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ABSTRACT

This paper reports on the interaction patterns of 12 6th-grade students who participated in a teacher research study on mathematical discourse, presenting data on teacher-student and student-student interaction patterns. It highlights how one white, female student's participation and attitudes changed from passive to less passive between 6th and 7th grade. The study occurred at a suburban Maryland elementary school. Data sources included field notes, lesson and unit plans, transcripts of videotaped lessons, audiotaped interviews of target students, student records, and student work samples. A classroom observation instrument obtained data from the videotapes, which were the primary data source. Data analysis indicated that the target student's mathematical achievement, participation level, and mathematics attitude improved dramatically by the end of 7th grade. Her interaction level and attitude were dependent upon teacher variables. Although many factors contributed to her development and achievement in 7th-grade mathematics, the teacher variable significantly influenced her academic achievement. She credited her success to learning to agree to disagree in 6th-grade mathematics. The results suggest that classroom environment can build girls' confidence in their ability to do mathematics. (Contains 18 references.) (SM)

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FROM PASSIVITY TO PROACTIVITY:
A White Female's Development of Participation and Attitude in Middle School Mathematics

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From Passivity to Proactivity: A White Female's Development of Participation and Attitude in Middle School Mathematics

The topic of gender equity has received considerable attention in this decade (Bailey, 1996). While the gap between males and females has narrowed in mathematics achievement and course taking (Campbell, 1995), some believe that girls continue to be shortchanged at the elementary and secondary levels (AAUW, 1995; Sadker & Sadker, 1994). The school context, which includes curriculum, classroom interaction patterns, and school climate, may perpetuate gender inequity (Avery & Walker, 1993).

Some research studies have shown that females learn and participate in mathematics differently (Buerk, 1985; Campbell, 1995; Tartre & Fennema, 1995). In order to attain gender equity in mathematics classrooms, teachers must do more than call on equal numbers of boys and girls. Elementary and secondary teachers must be made aware of *Women's Ways of Knowing* (Belenky, Clinchy, Goldberger, & Tarule, 1986) and change their pedagogy to encourage activity instead of passivity from all students.

The purpose of this paper is to report on the interaction patterns of 12 sixth-grade target students that participated in a teacher-research study on mathematical discourse. Specifically, data on teacher-to-student and student-to-student interaction patterns are presented. In addition, data is presented to explain how one white female target student's participation and attitude changed during her sixth- and seventh-grade years.

Theoretical Framework

The narrative or sociolinguistic paradigm is believed to provide a framework for teachers to engage in active reflection and to share rich descriptions of their field-experiences with others (Carter, 1993; Eisenhart, 1988). The teacher-research study discussed in this paper used a micro-ethnographic and sociolinguistic approach to examine student participation and mathematical discourse.

Research Questions

The following primary research question guided the main study: How do students' interacting behavior compare and contrast when they engage in mathematical tasks within applied, integrated and abstract settings? After follow-up interviews with the five female participants, a new question emerged. How do passive females become more assertive and increase their level of participation in small group and whole-group mathematics discussions?

Definition of Key Terms

Participating behavior is defined as "an individual's interacting with the teacher and/or peers in a learning context, or engaging in group (large or small) activities in a way that contributes to the ongoing focal activity and is appropriate to the social or academic context in which it occurs" (Mulryan, 1989, p. 447). Pirie and Schwarzenberger (1988) defined mathematical discourse as "purposeful talk on a mathematical subject in which there are genuine contributions and interactions" (p. 461). Tasks are defined as "the projects, questions, problems, constructions, applications, and exercises in which students engage" (NCTM, 1991, p. 20).

Limitations of the Study

Classroom interactions and routines are complex and thus, difficult to capture in a single study. Social norms, teacher beliefs and individual and group status interplay to create a climate for classroom discourse to occur. The analysis of the target students' discourses allowed the teacher-researcher to elaborate on students' participating behavior.

However, no text can fully describe all of the events that occur in a classroom. The use of target students only provides a snippet of the types of discourse and participating behavior that took place during the main study. The findings reveal how these students interacted with their peers and teacher under controlled conditions.

The Setting and Participants

The main study was conducted at an elementary school in suburban Maryland. The population of 95 sixth-grade students was diverse: 69% Caucasian, 25% African American and 6% Asian. Twelve target students (7 males and 5 females) participated in the main study. Sarah was one of the five female participants in the main study.

Methodology

Teacher research provides an opportunity to use micro-ethnography is classrooms. Micro-ethnography allows researchers to apply a zoom lens approach to data collecting (Erickson, 1985). The data sources in this study included field notes, lesson and unit plans, transcripts of videotaped lessons, audiotaped interviews of each target student, student records and student work samples. A classroom observation instrument was used to obtain the data from the videotapes, which were the primary data source. Frequency tables and paired t tests were used to compare and contrast the type and amount of interaction that emerged during each of the three task settings.

Data Analysis

Research shows that gender differences begin to emerge as early as sixth grade in the area of problem solving (Campbell, 1995; Zambo & Hess, 1996). The objective of the main study was to ascertain which type of task setting improved students' verbal participation and thus, problem solving skills. In the main study, the mean problem solving scores on the Maryland Functional Mathematics Test (MFMT Level 1) were 49.27% for males and 41.79% for females in the fall of 1996. However, in the spring of 1997, the mean post-test scores rose to 65.69% and 58.90% for males and females, respectively. Thus, the gender gap decreased by 0.69%.

The teacher-researcher had an eclectic teaching style and presented the students with a variety of tasks that encouraged mathematical discourse. The tasks were described as applied, integrated, and abstract in the main study. Some of the activities the students did during the main study included building a structure (applied task setting), making a hydrometer (integrated task setting) and participating in a discovery lesson on matrices (abstract task setting). Each of these lessons were videotaped and transcribed. Table 1 shows a frequency table of the target students' interactions as they engaged in these tasks. Pseudonyms are used for anonymity and abbreviations are used to classify the students as White male (WM), Black male (BM), Asian male (AM), White female (WF) or Black female (BF).

Table 1

*Target Students Participating Behavior Across Three Tasks (N=12)

Student	Achievement Level	Task 1 (Applied)	Task 2 (Integrated)	Task 3 (Abstract)	Total (All Tasks)
Alfred (WM)	High	27	17	18	62
Philip (AM)	High	19	19	26	64
Calvin (BM)	Middle	23	20	18	61
Earl (BM)	Middle	11	16	15	42
Malcolm (WM)	Middle	24	9	12	45
Louis (WM)	Low	25	11	14	50
Martin (WM)	Low	19	8	7	34
Stephanie (WF)	High	13	16	18	47
Vickie (WF)	High	21	32	20	73
Felicia (BF)	Middle	33	12	14	59
Sarah (WF)	Middle	19	12	12	43
Amanda (WF)	Low	11	18	7	36

*Data collected a 1-minute intervals for a 25-minute period

Results

The mean number of participating behaviors for all target students was 51.33. The mean for males was 51.14 and the mean for females was 51.60. While there is some variability in the level of participation across the three tasks, no significant differences were found when a paired t test was used to compare the participating behaviors of males and females. Although the data show that high-achieving students had greater overall participation, all students participated in each of the task settings.

Table 1 shows that the high-achieving males had the highest level of participating behavior with a mean of 63.00. The middle-achieving males had a mean of 49.33, and the low-achieving males had a mean of 42.00. The mean number of participating behaviors was 60.00, 51.00, and 36.00 for high-, middle-, and low-achieving females, respectively. Since the level of student behavior is a predictor of academic achievement (Cohen & Lotan, 1995), these results are not surprising. However, three white females had a participating behavior rate that was lower than the female mean.

Stephanie, Sarah, and Amy described themselves in student interviews as shy and/or passive. After the study was completed in February 1997, Amy moved to another suburban community in Maryland. Thus, further analysis with Amy was not possible because of attrition, but Stephanie and Sarah were available for further analysis. In the main study, Stephanie and Sarah were observed on the videotape as marginally participating in the mathematical tasks. Furthermore, they stated that they were uneasy about interacting verbally in math class during student interviews.

Girls are more reluctant to participate in mathematics and are often less confident in their mathematical ability (Campbell, 1995). Though passive, Stephanie and Sarah were good math students. During the 1996-97 academic year, Stephanie earned all A's in math, and Sarah earned A/B grades. Because she had the most potential for growth and development, Sarah was a good candidate for further study.

During the course of their seventh-grade year, several white females, including Sarah, wrote letters to the teacher-researcher about their progress in middle school. Sarah reported that she had made all A's in mathematics and passed the MFMT (Level 2).. The teacher-researcher believed that Sarah's story would shed some insight about how passive females can become proactive at a critical juncture in their academic careers. Thus, Sarah was selected for further analysis.

<u>Sarah's Mathematical Development</u>

In the spring of 1997, Sarah scored 52% in problem solving on the MFMT post-test (Level 1). As a result, Sarah was tracked in an average middle school mathematics course in seventh grade. At the end of seventh grade, a follow-up interview with Sarah revealed some startling results. Sarah's mathematical achievement, level of participation and attitude toward mathematics changed dramatically. By the end of seventh grade, she had made all A's in math and scored 100% in problem solving on the spring 1998 MFMT (Level 2). What happened to Sarah over the course of another year to help her achieve this success? In order to answer this question, the teacher-researcher interviewed Sarah in June 1998. Portions of the follow-up interview are presented below.

<u>Interview with Sarah (June 18, 1998)</u>

L: Okay, Sarah, you told me that you passed your Maryland Functional Math Test.

S: Yes, I did.

L: How does that make you feel?

S: It feels good to have accomplished that and knowing I don't have to take it again.

L: You also mentioned that you had made all A's in math this year. What do you think helped you to do that?

S: Um, I think that your rule, agree to disagree, helped me through that because I wasn't afraid to give answers if I thought that they were good, and uh it gives me confidence to raise my hand.

L: Okay, but I remember quite well from last year that your hand would go up sometimes, but after a while you would take it down. How did you compare your behavior last year and now?

S: Um, well I think last year I was real shy and everything, and I wasn't as sure of myself as this year. This year I think I had more confidence in myself and answered more questions.

L: Do you feel like your math skills improved last year and that's what gave you the confidence, or do you feel like it was just the environment and how I taught the class that gave you confidence so that you weren't be afraid to answer questions?

S: Um, I think it was a little bit of both, and um it just helped me out a little bit more.

L: Tell me about the teacher that you had for math this past school year.

S: This year I had Mr. S., and he's been teaching for 30 years. Unfortunately, he retired this year. So we were the last generation her would teach. For warm-up he'd give us this really…you know kind of brain teaser, and we would have to think about it really hard, and he wouldn't get mad if you had the wrong answer as long as he knew you thought about it and had a reason for your answer.

L: Okay. Now that reminds me a little bit about how I taught the class, too. I never got upset if anybody had a wrong answer. As a matter of fact, if they had a wrong answer, I was happy about it because that gave us something to discuss. Do you think that his way of teaching had an impact on the way you participate in math now?

S: I do think it had an impact because um…just reminded me of you and how I knew he wouldn't get mad and everything and I could… It wouldn't matter if I got it wrong just as long as I thought about it, and it made me want to think about my answers, and it made me want to raise my hand and give my answers.

L: Tell me about the math class you just had. Was it an average, above average or high-level math class?

S: Well, my schedule said it was middle math, but Mr. I was teaching us some pre-algebra 'cause the math book said pre-algebra. He also said this was supposed to help prepare us for next year 'cause 75% of our class passed the MFMT, and he thought if he prepared us a little bit this year, we'd be able to do algebra next year.

L: Wonderful! So you had a very challenging curriculum. What kind of math courses do you think you might want to take when you get to high school?

S: Um, I definitely want to do algebra and just like to do the hardest I can get because I like to learn about math and learn these new challenging things to help me.

L: So you are not afraid of math anymore, huh.

S: No, I'm not afraid anymore.

L: Why do think that changed? What happened in sixth grade or seventh grade to change that? What has happened in the last two years that has made you want to challenge yourself to the max in mathematics?

S: Well, I just realized that if I'm one of those people who just sit there and wait for the answer, I'm never going to get anything done in life 'cause I not going to know how to do it. So it's just like I said. That rule to agree to disagree just helped me with the confidence, and now I'm an A math student, and I'm happy about it.

Significance

The major finding in this study is student interaction is dependent upon teacher variables. Although many factors attributed to Sarah's development and achievement in seventh grade mathematics, this study reveals that the teacher variable had a great deal of influence on her academic achievement. Sarah credited her success with learning to "agree to disagree" in sixth-grade mathematics class. This suggests that teachers' influence extends beyond the term of one school year. Students' attitudes toward mathematics and their level of involvement are influenced by teachers' attitudes and the kind of tasks they are given (Bush & Kincer, 1993, Leonard, 1999). Thus, teachers' actions—choice of content, pedagogical content knowledge, teaching methods, and establishment of social norms—impact how students will interact and achieve in the mathematics classroom.

Conclusions

Teachers must be pragmatic and continue to reform their teaching practices in order to influence the interaction patterns of all students, including passive females. The evidence presented in this paper supports the claim that the classroom environment can build girls' confidence in their ability to do mathematics (Campbell, 1995). Teachers must take the time to clarify problems, make historical connections, acknowledge multiple solution strategies, and encourage thinking instead of "correct" answers. This pedagogy will encourage passive students and females to take risks (Buerk, 1985). The strongest single predictor of future mathematics achievement is prior mathematics performance (Tartre & Fennema, 1995).

The traditional way of teaching mathematics has failed at large to make an impact of the achievement of minority and female students. Thus, traditional mathematics teaching perpetuates inequity in mathematics classrooms because high-achieving students and males are most successful in this type of learning environment. Elementary and secondary teachers must change the kind of mathematics they teach and the way they teach if women and minorities are to become active learners of mathematics and science. Once under-represented students are empowered to communicate and to "do" mathematics and science, the road to success will be paved with careers in these fields. Sarah's career goal is to become a veterinarian. Two mathematics teachers influenced her change of attitude about mathematics and schooling in general. If she continues to have supportive teachers, a high-level of self-confidence and academic success, her dream will become a reality. High academic achievement improves students' self-confidence; thus, teachers must create opportunities for all students to succeed in mathematics.

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