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Engagement in Secondary Mathematics Group Work: A Student Perspective

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ABSTRACT

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In the realm of academic engagement research, students are valuable sources of information to learn how and why students often engage unproductively in mathematics group work. However, although secondary mathematics students are often expected to engage in meaningful mathematical discourse in a small group setting, little research has been conducted to better understand student engagement in this setting from the perspective of the students themselves. This thesis attempts to understand how one junior high student described his own engagement in mathematics small group work as well as what factors influenced this engagement. By conducting several cycles of observations and interviews followed by qualitative analysis, we learned how this student engaged in a variety of ways in group work; on different occasions (and sometimes within the same class period), he talked with his peers about mathematics, remained silent, played on his phone, connected with peers across the room, and pursued off-topic conversation with his group mates. We also discovered that the student participant as well as his peers often ceased to engage productively when they encountered mathematics that they deemed too difficult. Several other factors impacted his engagement in complex ways, including his familiarity with group mates, fear of being singled out, and access to adequate help from a teacher. These results may inform researchers of new data collection and analysis methods to gain insights into student engagement and teachers of ways in which they may adapt instruction to better encourage students to engage productively.

Keywords: student engagement, productive engagement, small group work, secondary mathematics, student motivation, mathematics instruction, mathematics education

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CHAPTER ONE: INTRODUCTION

Current mathematics education research advocates for teachers to facilitate student discussion and mathematical discourse in task- and participation-based instruction (National Council of Teachers of Mathematics, 2000; Brahier et al., 2014). This is often implemented through collaborative learning in group or pair work (Brahier et al., 2014; Johnson & Johnson, 2008; Noddings, 1989; Sofroniou & Poutos, 2016). Productive group work can greatly benefit students by giving them opportunities to reason aloud about their own work, hear explanations of challenging concepts from peers (sometimes in simpler terms than the teacher might use), encounter new solution strategies or ideas as they talk or listen to peers, strengthen connections with friends, complete work efficiently, develop productive dispositions toward mathematics (Jansen, 2012), and achieve higher-quality learning (Noddings, 1989). It can also contribute to "cognitive development, social/democratic development, and moral development" (Dewey, 1916, as cited in Noddings, 1989, p. 608). Moliner and Alegre (2020) claim that students who work together during class improve their mathematics self-perceptions, perhaps by viewing themselves as more capable and valuable in mathematics. As students work in pairs to discuss their mathematics work, each may have the opportunity to both teach and learn; in this setting, both the tutee and the tutor often increase their own understanding of the material taught (Slavin, 1984). Students who work in a collaborative environment in mathematics classrooms may also improve achievement scores and increase social skills and motivation to learn (Moliner & Alegre, 2020; Mulryan, 1995; Nawaz & Rehman, 2017; Slavin, 1984). Implementing group work in mathematics classes can also lead to "friendships between minority students" (Mulryan, 1992, p. 261) and wider "acceptance of mainstreamed children" (Whicker et al., 1997, p. 43).

Clearly, there are many possible advantages to incorporating small group work in the mathematics classroom.

However, not everyone engages in mathematics group work as intended—that is, productively (Good et al., 1989-1990; Mulryan, 1992, 1995; Whicker et al., 1997). Subpar engagement in group work in a classroom where group work is the norm can be harmful for students. This occurrence denies students more than just further social interaction with peers; as Mulryan (1992) stated, "[i]n the cooperative small-group setting, students who fail to interact with their peers are unlikely to benefit from the learning opportunities provided" (p. 261-2). In a mathematics classroom, this could mean students who do not adequately interact with their peers to discuss mathematical content may not gain access to the debunking of misconceptions, answers to common questions, and multiple solution methods shared by group members.

Many studies on engagement have attempted to determine reasons for students' lack of engagement by using quantitative methods. Interviewing large numbers of students to come to understand their perspective can be time-intensive, so engagement studies have focused on what researchers identify as 'predictive' or correlated factors for engagement—factors tied to race, ethnicity, or cultural norms (e.g., Liu & Littlewood, 1997; Okagaki, 2001), gender (e.g., Lietaert et al., 2015), teacher moves (e.g., Gillies & Khan, 2008; Kelly, 2007; Skilling, 2014; Webb et al., 2006), or family situation (e.g., Connell et al., 1994). In implementing quantitative methods, the aforementioned studies ignore the individual voice of the student in favor of surveys or limited observation. We have research regarding researcher-identified factors influencing student engagement, but we have very little student input. Student voice is vital to understanding what influences students to avoid engaging fully in small groups in mathematics classrooms.

Understanding student perspectives on engagement—especially regarding their self-identified reasons for not engaging in mathematics in the ways teachers hope they will—can be valuable to teachers. One study on student motivation in sixth-grade mathematics classrooms found that teachers who had a good understanding of individual student motivations for engagement also had higher overall student motivation in their classrooms (Middleton, 1995). As teachers gain a better understanding of the factors influencing individual student engagement, they will also be better equipped to provide relevant and engaging instruction for their students. Researchers can help teachers by providing them with insights into how students who are demonstrating unproductive engagement levels think about engagement. We need these student-provided descriptions to help us as researchers and educators not only *know* what factors influence student decisions to engage in small groups within mathematics classrooms, but also begin to *understand* their experiences.

Martin (2006) and other proponents of Critical Race Theory (CRT) emphasize the need for listening to the voices (or counterstories) of individuals in marginalized groups, particularly people of color (Dixson & Rousseau, 2005; Esmonde et al., 2009; Martin, 2009; Miller et al., 2020). This theory, applied in an educational setting by Ladson-Billings and Tate (2016), has since inspired other branches to examine individuals and groups based on characteristics other than race. The use of counterstories serves to provide greater breadth to the experiences of many by bringing to light those stories that are missing from the existing narrative, the researchers' narrative. This focus on counterstories could be applied to students who do not engage in mathematics group work in expected ways; most research in this field has neglected to examine the perspectives of these students by seeking their input in their own voice. Not only can students benefit from sharing their experiences and being heard, but "teaching can be improved by

understanding how students think about their experiences in school" (Jansen, 2012, p. 40). Mathematics students who do not fit the mold by engaging in the classroom in the ways we expect them to have not been given the opportunity to share their perspectives with researchers. If we expect to improve our teaching practice to reach these students, we must involve them more in developing our understanding of the factors motivating their actions as students in mathematics classrooms. In order to make sense of the student experience, we must direct our questions to the students themselves. We must spend more time with individual students, conducting more than one interview over time to capture a more complete account.

Some researchers have explored student voice by implementing student interviews. For example, a study by Esmonde et al. (2009) examined aspects of student identity such as race, sex, sexual orientation, and socioeconomic status and the way these identities influence student involvement in group work by conducting a case study involving student interviews. This effort allowed them to develop a better understanding of these students' perceptions of group work and what factors characterize 'good' group work. Beyond this and only a handful of other studies (e.g., Jansen, 2012; Skilling et al., 2021), researchers have not taken the time to explore individual students' thinking regarding group work. Researchers have yet to solicit students' perceptions of their own engagement in peer work or self-identified reasoning for their behavior over longer periods of time in ways that highlight the students' own voices.

To better serve all secondary mathematics students and make mathematics group work as effective as it can be, we need to first understand why some students choose not to engage in group work as fully as their peers. To understand their experiences, we cannot simply rely on survey or observational data alone; we must ask students and allow them to explain the factors influencing their engagement in their own words.

CHAPTER TWO: BACKGROUND

Theoretical Framework

Past research on student engagement in secondary schools has centered around an observer approach: the researcher observes students in a class, determines how engaged the students are, then draws conclusions based on correlated data such as high school dropout rates, family life, race, and ethnicity (e.g., Archambault, et al., 2009; Uekawa et al., 2007). While it is not my intention to correlate student engagement data with these factors, we still must find ways to measure how engaged students are in their schoolwork before we come to any conclusions about how this engagement affects them and others. To this end, I detail my framework for identifying students who tend to engage in unproductive behaviors during group work (e.g., staying quiet during group work, talking about non-mathematical topics with peers, doodling instead of working on their assigned work, etc.). Some of these students may be labeled as *less engaged* or *disengaged* by educators and researchers alike. In this study, this definition and framework for engagement served to give a clear picture of how to identify a student who often engaged unproductively in math group work. However, as our study centers around allowing students to describe their engagement on their own terms, the framework ceased to be useful following the selection of our participant; thus, it is not mentioned in the results section.

One way researchers have characterized engagement is as the "intensity of productive involvement in an activity" (Ben-Eliyahu et al., 2018, p. 3). This engagement includes aspects of involvement, focus, participation, and persistence on a given task (Ben-Eliyahu et al., 2018). These aspects can be categorized under three main dimensions of engagement identified in psychology research, which are *behavioral*, *cognitive*, and *affective*, following the aspects of human development (Archambault, Janosz, Fallu, & Pagani, 2009). Involvement and

participation may fall under behavioral engagement, while focus and persistence may more closely align with cognitive engagement. Affective engagement is more difficult to define; however, descriptions for each of these three constructs are given below.

Behavioral engagement in academics describes the actions a student exhibits at school, or a student's observable participation (Fredricks et al., 2004; Furlong et al., 2003; Jimerson et al., 2003). High behavioral engagement implies an acceptable interaction with peers and content, called *prosocial conduct*, such as involvement in classroom procedures and school activities (Archambault et al., 2009; Furlong et al., 2003). The behavioral facet of engagement is often measured based on frequency of participation in classroom procedures or discussions with peers, completion of homework, and, occasionally, overall course grades and scores on tests (Archambault et al., 2009; Fredricks et al., 2004; Jimerson et al., 2003).

In a secondary mathematics classroom, we might see evidence of behavioral engagement in a variety of actions students take. For example, a student may take out a textbook or notebook and flip to the right page at the beginning of class, begin working on a warm-up problem set on the board, talk with peers about mathematics during pair or group work, turn in completed homework when due, or complete every problem on a test.

The second dimension included in this framework is *cognitive engagement*, or the thoughtful involvement in meaningful academic work in order to master difficult concepts related to the coursework (Fredricks et al., 2004). Investment in the tasks at hand, willingness to persevere, and the implementation of self-regulation techniques (e.g., setting goals, memorization) are also commonly included as aspects of cognitive engagement (Appleton et al., 2008; Fredricks et al., 2004; Furlong et al., 2003).

Cognitive engagement in the context of school mathematics comprises the level of focus a student displays in exerting effort to complete and understand a task and its possible solutions. A student may show cognitive engagement by asking questions—and follow-up questions—to their peers and the teacher, demonstrating their sincere desire to comprehend the concepts on a deeper level. They might show an intense focus on the task at hand through facial expression, demonstrate their desire to master the content by expressing their learning goals, or take time to try a problem again after they attempt a solution strategy that does not pan out.

In the context of schooling, *affective* or *emotional engagement* encompasses student feelings, or *affect* (i.e., interest, enthusiasm, anxiety) toward relationships with teachers, peers, school, and academic work (Skilling et al., 2021). Affective engagement is also often associated with a sense of belonging (Archambault et al., 2009; Furlong et al., 2003; Kong et al., 2003), though some argue that a sense of belonging should not be considered in affect, as belongingness also carries with it cultural, familial, and educational contexts which are separate from inner student emotions (Burrows, 2010). For the purpose of this study, we will consider sense of belonging as interrelated with student affect. Affective engagement may also encompass motivation to work on completing tasks (Calder, 2013).

Math students might demonstrate aspects of affective engagement in their body language or facial expressions during certain activities, such as teacher explanations or group work. For example, if a student slouches in their seat and attempts to remain as invisible as possible, this might indicate their discomfort or a sense of unwelcomeness at that time. In another situation, if a student is eager to converse uninhibitedly with peers about the task at hand, we might be more likely to believe they feel a high degree of both social comfort with those peers and interest in the task.

Together, behavioral, cognitive, and affective engagement describe the manner in which researchers have viewed the different ways students participate in a classroom setting. These three facets of engagement overlap in practice. Thus, many will label observed student conduct as falling into two or more categories at a time if needed (e.g., working on a task in class with perceived focus might be cognitive-behavioral engagement).

I utilized this three-faceted construct for engagement to identify students who did not take part in group work in the ways mathematics educators might anticipate. By looking for aspects of behavioral as well as cognitive and affective engagement, I hoped to be better-equipped to select a student who evidenced unproductive levels of engagement. However, I did not use this framework to continue my study of student engagement past the selection stage. As I will argue in my literature review, there is a need to understand engagement from the perspective of the student, which could be hindered by continuing to classify actions and reasoning into the three categories listed above.

Given that we need to understand engagement from a student perspective, it is important that the student we talk to understands what we mean by engagement. The literature is inconsistent in how it defines both engagement and participation; in some studies, they are indistinguishable. In others, they are distinct, with participation representing more of a quantitative idea of interaction with peers. As explained above, we see engagement as encapsulating both outward behaviors as well as inner cognitive and affective dimensions. While these two terms (participation and engagement) are different from each other, they are more interchangeable in vernacular. Of the two, participation is a more accessible word to junior high students than engagement. For this reason, I used the word participation in my interviews to flesh out how the student interacted with their peers. However, follow-up questions in the interviews

delved into what the participant was thinking and feeling during class in relation to his classroom behaviors. Thus, we have chosen to use the term engagement over participation throughout the results section.

Literature Review

Much of secondary mathematics education research on student engagement involves the use of instruments to measure engagement levels of students, followed by quantitative analyses to determine the reasons or correlated factors driving high or low student engagement (e.g., Peterson & Fennema, 1985; Uekawa et al., 2007; Martin et al., 2012; Sofroniou & Poutos, 2016). Some studies have concluded that sex and gender influence how students interact or do not interact with the content and their peers in classroom settings (e.g., Peterson & Fennema, 1985; Hyde et al., 1990). Other research indicates that race and ethnicity or other factors outside student control have a great impact on student engagement (Uekawa et al., 2007; Martin et al., 2012). While we gain useful insight from these studies of student engagement, all of the conclusions derive solely from a researcher perspective following analysis of empirical data that has been forced to fit into researcher-constructed categories. These studies do not tell us how students make sense of their own engagement.

For example, Uekawa et al. (2007) conducted a study involving students in urban high school mathematics and science classrooms. They asked how classroom activities influenced student engagement, and how students of different racial and ethnic backgrounds responded to different classroom practices. Uekawa et al. gathered questionnaire data from students at different points during classroom activities and observed the types of activities employed by the teacher to give context to the levels of engagement indicated by (largely multiple choice) student survey data. Finally, they aggregated total survey data and performed extensive quantitative

analysis to indicate engagement levels based on race and ethnicity and determine which classroom activities promoted higher engagement levels. Student experiences were reduced to statistics based on researcher-selected categories and constructs.

Although large scale quantitative studies such as Uekawa et al. (2007) can provide insight into classroom structures which may promote or detract from student interest in the subject matter, they do little to help us better understand how individual students perceive their experiences in mathematics classrooms. Researchers commonly impose narratives of classroom happenings based on little student input, develop categories of possible factors influencing engagement from researcher perspectives (regardless of whether the students in their studies would agree with these categories), and neglect student voices that would provide valuable insight. None of these studies ask students for their perceptions of how they are engaging in class and why, particularly students whom researchers might deem as demonstrating low or unproductive levels of engagement. Without student voices weighing in on their engagement, we can only hope to recognize student engagement behaviors, while ignoring the driving forces behind them.

Some studies have sought teacher insights about student engagement through qualitative interviews and observations (e.g., Horn, 2007; Mulryan, 1994; Skilling, 2014). Teachers have longer-term relationships with their students and are better equipped to understand their students' habits and personalities than researchers, but teacher voice without student voice provides only a limited understanding of students' experiences. Teacher voice alongside student voice can be problematic as well, as teachers may offer a differing perspective about certain students than those students would give of their own experiences. Furthermore, given teachers' authority and experience, it is possible researchers would give more weight to teacher accounts than student

voices, thus limiting the understanding of student engagement that could be gained by studying students' accounts.

Other mathematics education researchers have included interviews with students about their engagement levels in class, but have reduced student accounts to sets of categories by which to sort and label students according to their engagement type (e.g., Esmonde & Langer-Osuna, 2013; Good et al., 1989-1990; Kong et al., 2003; Martin, 2006; Middleton, 1995; Mulryan, 1994, 1995). Such research paints a more holistic picture of student activity by seeking student commentary. However, most of these studies have still neglected student voices and perspective in favor of the voice and analysis of the researcher. For example, Kong et al. (2003) developed an instrument to observe behavior of eight students in mathematics classes for signs of cognitive, behavioral, and affective engagement. They then performed a single follow-up interview with these eight students as well as 20 more interviews with students in the same class to determine the students' levels of interest, achievement orientation, anxiety, and frustration surrounding their engagement. However, the answers from these interviews were categorized into different subtypes of engagement and presented in a table without further discussion. While Kong et al.'s data collection methods allowed students to describe their own engagement, the researchers co-opted student accounts to achieve their purpose of categorizing student engagement rather than to understand how students perceived their own engagement. Consequently, their analysis is insufficient to understand student experiences in mathematics classrooms.

In contrast to the trend to ignore or co-opt student voice in studies of student engagement, a select few researchers have chosen topics and strategies for interviewing that returned results which more closely approximate the level of student input that this field of study merits. A

careful analysis of the research literature yielded only three studies that tried to capture student accounts of how and why they participate in mathematics classrooms: Jansen (2012), Esmonde et al. (2009), and Skilling et al. (2021). These research teams each implemented methods intended to emphasize student voices to some degree. However, none of these studies implemented more than one interview with each participant, and only one specifically acknowledged the day-to-day fluctuation in student engagement. Because of the strength of these studies in capturing students' accounts about their engagement, I discuss each one below.

As part of her study, Jansen (2012) interviewed 24 students to determine their perceptions of the benefits and drawbacks of small-group work in mathematics. Jansen described these interviews as "snapshots," and no member-checking was performed. From these interviews, Jansen gained insight into student ideas regarding the advantages and disadvantages of group work from the students' perspective. For her results section, Jansen selected two students from each of the two sixth-grade classrooms whose responses captured the general experience of the students she interviewed. These four students had been identified by their teachers—and subsequently labeled—as either "struggling problem solvers" or "successful problem solvers." This labeling pre-categorized each student before the reader had the chance to read the student responses from the interviews. While Jansen did not provide accounts of how students described their engagement, she did identify a handful of benefits or drawbacks to small-group work that were illustrated through the spotlighted students' answers. Jansen's purpose was to make general claims across the classroom conditions that led to certain student experiences. To this end, the results gave a wider breadth to the class as a whole but less depth to individual interviewees, since the responses were treated as a characterization of student experience in each classroom rather than individual student responses.

Esmonde et al. (2009) interviewed 14 students to better understand two topics: (1) how students describe cooperative group work in their mathematics class, and (2) how students' socially constructed identities influence their group interactions in mathematics classrooms. They outlined student responses regarding their engagement in and experience with group work in the mathematics classroom. They differed from the aforementioned studies in that they dug deeper into how students engage *from the students' perspective*. To answer their first question, Esmonde et al. used thematic open coding on student responses to determine the four most important and repeated factors influencing the outcome of group work according to students: interactional style, mathematical understanding, friendship and relationships, and social identities. However, to answer their second question, they used the interview responses and student demographics data to infer the existing social identities of the students and how they might be influencing their experience with group work in their classroom. While Esmonde et al. incorporated student responses in a valuable way that is not seen in most studies, they also imposed identities on students that may or may not have been the most important to or influential on students' experiences. Esmonde et al. (2009) also did not perform any observations of the students interviewed, relying solely on students' general recalled experiences in the forms of easily recalled stories. Observations of student behavior during group work would have allowed researchers to pair interviews with observations, enabling them to capture a deeper and more holistic representation of students' experiences across a longer period of time as well as triangulate interview data with observation data and vice versa.

The third study, Skilling et al. (2021), investigated middle school students' changes in motivation and engagement in mathematics classes. They first administered the same questionnaire to 6th- and 7th-graders at two different points in time (over a year period) to

measure their motivation and engagement. They then followed up by interviewing 37 students in 7th-grade who expressed a significant increase or decline in engagement and motivation levels in mathematics class, thus addressing fluctuations in student engagement over time. The single 20-40 min interviews focused on the students' beliefs about their achievement, classroom behaviors, achievement levels, and enjoyment of mathematics. The researchers categorized these students into four groups according to a high-/low-achieving and engaged/disengaging matrix, then provided a character profile for one student in each of the four categories. Unfortunately, Skilling et al.'s decision to organize the findings based on researcher generated categories and limit descriptions to a single student in each category over-emphasizes the researcher-created categories and ultimately deemphasizes student voices, despite gathering interview data from 37 individuals. Furthermore, they also did not collect any observational data to inform their design of interview questions to better understand student behaviors, the factors influencing their engagement and the specific ways their engagement changed over time.

In summary, past research has delved into student engagement using many data sources: engagement instruments, observations, teacher interviews, surveys, student interviews, or a combination thereof. A majority of these studies included little to no student input in their data collection and subsequent analysis. The few studies that did include student input and attempted to capture student voice regarding their own engagement were limited by researcher-imposed categories, interview questions that were not informed by observation, and general "snapshot" descriptions of engagement that did not capture how students perceived their engagement fluctuating across class periods and tasks.

Research Questions

To address the lack of nuanced student voice in the research on student engagement in mathematics classes, I performed observations and interviews with one student to answer the following research questions:

1. How does a student who commonly engages unproductively in secondary mathematics group work describe their engagement?
2. What explanation does this student give for engaging the way they do during group work?

CHAPTER THREE: METHODS

In this case study, I incorporated a qualitative approach to data analysis, utilizing certain elements of grounded theory (as described by Charmaz, 2014) to better understand how students described their experiences in mathematics group work as well as what drove them to engage the way they did. I discuss below the context and participants of the study, the types of data that were collected, and the methods for analysis.

Context

I conducted an observational and interview-based case study following one 9th-grade student who often exhibited unproductive affective, cognitive, and behavioral engagement during small group work in his mathematics classroom. My study took place in a 9th-grade Secondary 1 Mathematics classroom at a public suburban junior high school (grades 7-9) in the Mountain West. The school was on a block schedule, with the first class of the day meeting every other day for 80 minutes. Ninth grade was chosen because it represents a transition period for many students, as it is the last year of junior high before they enter high school. This age group is also particularly interesting to me as I will teach at the junior high level in the future. The Secondary 1 Mathematics curriculum taught in grade 9 integrated basic topics of algebra, including bivariate equations, as well as geometry, including some proof and construction.

Mrs. Wright (pseudonym), the teacher of the class I observed, had 12 years of teaching experience at the time of data collection and incorporated elements of inquiry-based instruction regularly, including regular small group work and occasional task-based activities. She was chosen because she used elements of reform teaching and had implemented frequent small group work for several years; this mode of instruction was not new to her. Most days, she gave each student a printed copy of the classwork and a portion of class time to complete it with their

groups. She also randomized the group seating chart every day. Mrs. Wright was pursuing a master's in mathematics education at the time of the study.

For part of the study, two preservice teachers in their final semester of university—Ms. Taylor and Ms. Schmidt (pseudonyms)—were also present in class. They were both preparing to student teach in Mrs. Wright's classroom, but had not yet taken over at the time of my data collection. When present, they observed and interacted with students during group work.

The student I selected for my study was Jake (pseudonym), a white male 9th-grade student. To recruit him, I approached Mrs. Wright via email and described the chosen framework of behavioral, affective, and cognitive engagement, then asked her for suggestions of students from her first period classes who tended to engage unproductively in those categories. I limited the pool of students to those in her first period classes to both accommodate my schedule and allow for time to interview the student immediately following class; most days, there was a flexible-use 40-minute block of time right after first period. In response, Mrs. Wright sent back a list of students she felt fit the criteria for unproductive engagement in the three categories along with a short description of how they fit. Mrs. Wright described Jake in part as a student who goofed off when he felt vulnerable, which fit my criteria and framework; goofing off is clearly unproductive behavioral engagement, while Mrs. Wright's perception that this occurred when he felt vulnerable seemed to indicate a possible affective element as well. I observed Mrs. Wright's class, focusing on the students on the list she had provided. On the day I performed a preliminary observation to determine who to select, Jake engaged in off-topic talk and stayed quiet otherwise, confirming that he fit the criteria for the study. To reiterate, the framework of behavioral, cognitive, and affective engagement was only used to select our participant for the study. After this phase, it was no longer utilized.

The data collection included four interviews (including a pre-interview) and four classroom observations. I conducted an initial interview, followed by three cycles of data collection consisting of one observation and one follow-up interview directly after class. On one occasion, I was unable to perform the interview immediately after class due to previous engagements on the part of the student, so I instead conducted it after observing two classes. I collected data until it seemed that subsequent interviews with Jake no longer added much new insight, at which point I concluded the fourth and final interview. Data collection crossed over the end of a term. During the transition to the new term, Jake, switched into the other first-period class taught by Mrs. Wright. As many of his peers also switched classes and there was no noticeable difference in his engagement in my observations or mention of this shift in his interviews, I did not find this to have much of an impact on the study overall.

Data Sources

Data types for this study included observation notes (including blank classwork) and interview transcripts. Transcripts for each interview served as the main data source, while observation notes helped guide interview questions and better understand Jake's responses in context of the class to which he referred.

Observation Notes

Observations served to both help me determine what questions to ask during follow-up interviews and provide context for Jake's interview responses. During observations, I took notes on Jake's engagement behaviors throughout class, writing down what Jake said and did throughout the class, but especially during small group work. This permitted me to determine whether his engagement behaviors during small group work differed from his engagement during other class activities and note these differences to influence my questions when I interviewed

him after the observation. I also took particular notice of important interactions Jake had with peers and his teacher throughout class. Important interactions included any interaction perceived as emotionally charged (e.g., Jake got upset with a peer or vice versa or exhibited an observable change in mood, engagement, countenance, or behavior). I looked for when Jake made bids for attention, access to the group discussion, or class resources, as well as how his peers responded. Similarly, I noted how his peers attempted (or did not attempt) to include Jake and how Jake, his peers, and his teacher responded to these interactions. From these occurrences, I made particular note of Jake's behaviors that seemed to contradict my current understanding and theory of the student's engagement from previous observations and interviews, so that I could probe Jake further to form a more accurate and consistent account of his engagement from his perspective. These data points all served to determine what kinds of questions to ask during follow-up interviews, triangulate Jake's responses from previous interviews, and observe what behaviors he exhibited during classwork. I also collected a copy of the blank assigned classwork and noted any relevant verbal instructions the teacher gave in order to better understand Jake's experience in small group work during those periods. In addition to providing context for the types of mathematics addressed by the task, records of the task(s) and teacher instructions assisted me to better understand what opportunities were afforded to students to engage in group work while completing the task(s).

Interview Transcripts

I conducted and audio recorded four interviews to understand Jake's perspective on how he engaged in small group work. By audio recording, I could focus on listening to Jake's responses and determining what follow-up questions needed to be asked during the interview,

while also taking mental note of his body language and other important cues. The audio and transcript allowed me to focus on Jake's exact responses in each interview and across interviews.

My interviewing process closely followed what Charmaz (2014), among others, refers to as intensive interviewing, a technique often used in qualitative research. According to Charmaz, the purpose for intensive interviewing is to "[obtain] information, [gain] insight into experience, and [elicit] reflections about that experience" (1991, p. 385). Key elements of intensive interviews include implementing open-ended questions and avoiding confrontive questions (Charmaz, 1991). For example, rather than asking, "Why didn't you respond when your peer asked you this question?", an intensive interviewer might opt for a softer approach, such as, "Tell me about your thought process when your peer asked this question." This shift allows for the interviewee to remain more at ease and the interviewer to gain more insightful data. Rather than providing step-by-step interview questions, the common protocol for intensive interviews is to make an interview guide (Charmaz, 2014). In an interview guide, possible questions are listed in order to direct transitions in the interview. During the interview itself, the interviewer adapts the questions and follow-up questions to fit the responses given and maintain the flow of conversation. I created an interview guide in advance for the first interview, while the guides for the later interviews were outlined during data analysis and added to during observations (see Appendix B for all interview guides).

In the initial interview, I asked about Jake's beliefs regarding the purposes of group work in math class and his role in it, past experiences with group work within math classes, and his own feelings toward mathematics. I also attempted to uncover what he viewed as good engagement in mathematics classrooms and how he described his own engagement behaviors. This information allowed me to form a preliminary account of Jake's beliefs about mathematical

engagement in school as well as his own engagement in a classroom and small-group context. The first interview gave me an early insight into how I might answer each of my two research questions.

In each subsequent interview, I sought to gain greater insight into Jake's behaviors in class and how they fit with his account of engagement. To this end, I asked Jake about what I had observed in the class immediately before the interview as well as clarifying questions regarding previous interviews and observations. The purpose of these subsequent interviews was to form a deeper and more accurate account of Jake's experience with small group work during the observation as well as situate this account with the accounts he had previously provided. These interviews elicited how Jake viewed and made sense of his own engagement that day and assisted me in forming and updating my theory of how he engaged in small group work in general.

Soon after each interview, I listened to the audio recording and transcribed the word for word questions and responses as well as long pauses and telling changes in response tone or inflection as captured by the audio. When relevant, I also included any changes in affect or comfort level of Jake as I recalled. In some cases, I had made notes about body language or context of the interview in a short memo in case I did not remember these details when re-listening to the original interview; I included these notes in the transcript. Having Jake's exact phrasing and the nuances of the interview recorded in each transcript allowed me to keep my analysis as faithful to his words as possible.

Data Analysis

Line-by-Line Coding

Following each interview, I implemented initial line-by-line open coding with gerunds on each interview transcript, following Charmaz's (2014) take on Glaser's (1978) approach. In my line-by-line coding, I assigned appropriate actions to each relevant line of Jake's responses. This differs from a thematic analysis or other open coding techniques in that the codes are actions described by the participant rather than nouns that capture themes that could be present (see Table 1). This initial coding method permitted me to examine Jake's own words and keep an open mind as I coded each transcript, allowing the insider voice embedded in Jake's words to emerge rather than imposing my own outsider voice and theoretical codes on his description. I performed initial coding with the goal of forming a more complete picture of Jake's description of his participation without jumping to conclusions or boiling down ideas too quickly. One goal of initial line-by-line coding was to begin to identify specific phrases or words that Jake commonly used or that seemed significant to him, called *in vivo* codes by Charmaz (2014). In order to do so, I highlighted phrases that seemed important by placing them in quotation marks during this stage of coding. See Table 1 for an example of my line-by-line coding of an excerpt from the interviews.

Table 1 *Example of Initial Line-by-Line Coding*

Transcript	**Codes**
Uh-huh, yeah. Um, Adrian, he was in my group and he didn't understand lots of the lesson and he didn't even like, try to keep going at it, but I just–for some of the easy parts, I could just help him with, even though he wasn't trying hard.	not understanding the lesson not trying to "keep going at it" helping others with the easy parts not trying hard

Focused Coding

After my initial coding of each interview, I performed focused coding by looking across my initial line-by-line codes first from the most recent interview transcript, and then across all memos and interview transcripts to draw out the most frequent initial codes for analysis. I then identified higher-level, *focused codes*. Some questions I considered as I perform focused coding and selected focused codes included the following:

1. *In which ways might my initial codes reveal patterns?*
2. *Which of these codes best account for the data?*
3. *What do my comparisons between codes indicate?*
4. *Do my focused codes reveal gaps in the data?* (Charmaz, 2014, pp. 140-1)

Note that while some of the focused codes were selected directly from the set of initial codes I created, other focused codes were added to summarize or capture an emerging phenomenon or process. Many of the codes I identified as focused codes were *in vivo* codes, such as *getting things going*. Jake used this phrase frequently in varying contexts, showing it was not only a significant phrase to him in describing his engagement, but that it was also nuanced and worth investigating further.

Memo-writing

As focused codes emerged from my data analysis, I wrote memos about what those codes might mean and the relationships between them. At this point, I began to form a theory of Jake's engagement, and wrote in bulleted lists and stream of consciousness to capture my thoughts on the data. I mostly wrote about focused codes that emerged (e.g., *being shy*, *getting things going*, and helping each other) as well as contradictions or confirmations of earlier observations or interview responses that arose. I considered what I would look for in my next observation. In my

memos, I often wrote down questions I would like to ask Jake, coming up with a rough interview guide for the next interview. These memos, while informal, helped me to revise my next round of interview questions and prepare for the next cycle of observation and interview.

This process of initial line-by-line coding, focused coding, and memo-writing was repeated following each subsequent interview. However, as I advanced through each cycle of observation and interview, I performed focused coding and wrote memos to capture ideas across all observations and interviews up to that point, rather than just for one isolated interview. Irregularities and inconsistencies within the data indicated to me that I had more to learn about Jake's perceptions and engagement. See Figure 1 for an example of the memos I wrote.

Figure 1. *Memo Exploring the Focused Codes* Getting Things Going *and* Being Shy

Memo 2/22/23

"Getting things going" categories:

- *Math context*
  - Understanding
  - Getting answers/getting the math done (are these different to Jake?)
  - As an individual vs. as a group?
- *Outside math*
  - Talking to each other, maybe breaking the ice, getting a conversation flowing?
- *Other idea*: Not understanding disrupts ability to get things going

What does it mean to be shy?

- Not talking
- Not contributing
- Not participating well in group work
- Feeling left out?

Things to explore: being "super deep into a conversation" (e.g. 1.176 "super far into it")

Questions: Shy/outgoing– what is the relationship to getting things going?

I direct your attention here to the portion of the memo marked '1.176,' referring to Interview 1, transcript line 176. This is the way I cited specific lines of individual interview transcripts throughout my memo-writing phase and in Chapters 4 and 5.

By writing memos after each observation cycle, I identified focused codes that seemed central to Jake's described and observed engagement. I began to treat these central codes as *categories* (Charmaz, 2014), and explored and compared the data to identify and develop the properties associated with the phenomena captured by these categories. As I developed these categories and explored the relationships between them through written memos, I began to construct a theory of how and why Jake engaged in small group work based upon his accounts and observed actions. For example, some of the final categories that emerged were the four main factors that seemed to influence Jake's engagement the most: mathematics difficulty level, familiarity with peers, *being shy*, and adult help.

Writing as Analysis

The final step in my analysis consisted of writing out my theory concerning how Jake saw himself engaging in group work and the factors influencing his engagement. This description emerged from organizing and analyzing all my memos, categories, and focused codes and theories up to that point. This final analysis entailed looking across all these analyses as data sources to identify, confirm, and describe the theoretical constructs and their relationships. As I wrote a description of Jake's engagement, I constantly reviewed interview transcripts and observation notes as well to see how well my description captured Jake's own words and fit his accounts. As disconfirming evidence was found, I returned to coded data, memos, and my writing to revise my description so that it better fit the data. I continued this cycle of revision until the description seemed to be consistent with the data.

At this point, a member check might have been appropriate. However, I decided not to include a member check in this study due to the sensitive nature of the topic. Jake may have found it to be triggering or discouraging to hear a description of his engagement in mathematics

class because it could show him in a negative light, even if formed based on his own responses and actions. Similar studies involving student voice also chose to forgo a member check. Therefore, after writing my description of Jake's engagement by the process detailed above, I concluded my data analysis.

CHAPTER FOUR: RESULTS

In this section, I describe Jake's perspective on engagement in group work by summarizing his reasons for engaging in group work, his conception of what counts as good engagement, the factors that seemed to influence his engagement, and his off-task behavior when factors for good engagement were missing. Jake enjoyed working in groups during math class, as it allowed him to get to know and converse with his peers, complete his classwork, give and receive help, and identify and address misconceptions. He thought that good engagement during group work consisted of talking with group members to develop understanding and finish the problems on his assignments. While the presence of on-task talk was necessary for good engagement, Jake seemed to accept a wide variation in the amount of talk and the degree to which all members were included in the discussion. His engagement in group work seemed to be affected by four main factors: how hard he found the math content, how familiar he was with his group, how comfortable he felt talking with his peers, and what kind of help he received from adults. When the math felt too difficult for Jake, he responded in a few different ways. Most frequently, he stayed silent, played on his phone, interacted with peers across the room, or talked with his group about nonmathematical topics.

Purposes for Group Work

Over the course of our interviews, Jake identified four main reasons for engaging in group work. For him, group work served to (1) meet social needs, (2) complete assignments by *getting things going* as a group, (3) help each other understand, and (4) remediate individual misconceptions.

Meeting Social Needs

For Jake, interactions within small groups in math class allowed him to achieve an immediate social goal: getting to know other people. Jake said, "I like how she [the teacher] like, mixes up the people you work with, so you're familiar with everybody and that–you just work with everybody well" (1.57). Despite being sociable, throughout our interviews, Jake only referred to one person specifically as his friend (3.59). Instead, he typically classified peers based on whether he was familiar or unfamiliar with them. He described that he was more familiar with peers he knew from other classes. Because of this, he was better able to relate to them in math class by talking about their experiences in other classes:

> I mean some of the kids in there I've had other classes with in like, past grades, and [pause] yeah. So it's just easier, 'cause you can talk about the other classes you have together and so you can get something going. (1.69)

However, he indicated that regardless of how familiar he already was with his peers, he wanted to get to know all of them: "[T]here's only good things about working with other people and getting to know them" (1.80). Group work, therefore, provided another way for Jake to connect with peers he may or may not have known outside of math class. When asked whether he would ever prefer to work individually instead of in a group, Jake acknowledged that while he would occasionally like to work on his own, he was always open to working with others, even if he had no say with whom he worked. Jake's openness to group work is expressed in the following quote:

> It just depends on the seating chart, so I don't really know until I get in class and–and even if it's like, not a seating chart I want, I want to get to know some people so it's–it's good either way. (2.105)

Throughout the interviews, Jake regularly expressed a need to interact with peers, and he viewed group work as a promising context for meeting this need.

Jake also identified a more long-term social purpose for group work: the opportunity to learn how to work with others on a team. “It’s [group work] so you build team working skills that will help you in the future” (1.74). Jake believed that the ability to work well in teams was essential for successful employment in the future. He went as far as to assert that developing team working skills might be the most important reason for doing group work in math class. “That’s probably the biggest reason, but, um. I don’t know. Yeah, just like, group–like teamwork and working together. I feel like that’s the main reason she [the teacher] puts us in groups” (2.89).

“Getting Things Going”: Understanding the Mathematics and Completing Assignments

Throughout our interviews, Jake expressed that working in a group allowed students to *get things going*. He used the phrase *getting things going* often, describing what seemed to be a two-step process: starting a conversation within his group, then working with his group to *get stuff done*.

Jake seemed to view opening a conversation among his group members as a necessary first step to *get things going* and ultimately complete the assigned problems as a group. He described that talking about non-mathematical topics before discussing math sometimes made this process easier:

> I feel like talking about other stuff besides math makes you just like, get to know each other more. Because then you get to know more about their personal lives and like, you could talk about that to start a conversation, and that's how you can get things going, and so you don't have to be [pause]–not try to be talkative. (2.170)

Jake's phrase *try to be talkative* seemed to indicate that he felt that starting group work by immediately discussing mathematics could at times require more effort and feel less natural. During observations, Jake's groups often began their group work with talk about non-mathematical topics; however, his group occasionally talked about mathematics right from the beginning. For example, in one class, Jake related that he did not know his groupmates very well, and that they did not know each other. Despite this lack of familiarity, their talk in this class was focused on math: "We were all shy like we were kind of like, talking to each other. But we were talking about specifically math" (2.156). In each instance of working with groups wherein Jake had varying levels of familiarity with his peers, *getting things going* seemed to be a means to an end; he portrayed each start to a conversation as a way to lead into a mathematical discussion.

In order to complete the process of *getting things going*, the conversation needed to lead to the group making progress on their classwork, or *getting stuff done* (1.87). To Jake, *getting stuff done* referred to both achieving at least a procedural understanding and getting answers to the assigned problems. He explained the understanding portion of *getting stuff done* in the following quote:

> Getting, like, [pause]–understanding the thing before class ends 'cause if you don't understand [before class ends], then it makes it like that much harder to go online and then watch a video, and so it's just really, really to like not procrastinate. Get it done. (2.91)

Jake said that *getting things going* occurred as a group and that it led to getting the answers. "It's like [pause] a group effort. Like when [pause]–getting things going is like–I guess, when we're like, all contributing to find the answer" (3.110). For example, Jake described one group in which they talked together to get the answers:

> We like, made a table off of this graph, and then you made an equation. And yeah, we were–that was like, a pretty easy part, so we were like, flying through that as a group and talking, getting it done. (2.21)

Interestingly, Jake enjoyed *getting stuff done*; in fact, understanding and getting the right answers were the aspects he brought out in describing why math was his favorite subject:

> When I understand math, I–it's probably my favorite subject, 'cause then it like, when it like, clicks, I don't know, it's like fun, like I don't know, it's fun to do some of the math stuff… Like when you're like, you don't understand something, but then you get to like learn it and the–it, like–it's perfect, and then just–so you get the right answer, like every time and you just can keep doing it over and over again. I don't know, it's just fun. (1.26-28)

Helping Each Other Understand

Similar to *getting things going*, another aspect of how Jake described engagement in group work revolved around helping each other understand the mathematics. Jake saw working in small groups as a way to get help from peers to understand and complete difficult problems:

> It's easier to get stuff done, and faster…'cause if you're missing, like part of it and you're like too scared to ask the teacher about it, 'cause they're like talking about something else, then you can just ask your classmates and it's like, real easy (1.87-89).

Since Jake believed that completing the assigned problems was one of the main purposes for talking with each other in the first place, he saw his peers as an important resource for gaining the understanding necessary to do so; as everyone in a group helped each other out, each individual could complete their classwork. Jake felt this help came through talking: "Like, I don't know, be talking, so we can like get like–hope they'll understand and hope also, like if they

know something we don't, like, help us understand too" (1.106). He agreed that sharing his own thinking and listening to his peers during group work was valuable: "Yeah, for sure because like their–their opinion can like, change the way you think about other things and either can help you [pause] or what they're saying is wrong and you can help them" (1.150). During observations, I saw Jake both help and receive help from his group mates and friends.

While Jake valued help and helping, he clarified that not all help was equal and described which types of contributions by his group members were helpful and unhelpful to him. He explained that for him to achieve understanding when he was confused, his peers had to be willing to do more than give a quick answer. He characterized unhelpful group mates in the following way: "Yeah, they would just like–they wouldn't have been very talkative, they would have just given the easy, short explanation. And it wouldn't have been very helpful" (4.78). He then described what would have been more helpful: "It could have been anybody who would help me through it instead of just giving me like one plain answer" (4.84). The kind of help Jake saw as most valuable was when his peers would walk him through a solution rather than just give him the final answer. During observations, Jake occasionally could work backwards from an answer he got from others to understand the process and apply it to subsequent problems. However, Jake was typically unable to work backwards from an answer, and thus received little benefit from this type of help.

When he understood the mathematics, Jake saw it as important to help others understand. In one class period, Jake recognized that his group mate, Adrian, did not understand much of the lesson. He knew Adrian from a robotics class and they seemed to be friendly with each other, joking around and asking each other questions. While Jake noticed that Adrian was putting in little effort to understand, he still helped Adrian with the math during this class period:

> I just pointed out the problem and he was like, 'How do you even do this?' And I was just, 'Uh, well, you just take that from the graph. Put it there, and then add those together and put it over there' (2.60).

In this instance, Jake's help, while procedurally focused, fits the description of the type of help Jake prefers (4.84).

In addition to helping those in his group, Jake said that he would also help his friends all over the classroom. Describing a hypothetical situation wherein he understood the math and felt motivated to complete his classwork, Jake said he would reach out to those around him as well: "I woulda just probably zoomed through the whole thing and then after I was done, I would help my–my partners and–and then go to Ben and see if he needs help" (4.88). Ben was Jake's friend who sat in a different group on this day, so it is clear that while Jake would have prioritized his own completion of the classwork, he also saw it as important to help both his group mates and his friends, regardless of where they sat.

Jake also spent time on the receiving end of help. In one class, he described receiving a refresher from one member of his group on the Pythagorean Theorem, which he had been struggling to remember. "Just $a^2 + b^2 = c^2$ [A squared plus B squared equals C squared]. Yeah, I just kind of didn't understand that for part of it. And she–she was helping with that" (3.128).

Occasionally, Jake received help from friends outside of his group. For example, during one class, Adrian was seated in another group. However, only a couple of minutes after beginning the group work portion of the lesson, Adrian came over to Jake's desk to ask him how to do a problem on the classwork. When Jake said he wasn't sure, Adrian got help from the teacher and then returned to help Jake. When given the answers for each part of the point-slope equation (e.g., the y-intercept and each coordinate point), Jake described that he could work

backwards to figure out how Adrian got the answer. “It was our first equation. And [Adrian] gave me–he gave me the answers. So like the answers for each thing and where to put them. And so from then I knew I just–put it together” (4.31).

Addressing Misconceptions

Working in a group also allowed Jake to discover when he had misconceptions and correct them as needed; furthermore, he preferred correcting misconceptions through group work than by asking the teacher. Regarding group work, he said, “When you share your thinking, they can like–they can correct you, or help you through if you're wrong or right” (1.152). He claimed that asking peers was an easier way to address his misconceptions than asking the teacher, since he found it intimidating to talk to someone who always knew the answer. He felt nervous to share his thinking with the teacher when he was not certain it was correct:

> I feel like it's when you like, don't like, fully understand the concepts so if like, you say something wrong, or like, I don't even know why I'm afraid to like, get something wrong, but it’s just, I think, yeah, that's why. (2.111)

Jake clarified that he did not usually feel as nervous to talk to his group mates as he did with the teacher; he found them to be generally less intimidating.

> Well, I feel like my group makes probably more mistakes than the teacher does with it, so it's like, maybe you guys made the same mistake. But the chances of the teacher making the same mistake with you and being able to just talk about that mistake is, like, [pause, shrugs]. (2.113)

Jake’s Definition of Engagement (as Talking)

While Jake saw engagement as more complex than just talking, he most often vocally characterized engagement in math group work in terms of who talked and who did not. He

initially described good engagement in terms of "who's talking most–like if you can hear 'em and like, who's raising their hands and talking and like, telling how to solve it" (1.115). Later in the first interview, Jake clarified the type of talk that characterized good engagement: "When everybody's talking to each other and like, you know, contributing to part of the solution… So they can all just build it up and get the answer" (1.82, 85). Talking seemed to be the most salient indicator of good engagement to Jake; in order to engage well, students needed to talk with each other about relevant mathematics and each get the answers to the assigned problems. In contrast, he characterized those who did not engage well in group work as not talking at all, which he equated with *being shy*. He believed that *being shy* inhibited good engagement in group work. Jake described those who did not engage as follows: "They're like shy and they're like, not moving their mouth, like you can just see everybody like, looking at each other and like, talking, but they're like, just sitting there. Not contributing" (1.117). Clearly, contributing verbally to the mathematical discussion was seen as important for good group work to Jake, and acting *shy* could hinder group member's progress to find solutions.

Jake later qualified his description of good engagement in terms of who talked the most by acknowledging the possibility of off-topic talking. He used the term *being outgoing* to describe being able to start nonmathematical, group conversations, which later could be used to segue into mathematical conversations. As was previously mentioned, Jake felt that non-mathematical discussions were sometimes good launching points for starting mathematical conversations:

> Well, in a way it's like good because [by having a non-mathematical conversation] then you're starting to like get with them, but if you can like, take Fortnite away from their conversation, then you're already like–um, well like you're talking with them well, and

> you could just switch the subject on that and talk about that [math] well, instead of Fortnite. (2.131)

However, Jake also acknowledged that when his group engaged in conversation that ended up distracting him instead, he no longer considered it good engagement:

> I don't know, they just talk about something that's completely not math-related, and sometimes it's good to hear about that and like get stuff going, but like, and like talk to each other about things but–um, I don't know, sometimes it can just–like you can focus on that too much and then like, zone out when the teacher is trying to teach you something important about the lesson. (1.113)

When Jake became too engaged in and comfortable with the ongoing non-mathematical conversation with his peers, which he also referred to as *being too outgoing*, he admitted he could be easily distracted. In one group, Jake and his peers became engaged in an extended discussion of Fortnite, which he described as follows:

> Well, maybe we had like, it was like, a really bad group. Like a really bad group. So if we all didn't, or weren't super outgoing with each other [pause]. I feel like being shy is like, bad, but being too like, outgoing is also bad, so you just want like, a perfect middle. Because you can get really distracted really easily. (3.156)

While a level of being talkative and *outgoing* with his peers was seen as acceptable and helpful to starting a conversation, Jake saw that going too far and *being too outgoing* could lead to lengthy, off-topic discussions that drew his focus away from doing mathematics (3.156).

Consequently, Jake believed that good engagement typically involved talking that was a *perfect middle* between *being shy* and *being too outgoing*. Hitting this *perfect middle* required being outgoing enough to start a conversation that eventually led to *getting something going*, but

not *too outgoing* so that he got *pulled away*, i.e., distracted (3.156). He believed it was important to talk enough with his peers so that they could complete the assigned math problems, while not getting too distracted by conversation about other things. Perfect-middle talk seemed to consist of mostly mathematical conversations that resulted in mathematical understanding and completed assignments.

Through subsequent interviews and observations, I noticed that a high quantity of this perfect-middle talk was not always critical to good engagement in group work. Rather, if everyone within a group already understood the mathematical content, Jake did not find it necessary for the group to converse often:

> I feel like if you all work together for like a small part, you hear like the answer or whatever, or what you're supposed to be writing down, and then you all understand it and then get going at the end. The like, chemistry is going and so that's like getting it going, I guess. (3.119)

This notion of good engagement was illustrated in the following example. In this particular class, Jake and his group did not talk with each other much during the time allotted for group work, but he claimed they were still able to engage well together while working on the review portion of the classwork: “We knew how to like, do all that stuff, putting the terms into a sequence and into a table and stuff and so that was easy. And that's where things got going” (3.21). Since Jake and his group knew most of the material already, they established a flow of doing the mathematics, at least for the review portion of the lesson. He elaborated, “Well, I think we didn't talk that much ‘cause we're unfamiliar with each other. But I think I knew that–the stuff and–and it was also helpful for the stuff I didn't know and I'd ask, they’d just give me answers” (3.23). From observation, Jake and his peers largely worked individually for the first part of class on the

review page. However, he seemed to classify this time as when *things got going* in his group because from his perspective, up to that point, everyone in his group understood and was making progress. Jake felt like he could check in with his group members as needed to ensure he was completing his assignment correctly. He did not explain how he knew that everyone else in his group understood what to do. For Jake, since everyone seemed to understand the content, engaging well, or *getting things going* in this instance did not necessitate a constant group discussion; instead, it seemed to refer to a feeling of confidence in his ability to complete the classwork and assurance that his peers would share their answers to check with his if he requested it.

It was also unnecessary for Jake to talk with all members of his group to consider his engagement adequate. For example, in one class, Jake was placed in a group with two students learning English, Ana and Diego, and another native English speaker, Maddie. Jake felt that he worked well together with his group despite talking occasionally with only one of his group mates, Maddie. He clarified that he did not always need to talk with everyone to engage well, as long as everyone could understand and complete the classwork:

> Like sometimes it's not with the whole group. I think–I think the other girl [Maddie], we were talking a little bit more often. And even like, for the like, moments–the little moments that we were talking, then we could all understand and get that written down. And then after we're done with that, then we meet up again for like a couple seconds, and then keep going. (3.114)

Jake described that Diego had a hard time communicating, which may explain why Jake did not speak with him: "Well, I think Diego doesn't know English that well, so it's like, kind of hard for him to talk about it. But, um–and I think he's pretty shy and the rest of us were kind of–we

worked together" (3.112). Although it is possible I overlooked some talk, from what I observed, neither Diego nor Ana spoke at all during group work. Despite Jake's classification that the whole group worked together, as an observer, I only observed him converse briefly with Maddie a couple of times. For this reason, it is unclear how or why Jake concluded that the entire group was able to "understand and get [the answers] written down" whenever he was able to (3.114). However, to him, this group worked together sufficiently well for Jake to comprehend and complete his classwork; he could mostly focus on getting the math done, only pausing to verify he was on the right track with one of his group mates.

Factors that Influenced Jake's Engagement in Group Work

Four factors seemed to influence Jake's engagement in group work the most: (1) his perceived difficulty level of the math content, (2) how well Jake knew his group mates, (3) Jake's overall comfort level or *shyness*, and (4) whether or not Jake received help from an adult. The math difficulty level on a given day seemed to influence how Jake responded and engaged in nearly every instance I observed or that Jake described and explained. However, most often, Jake's engagement was influenced by a mix of these four factors at once. For this reason, the following sections contain examples addressing multiple factors at once, but I placed them in the section to which they seemed to provide the most context.

Math Difficulty Level

Each of the four factors that showed up the most in Jake's interviews overlapped regularly in the examples Jake highlighted, but the accessibility level, as perceived by Jake, of the mathematical content covered on a particular day colored his experience and engagement in every instance he described. For this reason, Jake's understanding of the mathematics (or lack

thereof) on a given day seemed to have the greatest impact on how he engaged in group work that day.

The difficulty of the mathematics content each day impacted Jake's level of confidence and willingness to share his ideas and answers with his group and teacher. When Jake considered the math to be easier, he felt more confident in his answers and might share them with his group to get the discussion going, regardless of whether anyone else in the group was talking:

> It's like easy, easy parts of the lesson, then I'm like, OK, if you guys don't say anything about this, I'll say something about this and get something going and then we'll talk to each other… 'cause then I'm for certain that it's like a correct answer. What I'm saying is. (2.70-72)

In one class, Jake mentioned that there was a "refresher" of familiar topics at the beginning of the classwork (3.17). He recalled how to graph equations from the semester before, which helped him feel more confident about starting the problems on the worksheet. "I kind of just remembered it. Like we added a couple of new things, but like getting it started was easy because it was the things we learned from last semester" (3.5). During that same class, he mentioned that he felt like everyone knew the content well already and could discuss questions as they went.

In contrast, when Jake perceived the math to be more difficult, he and his peers became *stumped*, and ceased to engage productively:

> Yeah, I was able to help each–we were able to help each other because–yeah, we just already knew that stuff so we didn't have to think too hard about it. And, but we were kind of stumped when we got to the harder spots that we didn't know yet. (3.25)

If everyone in his group was equally lost, they typically did not begin or continue a mathematical discussion:

> I think the easier parts get us talking because we know what to do, and so we're not stumped and not talking to each other. But when we do know what's happening, we can like, talk about it, I guess. (3.89)

Jake seemed to believe that there was no reason to converse with his group about mathematics if none of them knew what the next step should be.

When he was seated with unfamiliar peers, Jake typically sat in silence upon becoming *stumped*, even if others in his group knew what to do. He described one instance:

> I feel like on Thursday when it got–there was like the harder parts with the Pythagorean theorem. I don't know why; I usually understand that. But I couldn't today or that day [Thursday]. And–and I just, was like–I didn't know what to say because I didn't know it, so I just didn't say anything at all. I just like, sat there looking at my paper. (3.130)

Jake didn't know his group mates all that well during this class. When asked what might have helped in this situation, Jake only offered that if he had known what he was doing, he could have talked to his group: "I feel like if I had like, remembered or understood it, then that would have been better, and then I could have talked about it" (3.134). It is important to note that Jake's understanding fluctuated from day to day. He stated that he "usually [understood]" the Pythagorean Theorem, but that day he was really struggling to remember how to apply it (3.130). As a result, he did not feel that he could contribute to a mathematical discussion.

In groups comprising people Jake knew, if they all got stuck on harder math concepts, Jake usually talked with them about non-mathematical topics. He claimed it was easier for him to talk with these familiar peers about math:

> I don't know 'cause I feel like in the easy parts, it's easy to talk to them and like, especially easy to talk to them. Yeah, I don't know, and in the hard parts it's like you can still, like, get it going about what you don't know. (2.84)

Despite his claim that they could talk about what they did not know, this seemed to only happen when at least one of them understood the math. Otherwise, they could not persist when the math became too challenging. In one group, Jake engaged well with his group consisting of two peers he knew well up until the mathematics became too difficult for all of them. Describing this class, he said,

> The easier parts, the easier parts is like, where we talked. When we didn't understand, like, the hard parts, we just like, talked about Fortnite because if there's like–like what do we do? What do we talk about? How do we do this? And they're like, 'Oh yeah, well there's Fortnite, so [pause].' Yeah. (2.33)

While Jake painted his group mates as the instigators of the off-topic conversation, he went along with it whenever the talk of Fortnite came up. He clearly saw no reason to engage in mathematical discussion with his group when none of them had an idea of how to approach the problems.

Familiarity with Peers

Jake thrived on getting to know new people; this was one of the main reasons he gave for enjoying group work in math class. Since he viewed *getting things going* to be crucial to good group work, it was important for him to be able to talk to and work well with his group mates. Even so, his comfort level and his willingness to strike up a conversation with those in his group seemed to vary greatly depending on how well he knew them already and what common interests they had. Although he had the desire to become familiar with everyone, he seemed to have a

harder time getting to know certain people. However, if he was familiar with anyone in his group, this typically enabled him to start talking with them to understand and finish their classwork together. Despite Jake's preference of working with familiar peers, he did not always engage well with them; sometimes they became *too outgoing* (i.e., talkative) about their other interests and became distracted from doing math.

Although he wanted to get to know people in math class, Jake claimed he found it more difficult to get a conversation going when seated with unfamiliar people, which in turn inhibited his ability to understand the mathematics and complete the assigned problems. When he was placed in a group with people he did not know well, Jake typically waited until someone else took the initiative to start talking: "Um, sometimes, when like [pause]–I don't know, I get put with people that I'm less familiar with, then like it's harder to like, talk with them and get the math and stuff" (1.64). As a result, Jake waited silently when he became *stumped*. However, because he was interested in getting to know new people, if others could open the conversation in the group, he would typically jump in to keep it going. He said, "Usually, like I waited for them to say something and then just like–just–and I just keep that going so we can keep talking about that. And it just works its way up" (2.66). The following example illustrates this trait: in one class, Jake was placed in a group with Maddie and two English language learners, Diego and Ana, none of whom Jake knew well. He also mentioned that Diego still found it difficult to communicate in English, which may explain why Jake did not talk directly to him. At the behest of Ms. Schmidt, one of the visiting student teachers, Maddie helped him: "And she [Maddie] came in. She's like, kind of talkative and she knows–like, she's pretty smart so she helped us" (3.106). Later on in class, Jake talked to Maddie again later to check his answers, showing that he could keep a conversation going once someone else had broken the ice.

When Jake perceived the math as being easier, familiarity with the peers in his group allowed Jake to better achieve the aim of both understanding and getting answers. Referring to one class where he was seated with two people he knew outside of class, he said,

> When–when in like the easy parts that we just flew by, since I was already like, knew them and it was easy. I was like, 'Oh, how do you do this part?' 'Cause like it's easy to talk to 'em, and they'll just spit out an answer and then we can like–like, see why it's that answer. Let's get it going. (2.45)

He seemed more at ease asking questions with peers he knew well because he often viewed them as having the same level of understanding as he did. "I feel like all the people I'm familiar with are pretty like, matched–match with me. Like we're all the same smart–smartness" (2.117). Because of this, he may have felt he had little to lose by asking these peers, since from his perspective, they were all equally likely to need assistance. When his group contained at least one person he knew, they could work together to start the conversation: "Sometimes I'll like, try to talk to them. But if I know even one person on the table, like then we can get something going, and then the other people join in and we try and get them involved" (1.104). Jake described that he was more motivated to participate more in group discussions when someone in his group would help him continue the conversation once Jake started it:

> I don't know, like, it's easier to talk to some people over others. I don't even know how. It's just like–it's just [pause] like they can–if you say something, they can like carry that on, and like keep talking about it, which like, gets all of–everyone talking (1.132)

Jake acknowledged that while it was easier to start a conversation in a group in which he knew people, he still found it awkward to talk in the group if the peers he knew did not know

each other. While describing a situation in which Jake knew his group members but they did not know each other, Jake said,

> Still, it was like, harder to talk about things, even though I was familiar with both of them, they weren't familiar with each other, so it's just like the three-way connection that we had to make… Like if you're familiar with them, them, them [nodding three times as if gesturing to three classmates in a group] and they don't–they're not familiar with each other, it's still kind of weird until it like, clicks. (2.166-168)

He recognized that while this scenario was better than not knowing anyone in his group, it was awkward for him nonetheless.

Jake seemed more prone to view unfamiliar peers as being less willing to help him through difficult mathematics. In one class, he described that he did not feel like his group (composed of peers Jake did not know well) would have offered him adequate help if asked:

> I think [pause] I guess I could have asked my group partners. But [pause] I don't think they were very talkative… I felt like, if I would have got engaged in the subject, then they would have just like–like just said an answer, but like not helped me through it. And sometimes you just can't work backward, like backwards through that, so [shrugs]. (4.72-76)

In this instance, because he did not trust his group to help him understand the mathematics, Jake seemed unmotivated to get engaged in the first place once he got stuck.

Becoming more familiar with his group members did not always lead to better engagement for Jake, however. As mentioned above, Jake said that distracting talk drew him away from learning (1.111). Jake claimed that sometimes, his group became *too outgoing* with each other and ended up getting derailed by talking about other things. In one instance, he had

been paired with the same two group members for two classes in a row because the teacher had forgotten to change the seating chart. Referring to the second day, he explained, “Teamwork was [pause] better than last time, but better in a worse way” (2.154). He clarified that he and his group members had become *outgoing* with each other and it led to distracting, off-topic discussion:

> So last time it was like, we were all shy like, we were kind of like, talking to each other. But we were talking about specifically math. But now we're like outgoing to each other, and we’re talking about Fortnite, so it's different. (2.156)

He communicated that feeling *shy* and unfamiliar with his peers led to only “kind of…talking,” but it was on-topic. Acting *outgoing* with each other seemed to signify a higher level of friendship or comfort among the group members, which Jake seemed to value, but it also led to openings to talk about things outside the realm of math, which could detract from getting the math done as a group.

Being Shy

During math class, Jake was typically social; he often talked about mathematics or his hobbies with his peers. While Jake said he usually tried to talk to his group, sometimes he did not feel comfortable enough to either begin or continue talking to his group mates. As mentioned above, he described this feeling as *being shy*, and portrayed it as a hindrance to good group work (1.170). While *being shy* often happened when Jake struggled mathematically and felt unfamiliar with his group mates, *being shy* also included either 1) the perception of being left behind in or left out of a conversation, or 2) a sense of being singled out from others in a negative way.

Jake felt *shy* when he felt left out of a conversation. Often his lack of mathematical understanding contributed to his feeling of being left out. Jake explained the feeling,

> I don't know, everybody's like talking, and getting into it. But like I'm kind of not, and sometimes I don't get it, so it's like, harder to get like, talking about it so… Like I don't get the concept that we're learning, and they do, so it's just harder to get going about it. (1.168-170)

Jake described that when others in his group started a discussion, he sometimes felt like there was no entry point for him to involve himself to gain understanding and complete his own assignment:

> Sometimes they [his group mates] don't see that one person isn't like, understanding it, and it's like, hard to see through them to see if they don't understand it. So they're just talking about it and they're like, 'Oh yeah, this means this,' and you're like, 'How does that mean that?' But you don't like, wanna ask them about it because like, yeah. 'Cause they're already very far into the concept. (1.173)

When his group mates didn't recognize that Jake did not understand the math, Jake felt both left out and unable to enter the conversation. These quotes suggest that while he recognized that his peers could likely help him understand, he chose not to ask for their help at least partially out of politeness, as if asking would inconvenience them. Jake described similar circumstances outside of math class that elicited the same feelings of *shyness*:

> When you're just talking to each other and then they're like talking about something that like–something that happened, but you don't even know that it happened. And then you're just like–and you're just like, I wish I knew about that, but I don't. And I don't wanna ask about it. 'Cause then you're going to have to go back and repeat it all over again. (1.181)

Jake's desire to not interrupt and cause people to explain something everyone else seemed to understand kept him from interrupting the conversation.

Jake also felt *shy* when he had a lot of attention drawn to him in a way that singled him out in a negative way. He said he felt *shy* and uncomfortable about being called out or receiving attention from his group, especially when it was made up of unfamiliar peers: "If you're not even talking to anybody, they're just like looking at you…and you don't know them, and they're like giving you the awkward stare–that's just it" (2.146-148). When his peers in the class or within his group all stared at him, either for perceived misbehavior or for getting the wrong answer, Jake seemed to worry most that they might think negatively of him. He detailed one instance when he was called out in front of the class. "Oh I was like, I was talking to him–to one of my classmates about math. But [the teacher] was talking and so she's like–she said, [Jake lowers his voice] 'Jake, pay attention' or something" (2.135). He disliked the attention he got from his peers when he was called out by the teacher:

> I just see all the people like, looking at me and it like, makes me more shy. I think that's what makes me shy in the first place. Like the teacher calling me out, I don't really care, but then that just leads to the, um, students looking at me and that's just basically what makes me shy. (2.143)

While the above excerpt details a moment when Jake felt *shy* in front of the whole class, in other moments, he felt the same way within his small group. He said, "Yeah, sometimes I mean I just like–I'm like, I know I wanna say this like, out loud and I know that this will help them solve this. But I'm like, too shy to say it I guess" (1.164). It seemed that this discomfort stemmed from Jake's aversion to embarrassment and being singled out. He recognized that sharing his thinking without knowing whether it was correct or how it would be received by his peers put him in a socially vulnerable position, which was uncomfortable for him. He was

usually unwilling to risk being wrong and invoking judgment from his peers, especially when he did not know them well. The following quote illustrates this feeling:

> Like I feel like if I mess up, they're gonna like [in pretentious voice], 'Oh well, that's actually not [trails off].' I mean I guess that gets the conversation started, anyways, but [pause], then yeah, then it's just like a bad start to talking to 'em. (2.74)

He portrayed this immediate correction from his peers as a negative reaction to being wrong, perhaps viewing it as a rejection of his thinking.

However, being surrounded by familiar peers seemed to mitigate Jake's *shyness*, even when he was singled out and received attention from the teacher or other peers. He described that he and his group felt apathetic about getting called out or having attention drawn to them when they all felt comfortable with each other: "It just depends who's my group 'cause like, it can happen to all of us and [pause] since–it just–if we're like–if we're talkative together then it's like nobody really cares if we get pointed out" (2.146). Sometimes just having familiar peers in the classroom, and not necessarily in his group, could help avert Jake's *shyness*, even when he was singled out. He described that making eye contact with his friend Ben in a different group helped him to feel less worried about having negative attention drawn to him or feeling uncomfortable with his peers. "I don't know, 'cause whenever–whenever I did [pause]–I wasn't talking to my table, or didn't understand something, I'd just look at him and then, I don't know, it just–it just doesn't make me shy anymore, I don't know" (3.79). He went on to explain how even if the whole class were to look over at him, he no longer felt *shy* if he could make eye contact with his friend: "Yeah, so when it's like my friend, it's like, kinda different and so I only have his eyes all on me. And it's better… Because he like, laughs at me. And then I start laughing too because we're just being funny about us missing the answer, I guess" (3.81-83). This description shows

that once Jake could make a connection with a friend, he no longer worried about other judgment from his peers when he was singled out or got an incorrect answer. “I was like, ‘Who cares,’ I guess. OK, he's [Ben] there…If you get the wrong answer or whatever. So why be shy?” (3.73-77).

Adult Help

When Jake and his group mates all became *stumped* on difficult problems and neglected to initiate a conversation, sometimes the only way he got past this was when an adult stepped in. Jake described that when an adult was present, his group felt obligated to break their silence to talk with each other and work out the answers. On one occasion, a preservice teacher, Ms. Taylor, was observing his class and hovered around their table. Everyone in the group had previously been focused and working individually on the review portion. However, once Jake and his peers became *stumped* on a particular question, she intervened. Jake described,

> Well, she's–so when we get stumped she can like, tell? She can tell when we get stumped. So she's like, she looks at us, and we're just looking at our papers not doing anything or writing anything down. And then she gets the conversation started somehow. (3.140)

He detailed a specific instance of how she helped them:

> Well, she went through, since we were like, not talking to each other, she was like–she was like [indicating to different people as if in a group], ‘What's your answer? What's your answer? And what's your answer?’ And we'll–we'll see who has what and compare, and I think two of us had the same answer. And one of us didn’t. So then we were able to work it through. (3.37)

Jake said that with Ms. Taylor’s intervention, he and his group were able to start talking to each other. “We like, we talked to each other after she was–after she got it like going for us” (3.49).

He described having an authority figure stand over his table as "scary" (3.51). He explained why: "Just her looking over us because we knew–we knew she'd be like, she'd get on us if we weren't talking to each other. So then we all started talking" (3.53). While Jake's inclination was to sit in silence once his group became *stumped*, both he and his group seemed to recognize that Ms. Taylor would stick around until they talked and worked together, which helped them to start a valuable conversation and work productively on more challenging mathematics.

With help from a teacher figure, Jake was sometimes able to receive help from his peers and begin to *get things going* as a group. During group work on a different day, another visiting preservice teacher, Ms. Schmidt, helped get a conversation going in Jake's group that persevered to some extent even after she left to talk to another group. In this case, Ms. Schmidt noticed Jake's group's silence during group work. She stood next to their table and addressed Jake, asking him how to determine whether a triangle was right as well as how to find the lengths of each side. When Jake shrugged, she then asked his group mate, Maddie, to explain her process to Jake. Despite describing that he did not understand a particular problem about the Pythagorean Theorem, Jake had not asked his group for help, but accepted it when Maddie offered it. One possible explanation is that he may not have seen her as willing to help him until the student teacher encouraged their discussion. Another may be that since he was confused about the math, he did not feel he had anything to contribute to the group. This idea will be explored later on, in the discussion section. However, regardless of his reasoning, Jake did check answers with Maddie once more during the rest of group work that day, showing that Ms. Schmidt's aid likely helped him engage more productively to make progress on his classwork.

However, Jake did not always respond productively to adult intervention. One time, while sitting with students he was familiar with, Jake and his group chatted about non-

mathematical topics. Jake believed that he and his peers were unable to stop their off-task conversation: “Honestly, I think we were too deep into the conversation to get out” (3.164). Thinking back, he described that perhaps someone could have stepped in to help them focus again: “Yeah, maybe if I only had like, somebody there taking us away from Fortnite” (3.158). However, when the teacher stepped in to ask them about the mathematics near the end of class, Jake did not return to mathematical activity.

Jake also felt that he would have benefited from teacher intervention when he was stumped. In one class, he explained that he would have engaged better had he received help from the teacher: “I feel like if I had Mrs. Wright there and she saw me just not knowing what I was doing then she could help me and I coulda kept going, instead of being on my phone” (4.66). Jake felt there were times when he could have benefited from more frequent interaction with a teacher to persevere through difficult mathematics. He compared two different days in class with varying degrees of adult involvement: one in which the student teacher stayed with his group for longer, and another (Thursday) in which the student teachers rotated to different groups more frequently, leaving Jake’s group alone for longer. He mentioned that having an adult stay with his group for longer helped them overcome being *stumped*:

> Today we had somebody watching over us, like the BYU student, she was like, looking over us. And so when we got stumped, she was there. But if we had her like that day [Thursday, the day he got *stumped*]–They [the two observing student teachers] were like rotating around on Thursday. So it was like, harder for them to get to us… If we had ‘em like the whole time then that would be easier. (3.136-138)

Outcomes of Inaccessible Mathematics (to Jake)

In every instance wherein Jake did not engage well by his standards, he also did not understand the mathematics very well, and became *stumped* (3.25). This occurred at least once in every class period I observed, which shows us how important the math difficulty level was in influencing Jake's engagement. There were occasions when his peers or an adult helped him overcome being *stumped*. However, when he did not receive help, Jake seemed to react in one of four ways: (1) staying silent, (2) playing on his phone, (3) searching for camaraderie, and/or (4) talking about his hobbies instead of math.

When Jake found the mathematical content more difficult, he sometimes responded by remaining silent. For example, in an aforementioned class, after working on his classwork for the first part of class, Jake became *stumped*; he could not remember how to apply the Pythagorean theorem. As a result, he stared at his paper for a few minutes without making progress until the student teacher asked Maddie to help him. Although he did talk to Maddie briefly once more later on in class, aside from these two interactions with her, Jake did not speak to his group at all during class.

Another way Jake responded when he got stuck working on a tough problem was to distract himself on his phone. During one class, he was in a group with two students he didn't know very well. Despite being repeatedly encouraged by the teacher to work together, Jake said they worked slowly, each finding equations of lines in point-slope form individually (4.11). After getting help from Adrian (who had been sitting in a different group) on the first problem, Jake quickly got *stumped* in his attempts to simplify the equation. He said, "Like putting it into its place in the formula wasn't hard. But like simplifying it I guess was kinda hard" (4.27). Jake then pulled out his phone to Snapchat until he was reprimanded and put it away.

When Jake got stuck on the math content, he occasionally searched for connection with his peers from across the room. “Well, my friend [Ben] was on the other side of the class and we just keep looking at each other” (3.59). This frequently seemed to be an attempt to establish camaraderie either to converse, or particularly so he would not feel alone when he got the wrong answer. Referring to Ben, Jake said: “We were like, some–for some of the things we were like talking to each other, but other parts, we were like making fun of each other for getting the wrong answer or something” (3.67). Once he made eye contact with a friend, Jake seemed to feel more lighthearted about getting the wrong answer. His worry about receiving attention from peers and *shyness* also dissipated. He also sought out another friend, Adrian, to do this same thing: “We just, I guess we just looked at each other when–it's like the same thing with Ben. With Ben and I. It's just like when we got the wrong answer, we would laugh at each other or whatever” (3.148). When Jake saw that he was no longer alone in his misunderstandings, he felt a lot more comfortable with getting the wrong answer.

When the math got too difficult, Jake often engaged in off-topic conversation, whether with the group members he knew, or with his friends across the room. For example, in one class, Jake was placed in a group he did not know well and he became *stumped* on the math. In response, he engaged in a conversation with his friend across the room:

> I remember Ben and I were just looking at each other across the room, and [pause] I don't know. We were just talking about other things than math… I think we were talking about some Fortnite and like, um [pause] soccer. (4.62-64)

In two of the four observations, Jake ended up spending a good chunk of group work time engaged in non-mathematical conversation with his familiar group mates or peers across the room. On the other days, It seemed that when he understood the math (i.e. found it easy), he

most often spent his time completing the classwork and talking with his group about math. If the math was more difficult and no one in the group knew how to approach it, neither Jake nor his familiar peers would talk further about it, instead choosing to engage in off-topic discussions.

Discussion

Jake described engagement largely in terms of talking and completing the assigned mathematics problems. To him, good engagement seemed to consist of mathematics-focused talk within his group that enabled each individual group member to understand how to apply a solution strategy and complete the classwork. He recognized that good engagement might be preceded at times by off-topic discussions to start a conversation before transitioning into a mathematical discussion, demonstrating that he understood the need to draw upon social skills to engage in group work. He had well-defined, clear purposes for engaging during group work, including getting to know people, developing teamworking skills, understanding and completing the assigned math, giving and receiving help, and correcting misconceptions. Jake was also occasionally able to demonstrate this type of good engagement during class group work.

However, Jake did not consistently engage well during math group work. He explained he had a hard time *getting things going*, keeping the conversation going, and staying on task. He acknowledged that he was often confused and got *stumped* on his classwork, and that he typically did not ask for help or share his thinking. Instead, he stayed silent, played on his phone, interacted with friends across the classroom, or engaged in non-mathematical conversations with his group members.

Jake's struggle to engage well in math group work is somewhat surprising given many of the characteristics he possessed that seemed to set him up for success during group work. He enjoyed math and group work, had a good attitude about school, and was open to the classroom

setup. According to interview and observation data, Jake exhibited many traits that most math teachers, especially those who implement group work, see as desirable: he preferred working in groups to individual work, saw teamwork as an important skill, seemed accepting of others, enjoyed talking to and getting to know new people, and wanted to complete his assignments in class. He thought it important to hold mathematical discussions as well as give and receive help within groups. Math was his favorite subject and he demonstrated a desire to learn and understand the mathematical content—at least procedurally—to complete his classwork. He recognized that working with others in groups gave him valuable opportunities to get his questions answered and gain understanding. Furthermore, Jake was cooperative during interviews and seemed truthful about his mathematical understanding and thoughts about class. Although some might argue that Jake's unproductive behaviors during small group work contradict the claim that he wanted to work with others and learn mathematics, we recognize that human beings are complex and their actions may sometimes appear to be inconsistent with their words. Thus, in this study we allowed Jake to speak for himself and trusted the account he gave of how and why he engaged the way he did; because Jake described that he wanted to learn as well as get to know others, we believed him.

Despite having all of these traits, which seemed to set him up for productive engagement in math group work, Jake explained that he was typically pulled away from math group work because the math became too difficult for him to continue. This is corroborated by observation data; he regularly became *stumped* on difficult problems during each of the four class periods I observed. In these instances, he described that the only way he could proceed would be to receive help to understand the math and continue on with his classwork. However, he did not frequently seek or receive such help.

Jake found it difficult to request help from group mates he did not know well. In fact, if he did not understand the math and none of his group mates broached the mathematical conversation, he preferred to stay silent rather than risk being singled out. Despite recognizing that mathematical discussion was vital to good group work, he felt unable to overcome social barriers to start conversations with peers he worried might single him out and judge him for not understanding the mathematics. This worry seemed particularly acute when he perceived that everyone in his group already knew what they were talking about; Jake seemed to worry he would hold them back or receive unwanted attention if he interjected with his own questions or untested ideas. He was concerned that if he was wrong, everyone in his group might give him an "awkward stare" and make him feel *shy*, which he wanted to avoid. As a result of this worry, while he desired to get to know his peers better, Jake seemed to be reluctant to ask unfamiliar peers for help when he viewed them as either unwilling to help him or unable to give him the right kind of help. It appeared that the possibility of receiving help to overcome being *stumped* was not worth the risk of being singled out and judged for his lack of skill or understanding. It seemed Jake only felt comfortable making a mistake when he had friends who made the same mistake, whether in his group or across the room, helping him to not feel alone anymore. Unfortunately, because Jake was unwilling to ask unfamiliar group mates about the parts he did not grasp, he denied himself the opportunity to possibly get the help he needed to understand the material and engage in productive group work.

In contrast, Jake was sometimes able to get help when he worked with familiar peers. Leveraging social capital such as existing relationships and common hobbies typically allowed Jake to engage better with his peers. If he knew his group members, he could draw on their relationship to talk about mathematics because they were already comfortable with each other.

This in turn helped him to progress on his assignments and gain understanding when the math became too difficult for him to do alone. However, this only seemed to happen if one of his group members could help him along. Neither Jake nor his peers seemed to find it helpful to continue a mathematical discussion if they did not know the next step. Instead, they became distracted with off-topic conversations, showing that always being placed with familiar peers would not eliminate engagement issues for Jake.

Jake also struggled to ask adults for help. While he recognized that getting help from his teacher could be beneficial when he became *stumped*, he typically was not willing to ask her for assistance. He admitted to feeling more intimidated by the teacher since she did not make as many mistakes as his peers, which affected his willingness to ask her questions. He expressed that help from group mates was often easier for him to understand. He also seemed to worry that he might receive unwanted attention from his peers if he were to ask the teacher for help in front of them; this could lead to him feeling singled out when he did not know what to do.

As a result of Jake's reluctance to ask his peers or teacher for help, the only way to receive adequate help would be if someone were to notice him struggling and step in to get him back on track. Jake recognized that most of his peers did not seem well-equipped to offer help unsolicited—they either did not notice him struggling, did not have the ability to explain their thinking, or were equally as confused and unable to help. Those who did attempt to help him on their own did not offer the right kind of help to get him back on track, typically providing him with answers only instead of a solution. Jake also felt that such help was often accompanied with judgment and an air of superiority.

While Jake expressed more confidence that the teacher could provide unsolicited help that would assist him overcome being *stumped* and engage more productively, he felt that the

teacher was not often available to them to provide the help they needed. His accounts of interactions between him and the teacher or student teacher suggested that the duration and type of help, as well as when that help was offered during the class period, determined how beneficial it would be to him. For example, when the student teacher was present for an extended period of time at his group, asked students to share their thinking, and provided support so that students could understand each other's thinking, Jake found this beneficial and engaged more productively. Jake acknowledged that the mere presence of an adult who intended to stay until he and his group members talked to each other was enough pressure for them to overcome their discomfort with asking questions or sharing ideas they were unsure of. Also, this help was offered at a time during the class period where students still had a significant amount of time to work together. In contrast, when Jake was offered help by the teacher near the end of the period, the teacher intervention did little to change how Jake and his group members engaged in group work. If we believe Jake's account that teacher oversight could have helped this group, had a focused check-in with the teacher occurred earlier during group work, it may have helped Jake and his group to persevere even when the mathematics became difficult.

The results of this study show that Jake, despite having a positive outlook on both mathematics and group work, was unable to consistently engage productively during math group work. Although we did not conduct interviews with them, many of Jake's peers also appeared to find the mathematics to be too difficult at times, as evidenced by Jake's account that he and his peers started talking about Fortnite when none of them knew what to do. These results show us that it is not enough to simply tell students to work together to answer questions; they may either lack the skills to explain their thinking well or lack the mathematical insights necessary to help their peers understand. It is also reasonable to assume that, like Jake, many other students also

face myriad social barriers, including the desire to avoid being singled out by not bringing too much attention to their perceived shortcomings and incurring judgment from peers. Pairing these together, even students such as Jake who desire to understand and engage well, who see the value in both group work and learning mathematics, are not always able to do so. Clearly, when faced with difficult mathematics and the aforementioned social barriers, Jake did not know how to begin to engage productively or ask for help. According to Jake, teacher help, when offered to him, might have helped him to understand the mathematics in certain instances. However, in a typical classroom, there is only one teacher, and they cannot stand at every table for long periods of time to keep the students on track or help them right when they become *stumped*. Jake's case suggests that student engagement issues cannot be boiled down simply to lack of motivation or desire to learn. Clearly, when we examine student experiences through both observations and interviews, there is far more at play under the surface.

CHAPTER FIVE: CONCLUSION

Summary

Mathematics educators often implement group work in the classroom, but many students do not engage productively during group work. The majority of past research on student engagement has been limited to quantitative, observational, or single-interview studies, which does not allow us to see engagement from a student perspective. In order to address how students engage from their perspective and what explanations they give for engaging in these ways, I performed this case study involving multiple observations and interviews. Open coding and multiple iterations of data collection with one participant, Jake, allowed me to form answers to my research questions regarding how Jake saw his own engagement as well as what reasons he gave for engaging in the ways he demonstrated during observations. While Jake viewed mathematics group work as important, he did not consistently engage well with his group mates. The results showed that Jake viewed good engagement in terms of mathematics-focused talking that led to at least some mathematical understanding as well as completion of the assigned math problems. His engagement seemed to be most influenced by how difficult he found the math, how well he knew the members of his group, how comfortable he felt within a given group or situation, and whether he had access to help from a teacher. He engaged by getting his work done in class and helping his peers when he could, but when he did not understand and get the help he needed, he remained silent at his group, played on his phone, tried to establish a connection with a friend, or talked about non-mathematical topics with his group or peers across the room. Unfamiliarity with peers, math difficulty level, and lack of adequate help seemed to contribute to the unproductive engagement of both Jake and his peers, showing that these might be the areas to focus our attention.

Contributions

One of the main contributions of this study is the method implemented to study student engagement. Past research has used various approaches that have not demonstrated the same scope and breadth of variation in the individual engagement of single students as shown by the approach in this study, as I will explain. Some of this past research employed quantitative data collection, which often focuses on predictive factors for student engagement, testing whether a particular factor has an impact on student behavior in the classroom. These neglect student voice and the variables that students themselves see as most influential in the way they engage; in contrast, the approach used in this study gives space for students to share their perspectives about their engagement. Other studies utilized single observations or standalone interviews. By conducting multiple observations, I was able to see the variety of ways Jake attended to engagement in different circumstances. By conducting interviews in between observations, I allowed Jake to fill in the gaps and answer the questions I was left with from previous observations and interviews, providing a depth to Jake's account of his engagement that I could not have seen by only observing him or interviewing him once. The nuance in the ways Jake described his engagement and the motivations behind his behavior and thoughts was brought out by incorporating multiple interviews (rather than a single interview) as well; in subsequent interviews, I could revisit ideas Jake had mentioned previously that remained unclear, allowing him to bring up new ideas that he had not yet shared.

The methods for data analysis also proved useful in providing deeper insight into student engagement. While current studies in student engagement often use statistical analysis to paint engagement with a broader brushstroke, I found that a qualitative approach to analysis allowed me to see individual engagement in new ways. Past studies that used qualitative analysis used

thematic coding or pre-determined categories, both of which can lead to interesting results. However, by incorporating elements of grounded theory, such as open coding, instead of fitting his experiences into predetermined categories, I allowed the way Jake perceived his own engagement to emerge. While set categories like behavioral, cognitive, and affective engagement were helpful in identifying Jake as a good candidate for this study, analyzing his data with these in mind would limit results to fit neatly within these categories. Instead of starting with clearly-defined categories or assumptions about Jake's engagement, implementing open and focused coding as well as memo-writing created space for messier results that did not fit nicely into categories. This forced me to examine these messy results more closely to understand Jake's perception of his engagement and the driving forces behind it. Through our data analysis, Jake told a richer, more insightful story of his engagement in his own voice beyond what categories or quantitative analysis would allow. His own words became codes, then focused codes, then categories, all emerging directly from his interview responses and triangulated by observation and other interview responses rather than imposed by me. Overall, the methods for data collection and analysis captured more clearly how Jake behaved differently in different settings and with different people as well as why. Since people change and adapt depending on their circumstances, this approach is more insightful and nuanced than a single snapshot approach.

Along with these new methods for examining student engagement, this study contributes new insights into the role of social factors in engagement. Within group work, our results highlight the impact of Jake's familiarity with his peers, his tendency to remain silent or engage in off-topic talk, and how his desire to engage did not outweigh or overcome his desire to avoid being singled out. When Jake felt he could not bring anything of value to the conversation, be that mathematical knowledge or social capital, he did not initiate a conversation with his group,

share mathematical thinking that he was unsure of, or ask for help, for fear of being singled out. Having friends in class who could connect with Jake when he made a mistake helped him to avoid feeling *shy* and becoming self-conscious about being singled out; even the simple act of making eye contact across the room with a friend helped dissipate Jake's *shyness*. This tells us that existing social relationships within classes can be a source of relief from unwanted attention or negative judgment and perhaps help students feel both more comfortable making mistakes and willing to share them.

Another major contribution from this study to the literature on student engagement is how frequently some students become *stumped* on difficult mathematics during group work and as a result, do not engage productively in group work. Jake himself became *stumped* during every class I observed, and described that he had little recourse to engage productively when he was *stumped*. When his group members also did not understand, they all tended to engage unproductively (e.g., by resorting to off-topic talking or silence). Being told to talk to each other by the teacher did not seem to have much of an impact unless the teacher guided them to begin a productive conversation about their answers and methods. That students like Jake who have a good disposition toward mathematical learning could become stuck so frequently and cease to engage productively in group work tells us that positive attitudes toward mathematics and group work are insufficient to support some students to engage productively.

Implications

This study shows us that student perspectives are not only valuable to, but should also form more of the conversation on student engagement. Although current research methods have provided valuable insight into student engagement by surveying a wide range of students, there is a need for additional methods to provide a greater depth of understanding into individual

student engagement. People change; the way they act and feel in different situations is not clear-cut or easily predicted. For this reason, the way we approach understanding student engagement and what drives it must go beyond single observations, single interviews, and quantitative tools for measuring student activity: we need another approach to data collection and analysis to study individual student engagement. The rich results of this study show that students have valuable insights about what engagement means to them and what factors impact their daily engagement, such as how becoming *stumped* and feeling singled out can inhibit good engagement. Student perspectives are not accounted for in the existing literature, indicating a need for new methods to better capture ideas about engagement from the perspective of the student. I propose we allow students to share their perspectives on their own engagement by conducting multiple observations and follow-up interviews, followed by data analysis methods that permit student voice to emerge. To capture the nuance of student perceptions of engagement more authentically as well as augment the current studies performed using traditional approaches to data collection and analysis, I propose more case studies be performed using multiple iterations of observations and interviews. I also propose that open and focused coding be implemented on these additional studies to allow categories to emerge from student words rather than be imposed on the data right away.

While not necessarily novel, another implication of this study is that social relationships (or lack thereof) should not be overlooked in deciding on the best setup for group work. It seems that there may be occasions where social relationships could be leveraged to help students feel more comfortable and able to engage in certain groups. For example, using their own judgment, teachers may choose to keep a pulse on social relationships and place pairs of familiar students in the same group together (avoiding creating groups composed solely of friends to mitigate the

possibility of the whole group descending into off-task talk) in hopes they will feel more comfortable making and sharing mistakes with each other, ultimately learning and progressing on their assignments together while strengthening their existing relationships. This may take some trial and error to determine for which students it is helpful to place them together with familiar peers, and for which students it is unhelpful (e.g., when these students constantly only engage in off-task talk). These social dynamics are also subject to change over time, so in order to leverage them to encourage productive engagement and learning, teachers must be willing to adjust and try new group pairings and approaches to account for these changes.

Where it is unhelpful or not possible to place familiar students together, it may be useful to offer more support in these groups of unfamiliar students to help students overcome behaviors such as tendencies to stay quiet in order to engage with each other. For example, teachers may keep an eye on groups composed of students who do not know each other or are less likely to talk with each other and check with them regularly, asking specific group members to share their solution methods with their group (as opposed to reminding them to talk with each other) and staying with them until a conversation begins to flow. Adult help proved useful to Jake and his groups when they got stuck wading through challenging math problems, so offering it in more abundance could prove useful in motivating more productive engagement within group work. I recognize that there are many social facets of engagement that Jake did not describe as part of his perception of how he engaged; for example, some students may have general anxiety disorder, social anxiety, or mental health conditions that may require care beyond guidance and encouragement to talk to group mates. In these circumstances, it would be important to consult with the school counselor as needed to offer specific supports to these students.

Given that Jake and many of his peers became *stumped* so frequently, it seems that our mathematics tasks could use more scaffolding to help students engage productively even when the math gets hard. Jake and his peers often did not know what to talk about when they did not understand what to do, seeming to believe that they each had nothing to contribute to a mathematical discussion. Incorporating more open-ended tasks including questions breaking each task or problem into fewer steps to guide students' focus may give students opportunities to engage in more difficult problems and begin to think about the underlying concepts rather than whether or not they remember a formula. With these scaffolding techniques, students may find that while they may not have a solid grasp of the whole mathematical process of a certain challenging problem, each of them may be able to contribute in smaller ways to determine how to proceed. This could help them to overcome being *stumped*, or at the very least, help them identify exactly which step they do not understand.

Limitations and Directions for Future Research

One of the main limitations for this study is that, as a case study, it was limited to only one student. While certain aspects of this data can be generalized as part of the student experience, it is unclear how much of it is generalizable. Given the amount of data collected and the level of analysis performed, it was not feasible to collect, analyze, and present results for more than one student in this study. We need many more stories from a diverse population of adolescents in various settings to better understand student perspectives on engagement during group work. For this reason, further research focusing on individual students should be conducted to add their voices to the ongoing conversation about student engagement. More studies will demonstrate which findings can be generalized, while still allowing for nuance of

student voice and fluctuation of engagement over time and across varied circumstances to shine through.

Another limitation of this research is that only four observations and four interviews were conducted to understand the participant's perception of his engagement. While this is far and above what data past researchers have collected for individual students, it is unlikely that the data from this study capture the entirety of Jake's experiences, thoughts, feelings, and motivations for engaging in group work in the ways he did. However, once subsequent interviews with Jake seemed to repeat past ideas without adding too much new content, it seemed adequate to form some conclusions about Jake's engagement without continuing to observe and interview. While I am certain that collecting more data with Jake could have helped us to capture more of his experience and color our results, this could be said of perhaps any other study following human behavior out there. My goal was to better understand student engagement from a student perspective, and the methods with multiple observations and interviews, though still limited to four each, did achieve that purpose through my rigorous data analysis process throughout and following the data collection.

Conclusion

Mathematics teachers who implement group work hope students will engage with each other to learn the mathematics within their groups, but often, students struggle to engage productively and reap the benefits of working in small groups. In this study, we examined how one student, Jake, described his engagement in his own words, which helped us to see how math difficulty level, familiarity with peers, level of comfort in a group, and access to help from the teacher all impacted Jake's engagement in mathematics small group work in nuanced ways. Researchers can uncover new insights about student perspectives on engagement by observing

and interviewing individual students of different backgrounds in various settings. This body of research will help us determine how teaching should be adjusted to better encourage productive student engagement in small groups.

References

Appleton, J. J., Christenson, S. L., & Furlong, M. J. (2008). Student engagement with school: Critical conceptual and methodological issues of the construct. *Psychology in the Schools*, *45*(5), 369-386. https://doi.org/10.1002/pits.20303

Archambault, I., Janosz, M., Fallu, J.-S., & Pagani, L. S. (2009). Student engagement and its relationship with early high school dropout. *Journal of Adolescence*, *32*(3), 651-670. https://doi.org/https://doi.org/10.1016/j.adolescence.2008.06.007

Archambault, I., Janosz, M., Morizot, J., & Pagani, L. (2009). Adolescent behavioral, affective, and cognitive engagement in school: Relationship to dropout. *Journal of School Health*, *79*(9), 408-415. https://doi.org/10.1111/j.1746-1561.2009.00428.x

Ben-Eliyahu, A., Moore, D., Dorph, R., & Schunn, C. D. (2018). Investigating the multidimensionality of engagement: Affective, behavioral, and cognitive engagement across science activities and contexts. *Contemporary Educational Psychology*, *53*, 87-105. https://doi.org/10.1016/j.cedpsych.2018.01.002

Brahier, D., Leinwand, S., & Huinker, D. (2014). Principles to actions: Mathematics programs as the core for student learning. *Mathematics Teacher*, *107*(9), 656-658. https://doi.org/10.5951/mathteacher.107.9.0656

Burrows, P. L. (2010). *An examination of the relationship among affective, cognitive, behavioral, and academic factors of student engagement of 9th grade students* (Publication Number 3420338) [Doctoral Dissertation, University of Oregon]. ProQuest Dissertations Publishing. Ann Arbor. https://www.proquest.com/docview/748836604/abstract/AB07E0B649C144E6PQ/1?accountid=175359

Calder, N. (2013). Mathematics in student-centred inquiry learning: Student engagement. *Teachers and Curriculum*, *13*, 75-82. https://doi.org/10.15663/tandc.v13i0.15

Charmaz, K. (1991). Translating graduate qualitative methods into undergraduate teaching: Intensive interviewing as a case example. *Teaching Sociology*, *19*(3), 384. https://doi.org/10.2307/1318205

Charmaz, K. (2014). *Constructing grounded theory* (J. Seaman, Ed. 2 ed.). SAGE.

Connell, J. P., Spencer, M. B., & Aber, J. L. (1994). Educational risk and resilience in African-American youth: Context, self, action, and outcomes in school. *Child Development*, *65*(2), 493. https://doi.org/10.2307/1131398

Corno, L., & Mandinach, E. B. (1983). The role of cognitive engagement in classroom learning and motivation. *Educational Psychologist*, *18*(2), 88-108. https://doi.org/10.1080/00461528309529266

Dixson, A. D., & Rousseau, C. K. (2005). And we are still not saved: Critical race theory in education ten years later. *Race Ethnicity and Education*, *8*(1), 7-27. https://doi.org/10.1080/1361332052000340971

Esmonde, I., Brodie, K., Dookie, L., & Takeuchi, M. (2009). Social identities and opportunities to learn: Student perspectives on group work in an urban mathematics classroom. *Journal of Urban Mathematics Education*, *2*(2), 18-45. https://doi.org/10.11575/PRISM/35652

Esmonde, I., & Langer-Osuna, J. (2013). Power in numbers: Student participation in mathematical discussions in heterogeneous spaces. *Journal for Research in Mathematics Education*, *44*(1), 288-315. https://doi.org/10.5951/jresematheduc.44.1.0288

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, *74*(1), 59-109. https://doi.org/10.3102/00346543074001059

Furlong, M. J., Whipple, A. D., St. Jean, G., Simental, J., Soliz, A., & Punthuna, S. (2003). Multiple contexts of school engagement: Moving toward a unifying framework for educational research and practice. *California School Psychologist*, *8*(1), 99-113. https://doi.org/10.1007/bf03340899

Gillies, R. M., & Khan, A. (2008). The effects of teacher discourse on students' discourse, problem-solving and reasoning during cooperative learning. *International Journal of Educational Research*, *47*(6), 323-340. https://doi.org/10.1016/j.ijer.2008.06.001

Good, T. L., Reys, B. J., Grouws, D. A., & Mulryan, C. M. (1989-1990). Using work-groups in mathematics instruction. *Educational Leadership*, *47*(4), 56-62.

Horn, I. S. (2007). Fast kids, slow kids, lazy kids: Framing the mismatch problem in mathematics teachers' conversations. *Journal of the Learning Sciences*, *16*(1), 37-79. https://doi.org/10.1080/10508400709336942

Hyde, J. S., Fennema, E., Ryan, M., Frost, L. A., & Hopp, C. (1990). Gender comparisons of mathematics attitudes and affect: A meta-analysis. *Psychology of Women Quarterly*, *14*(3), 299-324. https://doi.org/10.1111/j.1471-6402.1990.tb00022.x

Jansen, A. (2012). Developing productive dispositions during small-group work in two sixth-grade mathematics classrooms: Teachers' facilitation efforts and students' self-reported benefits. *Middle Grades Research Journal*, *7*(1), 37-56.

Jimerson, S. R., Campos, E., & Greif, J. L. (2003). Toward an understanding of definitions and measures of school engagement and related terms. *California School Psychologist*, *8*(1), 7-27. https://doi.org/10.1007/bf03340893

Johnson, R. T., & Johnson, D. W. (2008). Active learning: Cooperation in the classroom. *Annual Report of Educational Psychology in Japan*, *47*, 29-30. https://doi.org/10.5926/arepj1962.47.0_29

Kelly, S. (2007). Classroom discourse and the distribution of student engagement. *Social Psychology of Education*, *10*(3), 331-352. https://doi.org/10.1007/s11218-007-9024-0

Kong, Q.-P., Wong, N.-Y., & Lam, C.-C. (2003). Student engagement in mathematics: Development of instrument and validation of construct. *Mathematics Education Research Journal*, *15*(1), 4-21. https://doi.org/10.1007/bf03217366

Ladson-Billings, G., & Tate, W. F. (2016). Toward a critical race theory of education. In Dixson, A. D., & Anderson, C. K. R. (Eds.), *Critical race theory in education* (2nd Ed, pp. 10-31). Routledge. https://doi.org/10.4324/9781315709796-2

Lietaert, S., Roorda, D., Laevers, F., Verschueren, K., & De Fraine, B. (2015). The gender gap in student engagement: The role of teachers' autonomy support, structure, and involvement. *British Journal of Educational Psychology*, *85*(4), 498-518. https://doi.org/10.1111/bjep.12095

Liu, N.-F., & Littlewood, W. (1997). Why do many students appear reluctant to participate in classroom learning discourse? *System*, *25*(3), 371-384. https://doi.org/10.1016/S0346-251X(97)00029-8

Martin, A. J., Anderson, J., Bobis, J., Way, J., & Vellar, R. (2012). Switching on and switching off in mathematics: An ecological study of future intent and disengagement among

middle school students. *Journal of Educational Psychology*, *104*(1), 1-18. https://doi.org/10.1037/a0025988

Martin, D. B. (2006). Mathematics learning and participation as racialized forms of experience: African American parents speak on the struggle for mathematics literacy. *Mathematical Thinking and Learning*, *8*(3), 197-229. https://doi.org/10.1207/s15327833mtl0803_2

Martin, D. B. (2009). Researching race in mathematics education. *Teachers College Record*, *111*(2), 295-338.

Middleton, J. A. (1995). A study of intrinsic motivation in the mathematics classroom: A personal constructs approach. *Journal for Research in Mathematics Education*, *26*(3), 254. https://doi.org/10.2307/749130

Miller, R., Liu, K., & Ball, A. F. (2020). Critical counter-narrative as transformative methodology for educational equity. *Review of Research in Education*, *44*(1), 269-300. https://doi.org/10.3102/0091732x20908501

Moliner, L., & Alegre, F. (2020). Effects of peer tutoring on middle school students' mathematics self-concepts. *PLoS ONE*, *15*(4), e0231410. https://doi.org/10.1371/journal.pone.0231410

Mulryan, C. M. (1992). Student passivity during cooperative small groups in mathematics. *Journal of Educational Research*, *85*(5), 261-273. https://doi.org/10.1080/00220671.1992.9941126

Mulryan, C. M. (1994). Perceptions of intermediate students' cooperative small-group work in mathematics. *Journal of Educational Research*, *87*(5), 280-291. https://doi.org/10.1080/00220671.1994.9941255

Mulryan, C. M. (1995). Fifth and sixth graders' involvement and participation in cooperative small groups in mathematics. *Elementary School Journal*, *95*(4), 297-310. https://doi.org/10.1086/461804

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Author.

Nawaz, A., & Rehman, Z. U. (2017). Strategy of peer tutoring and students[1] success in mathematics: An analysis. *Journal of Research and Reflections in Education*, *11*(1), 15-30.

Noddings, N. (1989). Theoretical and practical concerns about small groups in mathematics. *Elementary School Journal*, *89*(5), 607-623. https://doi.org/10.1086/461595

Okagaki, L. (2001). Triarchic model of minority children's school achievement. *Educational Psychologist*, *36*(1), 9-20. https://doi.org/10.1207/s15326985ep3601_2

Peterson, P. L., & Fennema, E. (1985). Effective teaching, student engagement in classroom activities, and sex-related differences in learning mathematics. *American Educational Research Journal*, *22*(3), 309-335. https://doi.org/10.3102/00028312022003309

Skilling, K. (2014). *Teacher practices: How they promote or hinder student engagement in mathematics*. Paper presented at the 37th Annual Meeting of the Mathematics Education Research Group of Australasia..

Skilling, K., Bobis, J., & Martin, A. J. (2021). The “ins and outs” of student engagement in mathematics: Shifts in engagement factors among high and low achievers. *Mathematics Education Research Journal*, *33*(3), 469-493. https://doi.org/10.1007/s13394-020-00313-2

[1] This published article includes this typo.

Slavin, R. E. (1984). Students motivating students to excel: Cooperative incentives, cooperative tasks, and student achievement. *Elementary School Journal*, *85*(1), 53-63. https://doi.org/10.1086/461391

Sofroniou, A., & Poutos, K. (2016). Investigating the effectiveness of group work in mathematics. *Education Sciences*, *6*(4), 30. https://doi.org/10.3390/educsci6030030

Uekawa, K., Borman, K., & Lee, R. (2007). Student engagement in US urban high school mathematics and science classrooms: Findings on social organization, race, and ethnicity. *Urban Review*, *39*(1), 1-43. https://doi.org/10.1007/s11256-006-0039-1

Webb, N. M., Nemer, K. M., & Ing, M. (2006). Small-group reflections: Parallels between teacher discourse and student behavior in peer-directed groups. *Journal of the Learning Sciences*, *15*(1), 63-119. https://doi.org/10.1207/s15327809jls1501_8

Whicker, K. M., Bol, L., & Nunnery, J. A. (1997). Cooperative learning in the secondary mathematics classroom. *Journal of Educational Research*, *91*(1), 42-48. https://doi.org/10.1080/00220679709597519

Appendix A: Interview Guides

In this section, I replaced the word engagement with participation; they encapsulate similar meanings in vernacular, but participation seemed more accessible in an interview setting with a junior high student.

Interview 1 Guide

Get to know you

- Can you tell me a little bit about yourself?
- What is your favorite subject in school?

Group work: Purpose & benefits

- I noticed there is a lot of group work in your class. Do you like that? What do you like about group work? What do you dislike?
- From your perspective, what is the purpose of group work in math class?
    - What are some benefits of working in small groups?
    - What are some drawbacks of working in small groups?
- Tell me about what good math group work looks like to you.
- Why do you think your teacher has you work in small groups?
- What makes group work ineffective?

Engagement

- How do you usually participate in group work? How do other students usually participate in group work?
- What does good participation in mathematics look like to you?
- What does it look like for someone/you to participate in math class? In small group work?

- If you were the teacher, how would you determine who is participating well or not in the math/group work?
- How does your teacher expect the students in your class to participate in group work?
- What things are necessary for a group to work well together on a math task?
- What things are necessary for *you* to work well with others on a math task?
- What things influence how much you want to participate/contribute(?) to group discussions while you work in your groups?

Other

- Tell me about your experience with small group work in math class. Is it different from group work in your other classes? How?
- Do you find it valuable to listen to the thinking of your peers in class? Does it help you learn? Why or why not?
- Do you find it valuable to share your own thinking with your partner? With other peers? Why or why not?
- Do you believe any group can work well together? If not, what characteristics must the group members have in order to work well together?

General Post-Observation Interview Guide

- Walk me through today. How did today's class go? How did group work go?
- How would you describe how you participated in today's class? In today's small group work? Why did you participate the way you did?
- Was today typical or atypical for you? In what way?
- I noticed that [this observed event occurred]. Did I see that correctly? Can you tell me more about what happened?

- I saw [this action you took] and it seemed different to me from what you had said before. Does it feel different to you? How or how is it not? Why?
- Does this describe what you told me? Is there anything you want to add? Did I miss something?
- How do you feel about your group right now?
- What is working in your group? What is not?
- How is it working with your small groups now versus before? (in previous classes, or with previous partners)
- Anything else?
- If I understand correctly, [repeat some key points from what they said]. Is there anything you'd like to add to that? Anything you'd like to change to make it more accurate?

Interview 2 Guide

- You mentioned it's easier to talk to people you're familiar with. What if you don't know the people at your group? Have you had experiences with getting to talk with them?
- Are there some people that you're familiar with that you maybe wouldn't want to talk to? Or think it would be harder to talk with them?
- Last time, you mentioned the purposes of group work were teamwork and getting stuff done. Is there anything else? Any other purposes of group work?
- Between teamwork and getting stuff done, which one do you think is the most important purpose of group work?
- Do you think everyone thinks group work is always a good thing?
- Would you ever prefer to work individually or not in a group? Under what circumstances would you prefer to work individually?

- Why is the teacher hard to talk to?
- What does it mean when other students aren't focusing?
- How do other students draw you away? What other things draw you away? Do you ever draw others away?
- What does it mean to contribute in a group? Not contribute?
- Some students don't want to ask questions to their classmates in a group because they feel dumb. Do you ever feel like that?
- Do you usually get things going? Who usually gets things going in your groups? What makes it easier to get things going?
- When do you feel shy? When do you feel less shy?
- Is it always necessary for people to talk to work well in groups?
- If people talk more, does it always mean better group work?

Interview 3 Guide

This interview was performed after two class observations.

- Do you feel like things got going in this group today? How about on Thursday?
- When did you feel like things got going/started going well with the group? Change? Why?
- Were you familiar with your group members?
- What would need to happen for you to get things going in your group?
- You have talked a lot about group work being about working as a team and getting the math done/understanding. Do you feel like you worked as a team today? On Thursday?
- I noticed you didn't talk with your group on Thursday at all. Can you tell me what was going on in your head during the group work? What were you thinking about?

- Does everyone in the group have to be talking or participating in order for things to get going?
- Did you feel shy at all on Thursday? Today?
- Before the break, with Adrian & Luke, what would have made it possible for you to keep going without getting drawn away/talking about Fortnite? What was missing to keep things going?
- You've talked a lot about getting things going in group work, but it seems like you also work individually a lot of the time. Which is more important: teamwork or getting work done? Is getting things going more about teamwork or getting work done?
- Were you ever drawn away from working on the math in group work in today's class? Thursday's?
- Can you describe an instance where you talked with your group about math? What about something else?
- What were you talking about with Adrian across the room?

Interview 4 Guide

- Can you tell me a little bit about what happened in your group today?
- I noticed that Adrian came and asked you what was going on and I think you said, 'I don't know.' Is that right? Then he got some help from Mrs. Wright and talked to you again. Do you remember that? Can you tell me what he was talking to you about?
- I noticed you took out your phone today in class. Can you tell me what you were doing with that?
- Can you tell me what happened for the rest of class?

- What do you think would have helped you to stay focused and keep working in today's class?