:45%). However, because "designing" involved the aesthetics—as opposed to the content—of students' projects, it is likely that it was less consequential than "coding" in positioning students as academically capable or "smart." Still, it is noteworthy that Jason engaged in a greater proportion of turns during this particular phase of problem solving.

Designing (N=328):
(N=163):

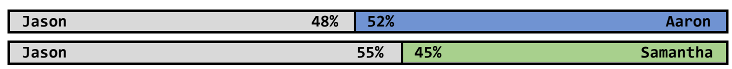

Figure 4. Distribution of talk when designing.

Content of Talk in Dyads

Complementing the previous analyses, the content of student talk was also analyzed to shed light on the nature of students' interactions. This section focuses on the two codes that occurred most frequently: "commands" and "questions." In the next section some of the less frequent—but potentially consequential—codes are discussed.

Note that while in a colloquial sense "commands" have a typically pejorative connotation, the operational definition used here was more neutral and referred to any turn in which one student directs her/his partner to execute a particular action. Still, issuing many directive statements may indicate a lack of respect for the intellectual capacity of that individual to contribute. Figure 5 shows the number of commands issued by students in each dyad. In the Jason-Aaron dyad, Aaron issued nearly 100% of the commands (N=123; J:5%; A:95%). This finding adds strong support to the hypothesis that their interaction was inequitable. While the pattern was not as pronounced in the Jason-Samantha dyad, Samantha did disproportionately issue commands at roughly a 2:1 ratio relative to Jason (N=71; J:35%; S:65%). However, the total number of commands was less overall compared with the Jason-Aaron dyad (71 vs. 123 commands). This is the first indicator that the Jason-Samantha collaboration may not have been as equitable as the analysis has indicated.

Issuing a command (N=123):
(N=71):

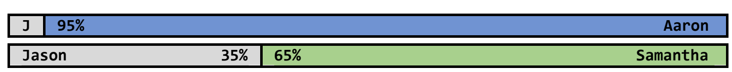

Figure 5. Distribution of commands.

In addition to commands, the act of asking questions to a partner is also relevant to positioning because it presumes that the partner can answer it. In other words, asking a partner a question can be seen as actively positioning that person as competent and, alternatively, *not* asking a partner a question can be seen as passively positioning that person as *less* competent. Figure 6 shows that in both dyads, Jason asked more questions than both Aaron (N=42; J:67%; A:33%) and Samantha (N=41; J:68%; S:32%) by almost identical 2:1 ratios. An environment where students are asking each other questions may still be equitable if question-asking is reciprocal. However, because question-asking was imbalanced in both dyads, it bolsters the hypothesis that the Jason-Aaron dyad was generally inequitable, and it further challenges the hypothesis that Jason-Samantha was an equitable collaboration.

Asking a question (N=42):
(N=41):

Figure 6. Distribution of questions.

Processes of Positioning

Key Sequences in the Jason-Aaron Dyad

The preceding analysis showed that Jason asked more questions than Aaron, and that Aaron frequently commanded Jason. Based upon our assumptions that questions positively position the partner who is asked, and that commands negatively position the partner who is being commanded, these data suggest that the Jason-Aaron partnership was inequitable. The qualitative analysis presented here demonstrates both how Jason is positioned as not competent through the use of commands, and also highlights how Jason's interactions with Aaron were consequential for his opportunities to learn.

A typical pattern in the Jason-Aaron dyad was a "command and clarify" routine: when Aaron was navigating that he would issue commands to Jason, and Jason would intermittently ask clarifying questions. To demonstrate this pattern, consider the following sequence of turns in which Aaron provides instructions to Jason to find a "When Space Key Pressed" block from the "Control" tab in the Scratch user interface, and to change the "space" key to the letter "D" key.

168 Jason: So what next?
169 Aaron: When "D" key pressed.
170 Jason: "D"…what?
171 Aaron: Control tab.
172 Jason: Oh…here?
173 Jason: Just press "D"?
174 Aaron: Don't just press "D," go to the Control tab.
175 Aaron: "When Space Key Pressed" [block]…do you see that?
176 Aaron: Space key pressed.
177 Jason: This?
178 Aaron: Yeah, drag it out.
179 Aaron: Change it to "D."

With Aaron issuing repeated directives and Jason responding with clarifying questions, Aaron is positioned as the "competent" partner and Jason is positioned as having low intellectual status. This inequitable dynamic relates to Jason's opportunities to learn. For example, there was evidence that Jason was not always engaging with the content of Aaron's commands, even when Aaron's commands would not produce the correct solution. Following the exchange detailed above, the students are attempting to write a program that will produce a 5-pointed star. To produce this geometric shape, the sprite must turn 144 degrees at each vertex. Students had not encountered the problem before, so it was not surprising when Aaron initially suggested that the turning-angle be 108 degrees:

190 Aaron: Turn one hundred eight degrees.
191 Jason: Turn – one hundred and. [speaking aloud while typing on the keyboard]
192 Jason: Eight.
193 Aaron: That's one-eighty [pointing out that Jason typed in 180, not 108]
194 Jason: Oh wait – you want one hundred and eight?
195 Aaron: Yeah.

In this interaction, Aaron instructed Jason to use the number 108, but Jason instead types in 180. Although Aaron's suggestion of 108 degrees will not successfully draw the shape, it is a reasonable estimate of how much the sprite should turn. In contract, turning 180 degrees is not reasonable because this would cause the sprite to face the opposite direction. Given students' prior experiences with Scratch-based geometry on previous activities that day and two days earlier on Day 2, we would expect that students could easily determine that 180 degrees should not be used in creating the shape. Jason's statement in line 194 ("Oh wait – you want one hundred and eight?") suggests that either he did not perceive 180 as an unreasonable solution or did not feel he had the authority to challenge Aaron. As a result, Aaron's incorrect estimate was left unchallenged, thereby impeding both students' problem solving.

There is further evidence that this type of uncritical execution of Aaron's commands hindered Jason's opportunities to learn, in particular. On the following day of class, Jason requested teacher help for a review problem that Aaron and he had completed the previous day. Jason reported to the teacher that he did not remember how to solve the problem *"I don't remember how to do it, [because] when we did—well I didn't do it, Aaron did. I was there but I didn't really like..."* (lines 287-288). Unfortunately, audio recordings are unavailable from when they completed the task for the first time. Jason's statement that he does not know how to solve the problem may be accurate or reflect his lack of confidence; however, both could plausibly have resulted from the negative positioning he experienced during his collaborative work with Aaron.

Key Sequences in the Jason-Samantha Dyad

While considering only the distribution of talk, the Jason-Samantha dyad appeared equitable. However, analyzing the content of talk revealed an imbalance between them, as Samantha issued more commands and Jason asked more questions. These two patterns may have positioned Jason as less competent. The preceding section discussed how Aaron overtly positioned Jason as not competent by directing his actions with commands. In the Jason-Samantha dyad, however, there were moments where positioning was more passive.

For example, recall that on Day 6 students were programming a game of "tag," where one sprite would earn points if it touched the other the sprite. On one occasion the curriculum asked students to write code for a "power-up," which is a special sprite in the game of tag that would afford a player bonus powers if touched. When Jason and Samantha reached this part of the curriculum, Samantha immediately calls a teacher over for help without consulting her partner. Samantha did not understand the concept of a "power-up." As the teacher explains the power-up, Jason repeatedly interjects comments explaining the idea of a "power-up." It appears that Jason could have been a resource to Samantha if she had asked him. After the exchange with the teacher, Samantha asks Jason: "You get it?" (line 127). This further indicates that she was not attending to Jason's contributions, in that she did not realize that Jason understood the concept of a "power-up" all along. However, this question may still show some level of investment in her partner's learning.

There were also three occasions (lines 347, 366, 574) where Jason was driving but Samantha made a bid to use the keyboard or mouse. In these moments, Samantha seemed impatient with how quickly Jason was typing or perusing the Scratch interface. Recall that one of the purposes of the driver/navigator participation structure was to fairly distribute access to the computer, which was highly valued by all students in the class. Only students in the driver role were supposed to use the keyboard and mouse. Thus, Samantha's bid for the computer (i.e., to "drive") can be interpreted as an implicit refutation of Jason's ability to handle the computer. So although such moments in their interaction were infrequent, they may have served to position Jason as a less than equal contributor.

Discussion and Implications

This paper offered an analysis of how equity and inequity can emerge on multiple levels as students interact in collaborative learning situations. In the Jason-Aaron dyad, Aaron dominated the conversational floor and overtly positioned Jason as less capable of contributing to their joint problem solving. In contrast, the Jason-Samantha dyad appeared more equitable (e.g., they tended to share the conversational floor). However, analysis revealed subtle inequities in some of the more passive ways in which Samantha also positioned Jason as less competent.

The Jason-Samantha case, in particular, suggests that rather than conceptualizing equity as a binary phenomenon (i.e., an interaction is deemed equitable or inequitable), it may be more useful to conceptualize equity as contextual. That is, in any given interaction there may be situations where a student had more or less access to the resources needed for learning. In fact, recall that even within the Jason-Aaron dyad, the distribution of talk was roughly equal during the "designing" activity context. Although "designing" may not be as high-status as "coding," it is possible that the opportunity for Jason to engage within this activity may have prevented him from disengaging altogether from an interaction where his partner was dominating. A different computer science classroom in which students had no opportunities for "designing" may have provided even fewer opportunities for Jason to participate in his collaboration with Aaron.

A limitation of this research is that it took place in the privileged context of an opt-in summer program for high-performing students. But while the students in this study may not be representative, it is plausible that the mechanisms of positioning identified in this paper would also occur in other educational contexts. Another consideration is that the analysis of positioning and equity presented here was confined mainly to the local learning environment. However, social interactions between learners are also situated within broader societal discourses (e.g., gender, race) that also can affect how students are positioned, especially in technically oriented domains where stereotypes about the capabilities of different groups exist (Shah, 2012; Langer-Osuna, 2011). Future research in this area should aim to account for how such discourses mediate student interaction.

There is growing interest in the learning sciences in issues of equity. To date, though, the field has few tools for measuring equity in a collaborative learning context. And indeed, there is no consensus standard by which researchers can definitively determine the degree to which a given learning situation was equitable. Still, the methodological approach presented here aims to contribute one way of operationalizing equity through quantitative and qualitative measures. Efforts to specify what we mean by "equity" can only serve to facilitate progress toward the long-term goal of creating learning environments that foster student agency and preserve all students' opportunities to learn.

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