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The Case of Mitchell's Cube: Interactive and Reflexive Positioning During Collaborative Learning in Mathematics

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Using positioning theory as a guiding framework, this qualitative research examined the experiences of students who appeared to be marginalized from collaborative learning in mathematics in a middle school setting. Positioning theory describes the discursive process whereby people are located in conversations as observably and subjectively coherent participants in jointly produced story lines. Interactive positioning describes when one or more persons position another individual. Reflexive positioning describes the positioning of oneself. In this research, I examined instances of (mis)alignment between interactive and reflexive positioning during collaborative learning. Factors potentially contributing to (mis)alignment are considered as well as implications for students, learning, and instruction.

Collaborative learning has been widely endorsed both in research and policy statements pertaining to effective pedagogical practices in mathematics education (Expert Panel on Student Success in Ontario, 2004; National Council of Teachers of Mathematics/NCTM, 2000; Ontario Ministry of Education and Training/OMET, 2005). This endorsement has occurred despite concerns that research about collaborative learning has lacked rigorous analysis, and despite suggestions that collaborative learning may not produce any significantly enhanced results in terms of achievement over other types of learning (i.e., individual centered, teacher centered; Anderson, Reder, & Simon, 1996; Stacey & Gooding, 1998).

Anderson et al. (1996) suggest that some studies "tend to gloss over difficulties with the approach and treat it as an academic panacea" (p. 9). Moreover, Anderson and colleagues claim that collaborative learning "is applied too liberally without the requisite structuring or scripting to make it effective" (p. 10). Although collaborative learning has been shown to be an important teaching and learning strategy for many students, this has not been the case for all students (Anderson et al., 1996; Barnes & Todd, 1978; Cohen, 1984, 1994; Gillies & Ashman, 2003; D. W. Johnson & Johnson, 1994; Peterson, Wilkinson, & Hallinan, 1984; Slavin, 1995; Vermette, 1998).

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It is important to note that this point is not unique to collaborative learning and may be true for any teaching and learning strategy. No one approach works for every student.

Collaborative learning, for the purpose of this research, is defined broadly as learning environments where small groups of students (i.e., in pairs, groups of three or more) work together to complete a mathematical task (Dekker, Elshout-Mohr, & Wood, 2006; Gabriele, 2007; Kieran, 2001; Kramarski & Weiss, 2007; Mercer, 1996; Pijls, Dekker, & van Hout-Wolters, 2007). Through the process of working together, students solve the mathematical tasks and also have the opportunity learn, although this cannot be assured simply from the process of engaging in collaborations. Collaborative learning and cooperative learning for this research could be used interchangeably (D. W. Johnson & Johnson, 1989; S. D. Johnson & Chung, 1999; Kagan, 1994; Slavin, 1995; Vermette, 1998).

In this research, *positioning theory* and specifically the *interactive* and *reflexive* positioning of other and self, described shortly (Davies & Harré, 1990, 1999; Harré & van Lagenhove, 1999), are used to understand the experiences of different students during collaborative learning. To state outright, it is not the intent of this research to discredit collaborative learning. As outlined earlier, collaborative learning in mathematics has been shown to be beneficial for many students—but this has not been the case for all students (Esmonde, 2009; Kotsopoulos, 2007, 2008; Sfard & Kieran, 2001; Sfard, Nesher, Streefland, Cobb, & Mason, 1998; Sinclair, 2005). Yet, few studies highlight the implications to students when collaborative learning is not beneficial.

Consequently, the goals of this research were as follows: (a) to examine the positioning of students that appeared to be marginalized from the group activities during collaborative learning, and (b) to consider the potential social (interpersonal) and disciplinary implications of students' positioning of themselves and by others during collaborative learning.

THEORETICAL FRAMEWORK

This research draws and extends upon Harré and van Lagenhove (1999) and Davies and Harré (1990, 1999) conceptualization about "positioning," which is used to describe relationships and interactions of people jointly engaged in conversation and/or activity. This research also draws on related research that considers the potential portability of positioning to future interactions, activities, and conversations (Evans, 2000; Gee, 1999; Wortham, 2004).

According to Davies and Harré (1999), positioning is defined metaphorically as "the discursive process whereby people are located in conversations as observably and subjectively coherent participants in jointly produced storylines" (p. 37). Collaborative learning environments in mathematics, and in other disciplines, are instructional environments in which story lines and positioning can be enacted. Story lines are conceptualized as conversations or interactions between two or more people whereby individuals can assume multiple and shifting roles (Harré & van Lagenhove, 1999). The story lines "can stem from culturally shared repertoires or can be invented" (Wagner & Herbel-Eisenmann, 2009, p. 2).

Davis and Harré (1999) propose that with story lines "there can be interactive positioning in which one person positions another. And there can be reflexive positioning in which one positions oneself" (p. 37). They make clear that neither interactive nor reflexive positioning may be intentional. Moreover, interactive positioning can be potentially contested through reflexive positioning by the other person (Davies & Harré, 1990, 1999; Harré & van Lagenhove, 1999; Wagner

& Herbel-Eisenmann, 2009). In addition, interactive positioning may occur by one individual toward another or as a collective and jointly constructed action by a group of individuals. Also, the positioning within one story line can be ported to another story line in other settings or across periods (Evans, 2000; Gee, 1999; Holland & Lave, 2001; Wortham, 2004).

To illustrate interactive and reflexive positioning, the example given by Davies and Harré (1990) was a discussion between a principal, Bob, and a student named Shane. In this example, Bob had asked Shane to remove his hat while inside the school. Within this story line, Shane was subject to interactive positioning by Bob. Shane was positioned as rebellious when he did not comply, which resulted in his suspension from school for two days. Shane engaged in reflexive positioning when he did not comply with the request. He did not assume the subordinate power position ascribed to him through his interaction and conversation with Bob. He is not complicit about his interactive positioning.

The implications of the potential portability of positioning to future story lines is powerfully explained by Gee (1999), who says that interactions (i.e., verbal and nonverbal) can "infect" other interactions, be carried on through history, and "form human history" (p. 18). Davies and Harré (1999) support this notion of portability of positioning and argue that one may nevertheless perpetuate or continue with the positioning in future story lines, regardless of whether the positioning was intentional, interactive, reflexive, valid, or invalid to begin with. However, even when the same groups of individuals interact at another time they may not be bringing or port the same story line and positioning to the next interaction (Evans, 2000; Wagner & Herbel-Eisenmann, 2009). As Wagner and Herbel-Eisenmann (2009) suggest, story lines can shift and are dynamic.

Gee's (1999) distinction between socially situated identity and core identity is useful in understanding the potential implications of the portability of positioning. Socially situated identities refer to the "multiple identities . . . [taken] on in different practices and contexts" (Gee, 1999, p. 39). Whereas core identities describe "continuous and *relatively* [emphasis added] 'fixed' sense of self [underlying] . . . contextually shifting multiple identities" (Gee, 1999, p. 39). As Wortham (2004) explains, "stable individual identities emerge when various actors draw on multiple resources to establish an emergent, provisionally stable identity" (p. 165). Note my emphasis on the notion of "relatively" fixed aspects of identity. Although some aspects of core identities may prove to be durable and relatively stable over time, the potential for shifting core identities nonetheless does exist.

Possible factors that may contribute to the way in which students are interactively positioned within story lines are expectations about individual students by teachers and other students (Berger, Cohen, & Zelditch, 1972). Cohen (1984, 1994) describes "expectation states theory" as "status characteristics of group members [that] form the basis for expected competence on collective tasks" (p. 171). Status characteristics are described by Cohen in two ways: diffused status characteristics are attributed to race, sex, gender, and so forth, and specific status characteristics includes popularity, attractiveness, ability, and so forth. The degree to which diffused or specific status characteristics are durable and stable varies and is largely context dependent. Holland and Lave (2001) describe the durability and stability of these sorts of identity shifts as a "thickening" whereby an individual becomes recognizable over time by his or her positioning due to either social factors or individual processes.

Berger et al. (1972) speculate that specific status characteristics may be the most likely to determine the basis for expected competencies among group members despite the relevance or validity of the specific status characteristics to the task. As a result, there may be important

identity-, achievement-, and participation-related implications for the positioning of individuals in future story lines.

As Wagner and Herbel-Eisenmann (2009) propose, "people can choose how to act and develop their identities" (p. 3). That is, individuals can choose to engage in reflexive positioning that contests the interactive positioning by others. They assert that individuals cannot "enforce a particular storyline or positioning" (p. 6) and that individuals have the "freedom to conceive alternative practices . . . [and] to establish a particular positioning" (p. 6).

However, Harré and van Lagenhove (1999) argue that the extent to which individuals enact their own agency and contest story lines varies. Status characteristics that have infected story lines and have been ported through history and culture may be so persuasive that individual agency may be overestimated; the reification of persistent positioning across story lines may nevertheless occur (Evans, 2000).

Research by Wortham (2004) that follows the experiences of a ninth-grade student over one school year also shows how "teachers and students draw on institutional resources, habitual classroom roles, the curriculum, and other resources to position students in recognizable ways" (p. 165). In his research, he shows how a good student comes to be positioned as disruptive over the course of a school year. Wortham's research illustrates how positioning can be ported across multiple story lines. Similar results have been reported by Ritchie (2002), who traced the experiences of two girls during collaborative learning in science. Prior experiences in other groups impacted the girls' positioning in future groups.

Numerous theorists and researchers have demonstrated that the opportunities that an individual may actually have and those they may be perceived to have may be quite different based upon countless factors including power differential structures, gender, specific status characteristics, race, culture, and various individual cultural, linguistic, educational, socioeconomic capitals (Bernstein, 1971, 2000; Foucault, 1982; Jilk, 2006; Lerman & Zevenbergen, 2004; Packer & Greco-Brooks, 1999). Power structures and differentials between individuals have an undeniable role in the extent to which interactive and reflexive positioning occurs and is sustained throughout story lines and are perpetuated to future story lines (Davies & Harré, 1990, 1999; Evans, 2000; Gee, 1999; Harré & van Lagenhove, 1999).

METHODS

Participants

Data presented from this qualitative research comes from a yearlong study investigating collaborative learning in an eighth-grade classroom. The middle school was in a large urban setting with students from diverse socioeconomic backgrounds. In this particular class, there were 34 students in total, 19 boys and 15 girls, all of whom were either 13 or 14 years of age who had agreed to participate and who had parental/guardian permission to do so. Only one student was excluded from the research because this student was only partially integrated into the classroom due to severe developmental challenges. The students in the class were of mixed race and ethnicity. The male Caucasian teacher of the classroom had been teaching for more than 11 years.

The results presented here focus on a group of five students—Mitchell, Alice, Ella, Joanne, and Will. All the students were 13 years old at the time of this research. Each of these children had

parents with postsecondary education who were employed in professional fields. Only Mitchell had a stay-at-home parent.

All of the students in the group highlighted in the forthcoming results happen to have the same racial profile (i.e., Caucasian); however, this was not the case uniformly across all the groups analyzed. The students in this group had different ethnicities. Mitchell's and Joanne's families originated from England. Alice's, Will's, and Ella's families originated from central and eastern Europe, and Joanne's from Central America. The first language for each of these students was English. However, Alice, Ella, and Joanne reported that another language was "sometimes" used in the home although they themselves did not use the other language.

The overall achievement results for these students are reported in Table 2. In Ontario, Canada, student achievement in mathematics is represented in terms of levels (Ontario Ministry of Education, 2010; Ontario Ministry of Education and Training/OMET, 2005). Level 2 would be approximately equivalent to a grade average of 65%. Level 3 would be approximately equivalent to a grade average of 75% and is the Ministry of Education's target for minimum levels of achievement for all students. Level 4 would be approximately equivalent to a grade average of 85% or higher.

Data Sources

Data sources included classroom and collaborative learning video data that was transcribed and analyzed qualitatively, sociometric questionnaires completed before each task, participant interviews, and peer focus groups which were also transcribed. There were 38 hours of collaborative learning video data from the entire year. Transcriptions were done by an external transcription agency and then each checked for accuracy by the author by comparing the transcriptions to the actual video data over two or more viewings. In addition, overall achievement results in mathematics according to levels were made available to me by the classroom teacher at the conclusion of the in-class data collection.

Procedures

Collaborative learning was a routine occurrence in the research classroom. The teacher used many pedagogical strategies to prepare his students to work together collaboratively. The classroom teacher worked with the students in a whole group, as well as small-group settings to develop appropriate strategies for working together. The following pedagogical strategies were observed in this classroom: (a) brainstorming around strategies for group work; (b) role-playing of how to work in groups; (c) group member role assignment; (d) small-group reports on working together; and (e) constant discourse about the need to communicate, share ideas, and work collaboratively (D. W. Johnson & Johnson, 1989; S. D. Johnson & Chung, 1999; Kagan, 1994; Slavin, 1995; Vermette, 1998). As the groups worked together, the teacher would rotate through the groups, again reminding students about various aspects of group collaboration that had been discussed in class.

Data presented in this article were drawn from collaborative learning associated with the *open-top box task*. Working in groups of five, students were asked to construct an open-top box out of a sheet of 20 $\times$ 30 cm paper by removing perfect squares from each corner. The object of this mathematical task was to design a box, out of a given sheet of paper, resulting in the largest

volume. To achieve this, students needed to cut perfect squares from the corners of the sheet of paper. The remaining piece of paper became a "net," which was then folded to create a box without a top. Students were asked to determine the dimensions of the box that would hold the largest volume and to conjecture what the dimensions might be of an open-top box that would optimize the volume given a set surface area.

Students had three 70-minute mathematics periods to complete the mathematical task, evaluate their findings, and prepare a "defense" of their findings to be presented during a whole-class discussion which occurred at the conclusion of the task. In addition, each group had to present to the class their appraisal of the productivity of the collaborative learning. During the second half of the final 70-minute period, students presented their findings to the whole class. Students were evaluated both individually, in the form of a short quiz, and as a whole group.

Data Analysis

To recall, the focus at the onset of this research was to examine the positioning of students who appear to be marginalized from the group activities during collaborative learning and to theorize about the different ways in which these students were positioned. Consequently, in my qualitative analysis of the video data, I focused on story lines within the collaborative learning sessions in which students appeared to be disengaged from the actions of the collective group. I identified episodes of video that showed students working independently and not interacting with the group, instances where students were subjected to open animosity from their peers, and instances where students were predominantly off-task.

Sociometric questionnaires were completed by each student prior to each collaborative learning session to identify potential specific status characteristics that may be influencing students' positioning within the group (Berger et al., 1972). The sociometric questionnaire asked students to identify the following within their groups: (a) the leader, (b) the best mathematics student, (c) the weakest mathematics student, (d) the least likely to talk, and (e) the most likely to make good contributions to the group's collaborations. The teacher also completed a sociometric questionnaire prior to each collaborative learning session for each group. The responses from the sociometric questionnaires were not shared between or with students.

As shown shortly, I use responses on the sociometric questionnaire to infer prior positioning that may be infecting the current story line. I state at the outset that the sociometric questionnaires are themselves reflective of positioning in another context, rather than being reliable recollections of positionings in previous classroom settings, and should be analyzed with caution given that (a) perceptions of mathematics weakness and strengths are not approximations of mathematical ability and (b) may be as a result of experiences with each other beyond the classroom setting.

The purpose of the sociometric questionnaire was to enable the students and the teacher to articulate their own preexisting expectations about group members. I examined the responses to the sociometric questionnaires in relation to the video data to look for potential relationships between students identified in particular categories and the way in which some students participated and types of positioning in the story lines. Consistency between categories and observed positioning was seen as evidence of portability of prior positionings.

The analysis did not focus explicitly on asserting which status characteristics (diffused or specific) contributed to the positioning, although any opportunities to interrogate trends during

the data analysis were considered in the broader analysis of the full data set. For example, this analysis did not focus on gender structures within the groups and how gender may have influenced the positioning because this requires additional research and potentially alternative frameworks for further analysis. It should be noted, however, that no overt gender patterns emerged across the data set (cf. Ritchie, 2002).

Finally, during the interviews, I asked all the students to (a) talk about their perceptions of their involvement in the group, (b) identify challenges that they experienced, and (c) comment and reflect on their perspectives about their own as well as their peers' story lines. I asked similar questions during the focus group sessions, at which time participants also had the opportunity to collectively review video data from their collaborative learning sessions.

It is important to note that a researcher's identification of positioning within a story line may not be altogether accurate (Ritchie & Rigano, 2001; Wagner & Herbel-Eisenmann, 2009). Wagner and Herbel-Eisenmann (2009) suggest that although multiple data sources may be suggestive of a particular type of positioning within a story line, researchers are nevertheless still left with limited access to the depths of the dynamic and highly subjective nature of positioning. Consequently, this analysis involved triangulation between the three primary sources: my preliminary analysis of individual story lines identified in the video data, relationships between the story lines that were identified and the sociometric questionnaire responses, and interview/focus group responses. Generally, triangulation is the examination of similar constructs across different but yet corelated data sources (Creswell, 2005). Triangulation potentially minimizes bias by achieving convergence and/or divergence of the interpretation of the results (Creswell, 2005).

In the present research triangulation served two key purposes. First, as Wagner and Herbel-Eisenmann (2009) point out, "different people may see different story lines being enacted in any given situation" (p. 4). Consequently, triangulation potentially minimized, but did not altogether eliminate, researcher-biased interpretations of positioning by including students' voices and perspectives in the interpretive process. Second, triangulation was necessary to examine the extent to which positioning within the story lines was possibly being ported by students to other settings. By exploring own students' perceptions through the student interviews, focus groups, and sociometric questionnaires, I was able to establish some evidence about the extent to which the students were positioning herself or himself as a result of the interactions that were observed.

Triangulation of data sources is seen as a strength of this research design. As other researchers have pointed out, a researcher's identification of positioning, even across similar data sources, may not be altogether accurate (Ritchie & Rigano, 2001; Wagner & Herbel-Eisenmann, 2009). Triangulation allows for examination of a story line through multiple sources, including and very importantly the student's own perspectives. Students have the potential to act as co-constructors of knowledge when their ideas and understandings are included as potential data sources (Sleeter, 2001).

The methodological choice of triangulating different types of data (e.g., sociometric questionnaires, interviews, and observational data) rather than the same types of data (e.g., observational data in a series of collaborative learning sessions) may be viewed as a limitation of this research. To explain, it could be argued that the interactions between an adult interviewer and child participants could introduce an altogether different positioning that may shift the plot of the story line under examination. Such sites of interaction, between adult and child, are recognizably not neutral. Consequently, interviews and focus group sessions were approached with the potential power differential in mind. The potential benefits of providing opportunities for voice and clarification

to the students through the interviews and focus group sessions were deemed to outweigh the limitation. Moreover, the inclusion of multiple sources of data related to a singular story line could be viewed as an important methodological extension to future research related to positioning that has in the past predominately focused on similar sources of data to examine continuation of story lines and portability. Finally, as the results show, the interview and the focus group data provide solid grounds for the conclusions derived from the observational data.

The qualitative findings that follow are reported as a continuous story line. In actuality, data stemmed from two different videos, captured over three problem-solving days, which totaled approximately 120 min of actual collaborative learning and video. The story line was representative of the consistent patterns that emerged across the entire data set.

RESULTS

Some students observed to be only marginally participating during collaborative learning experienced no resistance by their peers about the nature of their participation or lack thereof. Their own reflexive positioning was aligned with the interactive positioning of them by their peers. These students did either menial tasks (mathematics or otherwise) or nothing related to the collective goal of the group, without challenge or resistance by the other students.

Other students were predominately and overtly marginalized throughout the collaborative learning. That is, they were not permitted to engage meaningfully in collaborative learning despite their interest and efforts in doing so. These students' own reflexive positioning was misaligned with the interactive positioning of them by their peers. Although some students, like Mitchell, whose experiences I outline shortly, did attempt to show resistance to the interactive positioning, no level of successful resistance was found in the entire data set by any student.

Mitchell's Group

From the video data it was clear that Ella emerged as a leader and a power figure in Mitchell's group from the beginning. Her role was consistent with what was expected by the other students as indicated on the sociometric questionnaires (see Table 1). Ella could be viewed as the primary initiator of the interactive positioning within the group.

At the onset of the task, Ella immediately assigned various dimensions to the two other females, Joanne and Alice, within the group regarding the constructions they should undertake as part of their investigation. These two other group members' own reflexive positioning was aligned with Ella's interactive positioning.

Will, the other male in the group, took up the task of cutting tape and paper for the others in the group, which he did for the duration of the collaborative learning without any suggestion from any of the other group members that he should be participating in other ways (i.e., with a construction of a box, or engaging in calculations to support another's construction). He performed the cutting job for the full three 70-min videos, although on some occasions he was also engaged independently in other off-task behavior. His participation in the story line was not challenged by the other members in his group. He did not offer any observable resistance to the task he had undertaken, which was peripheral to the assigned mathematical task.

TABLE 1
Sociometric Responses From Mitchell's Group

Name	*Who Will Be the Leader in Your Group?*	*Who Is the Best Mathematics Student in Your Group?*	*Who Is the Weakest Mathematics Student in Your Group?*	*Who Will Talk the Least in Your Group?*	*Who Do You Think Will Have Good Contributions to Your Discussions*
Teacher	Ella	Ella	Joanne	Mitchell	Ella
Alice	Ella	Ella	Mitchell	Mitchell	All
Ella	Alice	Self	Mitchell/Joanne	Mitchell	Alice/Joanne
Joanne	Ella	Ella	Mitchell/Self	Mitchell	Ella
Mitchell	Ella	Ella	Self	Joanne	Ella/Alice/Will
Will	Ella	Ella	Mitchell	Mitchell	All

TABLE 2
Overall Level of Mathematical Achievement

Student	*Overall Level of Achievement in Mathematics*
Alice	4–
Ella	4+
Joanne	2
Mitchell	4–
Will	3

Mitchell's experiences were in contrast to those of Will. Video data showed that Mitchell tried to resist his interactive positioning within this story line without success. Mitchell was identified as the low achiever in his group and by himself (but not by the teacher) in the sociometric questionnaire (see Table 1), despite the fact that he consistently performed in the 90th percentile of his class in overall mathematics achievement (achieving over Level 4, or 80%, across all strands in mathematics; see Table 2). Even though he identified himself in this way in the sociometric questionnaire, his resistance to his interactive positioning suggested that his reflexive positioning was different to some unknown extent.

Students were asked in the first part of the mathematical task to make an open-top box by removing perfect squares from each corner of a sheet of paper with the dimensions of 20×30 cm. Thus, in the case of the sheet of 20×30 cm paper, the optimal shape of the box having the largest volume is rectangular shape of, approximately, $22 \times 12 \times 4$ cm, which has maximum volume equal to 1056 cm^3. Given the constraints of the mathematical task, the optimum construction would not have been a cube because too much paper is removed from the corners to be able to construct a cube.

From the onset, Mitchell tried to create a cube-shaped box, first trying to do so with a single paper and then ultimately using several sheets of paper for his construction. Mitchell was not following the parameters of the task, which asked groups to construct an open-top box with the largest possible volume by removing perfect squares from each corner. He appeared

to be focusing on the optimization aspect of the mathematical task but neglected within the task guidelines the restriction to one piece of paper and only removing perfect squares from the corners. Mitchell's construction was an open-top box with dimensions $16 \times 16 \times 16$ cm. Mitchell's cube resulted in a volume larger (4096 cm^3) than the volume possible given the constraints of the task as assigned (1056 cm^3).

Mitchell's ongoing construction of a cube structure using several pieces of papers was met with resistance from Alice, who first observed he was constructing a model different than the models the three female students in the group were making, which were consistent with the guidelines of the task. In this short exchange, Mitchell also showed resistance by outwardly rejecting Alice's directive:

Alice: Mitchell, do a different one!
Mitchell: No!
Alice: Use both ideas, okay?
Mitchell: It doesn't look interesting.

Alice suggested that he could continue constructing his cube but he should also construct a second shape that resembled those being constructed by the female students in the group and that adhered to the guidelines of the task as outlined.

The motivation for Alice suggesting that he should build one of each was not clear during the video. During her interview she explained that she saw that he was not cutting the "right" kind of squares from the paper and his shape was not "rectangular." At no point during the peer collaborations does Mitchell explain to the others why he is constructing cubes. Despite Alice's suggestion to construct two structures, Mitchell does not.

Mitchell's contributions and his efforts to adopt a different story line and thus changing his positioning were met with resistance from his peers. Alice's comment suggests that Mitchell's cube was not seen as contributing to any part of the assigned mathematical task—even the second part that asked the students to conjecture about optimal dimensions—albeit restricted to the dimensions of the paper. Most important, there was no dialogue related to the mathematical structures to explore why Mitchell was opting to not follow the open-top box task guidelines or why he was aiming to construct a cube instead.

To some extent, it is understandable that Mitchell's activities were seen as counterproductive to getting the task done, as can be seen in this next exchange:

Alice: Mitchell is still doing it.
Ella: Mitchell's not doing anything!
Mitchell: I am doing something!
Alice: You keep telling yourself that, Mitchell.

In spite of the negative talk about Mitchell's construction, on three occasions his peers made the observation that there might have been some potential in Mitchell's cube, but this potential was not explicitly related to optimization.

The first observation was made by Ella, who noticed that Mitchell's idea may have potential. She had this exchange with Joanne and Alice:

Ella: I think the higher the sides, the more volume, like what Mitchell is doing.
Joanne: That thing there? It might be really wide and . . .
Alice: Like you never really know, it might be wide. Are there more pieces of paper?
Ella: You can predict a better one . . .

The discussions occurred apart from Mitchell as though he was not present and while he continued to work. From the discussion between the girls, there was some sense that Mitchell's ideas might be meaningful, but his ideas were not related directly back to the optimization component of the task or the restrictions of the task that should have prevented him from creating the structure he was creating. The girls did notice the use of more than one paper. Regardless of the girls' observations regarding the potential of Mitchell's cube, the general sense among them was that Mitchell was not actively supporting the completion of the task, which was in fact the case. Alice asked to this effect, "Mitchell, are you actually going to do something?"

Two thirds of the way through the problem-solving session, the following exchange occurred, now including Mitchell:

Joanne: Mitchell's looks like it would have big volume.
Alice: But Mitchell's looks weird!
Mitchell: No, it's going to be a cube.
Will: How come you think everything he does is weird? [He says this to Alice]
Alice: I know. Look at the way he's doing it, look! And everything he does do is weird.
Mitchell: Yea, that's what you think.
Alice: No, it's true, Mitchell!
Mitchell: No, it's not! No, it's not [With less emphasis].
Alice: That's different. Yah!

Alice then outright asked Mitchell to stop his work:

Alice: Mitchell, you can stop making these little, whatever . . .

To which Mitchell responded:

Mitchell: I guess you guys are dumb.

The negative talk about his mathematical thinking resulted in Mitchell stopping his construction and calculations, at which time he joined Will in the cutting of tape pieces used by the others for constructing their boxes. Will had already been doing this menial task throughout the entire time this group had worked together, with no viewed repercussions from his peers about the nature of his participation. Will had the benefit of having aligned his own positioning of himself with that of his peers. His peers were not concerned that he was not constructing an open-top box.

As the problem-solving session moved toward completion, and students were required to summarize their findings on chart paper, Mitchell asked the group:

Mitchell: Are you guys including me? [With respect to his cube]
Ella: No.
Mitchell: Well mine . . . [Voice trails off]
Ella: And the last one was Joanne's . . . [Continuing to write the findings, ignoring Mitchell's objections]

At the conclusion of the session, Mitchell's cube was not used in the overall results of the group. Indeed, it did not follow the task guidelines. However, the group could have used the cube structure Mitchell had created to perhaps extend and generalize their findings to show that, given the restrictions, only a certain optimization was possible (see start of this section) but if those limitations were not in place (i.e., perfect squares from the corners, paper dimension, single paper), other dimensions and other relations between dimensions (i.e., volume and surface area) could have yielded alternative and perhaps noteworthy results.

As shown in the next exchange, Mitchell's cube was used to collect the group's paper clippings, and other garbage:

Joanne: Okay, I'm going to use Mitchell's box . . . [To gather the group's garbage]
Alice: That's mean!
Joanne: Mitchell, will you throw your box in the garbage?

His positioning by his peers is overt and the power differential is clear as he seen to exclaim:

Mitchell: HEY! [In a frustrated or angry tone]

Mitchell's work was not presented as part of the group's presentation to the rest of the class, which suggests that his ideas were not seen as related or relevant to the overall assigned task. Three models, one from each of the girls, were presented. There was no model to present from Will, given that he did not construct a model at any time during the task. Because the mathematical task did not require a model from each student, the teacher was not aware of the structure Mitchell created and thus did not comment on the relevance of the structure.

At the conclusion of the collaborative learning, Mitchell's cube was used as the group's garbage container, which he was then asked to dispose of himself. He did not resist further and disposed of the cube along with the rest of the group's garbage.

During the focus group session, I asked the members of the group about the cube Mitchell was creating and the relationship of the cube to the optimization aspect of the mathematical task only. I indicated that it appeared to me that the structure Mitchell was creating did indeed have the highest volume compared to the three presented to the class and perhaps it could have been a contribution to the overall solution to the mathematical task.

I asked why Mitchell's ideas were not explored or acknowledged. Alice said, "He wasn't doing what we were doing." His participation was characterized in terms of their work and not necessarily in relation to potential extensions to the mathematical task. For the purpose of further interrogating whether the girls' resistance was related to the mathematics or to Mitchell specifically, I again stated that the structure he created had the largest volume and that it appeared that on several occasions, the girls had also noticed the potential of Mitchell's cube. There was

no mention of the use of several pieces of paper. There was no response at this point from the group. Only Mitchell, who said, "It was just a cube. That was one of the ones I was working on but everyone thought it was weird." Mitchell minimized his own thinking.

The resistance to Mitchell's cube did not appear to have a mathematical basis, especially given that his cube was potentially related to the aspects of the mathematical task that asked students to hypothesize about optimization. Rather, the resistance exhibited by the other group members seemed to stem from a social location. A mathematical justification was not given as to why Mitchell's contributions were not valued, nor was justification related back to the requirements of the mathematical task. This is not to say that mathematical and task-based justifications did not exist, but rather there was no evidence to suggest that this was the case.

I also asked about Will's contribution to the collaborative learning and noted that he did not create structure. Ella responded that Will was "helping" the entire group by preparing the materials for their constructions. In contrast, Ella persisted in her belief that Mitchell was unhelpful to the group: "Well, it wasn't one of the shapes we had agreed upon so he wasn't helping."

During Mitchell's interview, I again asked about his mathematical thinking about his cube to which Mitchell responded, "Others in the group didn't care." He reiterated, "It was just a cube." As though the cube, and consequently his thinking, were irrelevant. He made this defeatist comment even after I placed value on his mathematical thinking within the interview and within his focus group.

Mitchell indicated during his interview that he thought he was a much better mathematics student when he was working on his own. He doubted his thinking when he worked in groups. Despite having good grades in mathematics (see Table 2) he described himself as "not very good at it." He also said that it was one of the subjects he enjoyed the least. I pointed out to him that his grades suggested that he was good at mathematics. He shrugged at my suggestion and did not say anything more on this point. It would appear that his perception of himself was being infected to some extent by his experiences. His reflexive positioning may have had something to do with his identification in the sociometric questionnaires as the lowest achiever. The extent to which this was the case was not clear, however.

At the conclusion of his interview he did comment that the cube he was creating "seemed to be an ideal shape." I pointed out to him that he was using several pieces of paper and he was not following the guidelines of the task. I wondered with him whether it contributed to his experience within the group. His response was that the others appeared to have the task as assigned taken care of and he would explore something about the volume optimization aspect, which he noted was more interesting to him.

During her interview, Ella said this about Mitchell:

> He's just there. They're [low achievers] not lazy, but they're kind of. I don't know how to explain it but they're just kind of there, like they don't say anything or do much either, so I guess they're kind of lazy but that's kind of a bad word to describe it.

Ella is saying here that the "low achievers" are present but not necessarily attending to the collective goals of the group. Joanne described the low achiever in the group, or Mitchell, as the student who is the "weakest link" and "doing nothing most of the time." This is ironic because she herself was the lowest achieving according to the overall achievement results (see Table 2) and given that although he was not attending fully to the task as assigned, Mitchell was engaged in creating a structure and determining volume and surface area of his structure. He was not seen

off task until almost the end of the collaborative learning, which was likely in response to his interactive positioning within the story line.

DISCUSSION

The triangulation of the data suggests that Mitchell, and at least one student in every collaborative learning session observed throughout the year, was subjected to what I refer to as a *productive silencing*. The productive silencing occurred as a result of a misalignment between interactive and reflexive positioning.

To begin, "productive" as I use it is defined as having generative power, the ability to cause or bring about some circumstance, condition, the ability to carry on some condition, and so forth. The word *productive*, simply defined, means "to continue to produce" and can have either positive or negative implications or outcomes. Productive as potentially dystopic is consistent with the way in which many theorists have used derivatives of the word to describe the (re/co)production of social powers, structures, capitals, and so forth (Bernstein, 1971, 1972, 1990, 2000; Bourdieu, 1991; Fairclough, 1995; Foucault, 1977, 1982; Giroux, 1993).

During collaborative learning, productive silencing can be characterized as interactive positioning that is contested in some way by an individual. Students subjected to productive silencing may be motivated to participate and to learn contrary to what might be assumed by others (Gutiérrez, Bay-Williams, & Kanold, 2008). The silencing is productive in potentially multiple ways: (a) an ongoing barrier is maintained that limits or prohibits access to knowledge construction through collaborative learning and processes, (b) the positioning may be ported to other story lines, and (c) the positioning may result in the development of a core or "thickening" of identity to use Holland and Lave's (2001) term.

Mitchell's contributions and thinking appeared to be dismissed based upon his interactive positioning within his group, rather than the merit of his mathematical thinking, his contestation of his positioning, and his actual ability. Mitchell showed attempts at resistance with extremely limited success by continuing his work, despite the negative discourse from the other group members about his mathematical thinking. His actions in the videos suggested a misalignment between his own reflexive positioning and the interactive positioning he experienced. Mitchell tried to show some resistance to his interactive positioning and thus a degree of agency that is proposed to be possible in the positioning self (Herbel-Eisenmann & Wagner, 2007); however, he was unable to fully enact his agency, which is not altogether surprising. As Harré and van Lagenhove (1999) pointed out, some students depending on the social context are either unwilling or unable to do so.

There were occasions when Mitchell's peers noticed the potential of his cube. However, given that the cube was coming from Mitchell, and given that it was outside of the task parameters, his ideas were ultimately discounted or, literally and sadly, actually trashed. The group members also sent a clear message to Mitchell about his positioning by trashing his contribution. Ultimately, and despite his resistance, he is unable to change his positioning.

Mitchell internalized the group's positioning of him and ultimately was dismissive about his insight with respect to the cube he was constructing during his interview and during the focus group session. Mitchell, like other students who have been shown to be marginalized during learning, had erected a wall between his mathematical thinking and the task because of his positioning (Sfard & Kieran, 2001).

Despite the observed resistance during the collaborative learning task, his reflexive positioning appeared to have a degree of fluidity that is proposed to be possible within positioning theory (Davies & Harré, 1990, 1999; Harré & van Lagenhove, 1999). Mitchell had reflexively positioning himself as the low achiever on the sociometric questionnaires, but this was not reified in the achievement data. His initial positioning of himself as the low achiever (see Table 1) demonstrates well the potential portability of positioning from one story line to another. His reflexive positioning in the sociometric questionnaire and during his interview, despite his academic achievement, also shows the way in which core identities or the thickening of identity develop from persistent socially situated identities which may or may not have any basis or merit (Gee, 1999; Holland & Lave, 2001).

Mitchell was, in actual fact, one of the most able mathematics students in the class, yet he was positioned differently by his group and even by himself in the sociometric questionnaires. As Lerman and Zevenbergen (2004) suggest, the limited participation of some students in the group process regulates their ability to view themselves as able learners of mathematics.

Low achievers, perceived or actual, were observed across the data set as having both misaligned and aligned interactive and reflexive positioning during collaborative learning. Some low achievers participated at the periphery of the collaborative learning without resistance. For example, during a different problem-solving session, another identified low achiever in the sociometric questionnaires was unchallenged in their participation because the group implicitly understood the limitations of the student, who was identified in the class as significantly academically delayed (Kotsopoulos, 2008).

Consequently, achievement (perceived or actual) does not appear to be predictive of potential alignment of interactive and reflexive positioning. It is beyond the scope of this data set to determine why or what factors or status characteristics actually contributed to misalignment. This remains an important line of future research.

It is also important to note that low achievers were consistently characterized by their peers in the interview data as "lazy," "not doing anything to help," "doing nothing to help themselves [*sic*] learn," and so forth. These perceptions were not supported by the video data. In each of the videos students identified as low achievers continuously tried to work on tasks, some worked in isolated silence.

As Guitiérrez et al. (2008) point out, it is critically important that students subject to inequitable learning opportunities should not be viewed as complicit, lacking motivation, or mathematical unable—rather, that there are clear deficiencies in the opportunities the student has to learn within a particular learning environment. Viewing the student as complicit lays blame on the student and further perpetuates inequities in learning. Some students, like Mitchell, tried to contest their positioning; however, the social structures within the group prevented meaningful participation. These students were silenced.

Unlike Mitchell, who was repeatedly challenged by his peers, Will was not challenged about his role. He cut tape and paper during the entire task. Will was subject to some form of privileging. There was no resistance on behalf of the members of his group with respect to his minimal contributions, and he did not resist his positioning. His own positioning was aligned with his positioning by his peers.

Will's learning does not appear compromised (see Table 2). He was able to achieve at the acceptable Level 3 for mathematics—although one might assert that increased achievement is possible. I surmise that he may have specific status characteristics that allow him to

be privileged in this way during collaborative learning. The exact status characteristics are unknown.

It is not clear to what extent the sociometric questionnaires contributed to the socially situated identities and particular story lines from the onset. This may have been the case. Perhaps having the students complete the sociometric questionnaire at the end of the collaborative learning sessions as well as the beginning, or only at the end, may have yielded some alterative insights. In other work, Cohen (1994) makes use of sociometric questionnaires to show students how some students have strengths in some areas over others. In short, she uses sociometric questionnaires to build positive story lines. More research is also needed to understand the implications of the sociometric questionnaires and positioning. Achievement for students who experience privileging, despite their participation, may also be undermined—albeit differently than those subject to productive silencing.

In the present research, students constructed socially situated identities for one another based upon prior existing constructs of each other, possibly determined by factors such as academic achievement, social status, gender, and so on (Cohen, 1994; Lerman & Zevenbergen, 2004; Pijls et al., 2007). These socially situated identities, as was the case with Mitchell, were not necessarily based on any valid factors. The socially situated identities determined the students' positioning within the collaborative learning and thus the level of participation the student was able to achieve.

CONCLUSIONS

Students who appeared marginalized from the collaborative learning, and appear to have aligned interactive and reflexive positioning, participated at the periphery of the group with limited responsibilities to the group and despite the wider needs of the group. The student's lack of meaningful participation was not challenged by members of the group, or was overtly or covertly excused. Likewise, these students did not challenge their positioning within the groups. Therefore, there is no form of resistance on behalf of the student or by the other members of the group with respect to the student's participation or positioning. Students who had misaligned interactive and reflexive positioning had significantly differing experiences during collaborative learning.

It is important to emphasize that the pedagogical practices (e.g., class preparation, selection of the task, assessment, etc.) of the classroom teacher in this research, throughout my time in the classroom, were closely aligned to those suggested for successful collaborative learning in the literature (Barnes & Todd, 1978; Cohen, 1984, 1994; Gillies & Ashman, 2003; D. W. Johnson & Johnson, 1994; Peterson et al., 1984; Slavin, 1995; Vermette, 1998).

Nevertheless, collaborative learning was successful for some students and unsuccessful for others thus creating inequitable learning opportunities. Although appropriate scripting and structuring of collaborative learning is important, it is in and of itself insufficient. The story lines described in this research and the differential implications of (mis)alignment of interactive and reflexive positioning were seen to be representative of the evidence from the full data set.

Like Pijls et al. (2007), my assumption beginning this research was that collaborative learning would be beneficial for students. Teachers should be aware of the ways in which any pedagogical practices, such as collaborative learning, may function as a Petri dish for cultures of inequitable

practices for some students. At the forefront of all pedagogical choices made by teachers should be explicit consideration of who is privileged and who is silenced and marginalized by such choices.

Failed collaborative learning may have exacting results on the ways in which students come to see themselves (or not) as being able to participate in a mathematics (Berger et al., 1972; Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991). The nature of collaborative learning often remains beyond the sight lines of teachers, and so makes it possible for certain positioning to go undetected, in a regular classroom setting (Kotsopoulos, 2008).

Flawed pedagogy is often identified as the ultimate culprit for failed collaborative learning (Cohen, 1994; D. W. Johnson & Johnson, 1989, 1994). Social contexts and status characteristics may more appropriately be the largest challenge (Cohen, 1994). A key suggestion for educators is to keep in mind that for some students, like Mitchell, working collaboratively may not be in their best interest.

Participation in collaborative learning may create roadblocks for some students in their mathematical learning (Dekker et al., 2006; Sfard & Kieran, 2001; Sinclair, 2005), or in the way in which they come to see themselves as a mathematics learners or mathematically able (Gutiérrez et al., 2008). Although socially situated identities may be transformed through experience and thus are not inherently fixed (Gee, 1999; Packer & Greco-Brooks, 1999) and may not be reality based (e.g., a student may perceive himself or herself as not able to engage in mathematics when this may not be the case; Boaler, 1998), the potential risk of creating core identities that reflect mathematical disabledness remains a potential risk, particularly for students subjected to productive silencing.

Students should perhaps be permitted to choose whether to work collaboratively or independently—and choice may be dependent on the local social context. Teachers should examine carefully the reasons why a student might consistently choose to work in either setting. Teachers should also be aware of inconsistencies in mathematical ability emerging from collaborative learning versus other learning settings. Inconsistencies may suggest something about the learning setting rather the mathematical abilities of the student (Dekker et al., 2006; Sfard & Kieran, 2001; Sinclair, 2005)

As Gee (1999) says, interactions have the potential of infecting future interactions. For some those students who are privileged, like Will, implications may not be so tragic. For those students subject to productive silencing, like Mitchell, perceptions of mathematical disabledness are problematic and concerning.

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