MATHEMATICS, CULTURE, AND QUESTIONS:
A STUDY IN THE CULTURE OF THE MATHEMATICS CLASSROOM THROUGH A RANDOM QUESTIONING EXPERIMENT

By

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This work is dedicated to

my children, Julie and Tommy,

who have been with me every step of the way;

to my Mother, Selma;

to those who motivated and inspired me to do this work;

and to all the students and teachers

who have touched my life and made this work possible.

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A STUDY IN THE CULTURE OF THE MATHEMATICS CLASSROOM
THROUGH A RANDOM QUESTIONING EXPERIMENT

By

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This dissertation reports the results of an experiment to test whether removing control of whom to call on from the teacher in high-school mathematics classes, affects students' academic performance in, attitudes and beliefs about, mathematics and levels of classroom participation. In experimental classrooms, students were called on randomly to answer the teacher's questions. In the control classrooms, the teacher decided whom to call on for each question. Students in both intervention and control groups were given standardized academic tests in their subject area and questionnaires about their attitudes toward and beliefs about mathematics. Results indicate that calling on students at random does not affect change in student performance or performance rates, and does not affect their attitudes or beliefs about mathematics. However, ethnicity is a significant factor in accounting for differences in academic performance, in attitudes and in beliefs. White students perform at the highest levels followed by black and Hispanic students. Despite

this, white male students have consistently higher anxiety about mathematics than do their female counterparts. Black students have the highest enjoyment of mathematics and highest motivation scores and Hispanic students have the highest scores on the value of mathematics. Despite this, both groups' academic performance scores are the lowest. Within ethnicity, gender is significant with black and white female students academically outperforming their male counterparts, and the reverse being true for Hispanic students.

Focus group data show that competent teachers who develop a positive working relationship with their students, provide good quality and quantity instruction, and treat students fairly are the most effective; large class size and disruptive student behavior are detrimental to the learning process. Being prepared for and paying attention in class, doing routine homework and study, taking notes, asking questions, and seeking out extra help are the behaviors exhibited by highly successful students, along with a positive attitude. Curriculum offerings are often not broad enough to adequately address the varying needs of the entire student body.

CHAPTER 1
INTRODUCTION

Background

As a high school mathematics teacher in the public schools of north central Florida for the past 20 years, I have had a first-hand opportunity to observe some of the inequities in math education. In the early 1990s I became aware of research by Myra and David Sadker (1994, 1985) and others on gender inequity in mathematics classrooms (AAUW 1992). As I became more familiar with this research, I began my own informal experiments in my classroom. I became more aware of which students I called on to answer questions. I was clearly calling on more male than female students. As I continued to try to remedy this situation, I found that in order to maintain some semblance of classroom order I had to call on more male students to keep them from acting out and to maintain their attention. Later I became aware of further research (Weisbeck 1992) showing that teachers respond to pressure in the classroom. This was clearly what I was experiencing; I was being pressured by male students to give them more of my attention either by answering their questions or by calling on them to keep them in line.

I also became aware of research on women's ways of knowing and the tendency for female and minority students to be what are called *connected learners,* which means that they learn by access to others' experiences and by having a connection with the material, while male students tended to be separated learners who learn individually with little need for connection to the material (American Association of University Women AAUW

1992; Belenky et al. 1986; Perry 1970). I began to consider applications of all this work within my own classroom. I noticed that female students tended to respond to activities that were relevant or connected to their current interests and experience and that they responded less well to applications that were separated from their areas of interest. Given the opportunity to learn within context and alongside other students, the female students seemed to be more involved in the classroom. Additionally I observed that unless heavily coaxed, female students rarely contributed to the question-and-answer portion of the classroom routine. Time and again, female students expressed that they would rather ask me privately for help or that they were too shy or embarrassed to ask in class. Seeing the direct applications of these theories in the mathematics classroom led me to the present area of research.

Research Questions and Objectives

There is real, although subtle, intimidation that takes place in the classroom reinforcing the idea that women and minority students cannot do math as well as white male students can (AAUW 1992). Myra and David Sadker (1994) have shown that teachers tend to call on white male students more frequently than other students, respond to their questions and requests for help differently, and provide them with entirely different experiences in the classroom. This practice is routine across the curriculum but is especially evident in the area of mathematics. It is well documented that women and minorities on average tend to perform to a lesser standard than white men on portions of standardized math tests (AAUW 1998; Croom 1997; Fennema 1996). In addition, the traditional math curriculum is presented at the time that is most developmentally appropriate for male students, putting female students at a distinct educational disadvantage (AAUW 1992).

Built into these practices is the expectation that women and minority students cannot perform as well in the classroom as white male students. This resulting intimidation of female students, for the most part, is not intentional. Nevertheless, like racism and sexism in general, it is a product of history and is part of contemporary American life (AAUW 1998; Leder 1990). John Ogbu (1994) states that lack of opportunity and also attitudes toward minority students and minority students' responses to these attitudes contribute to the poor educational performance of minority students.

Even people who make an effort to rid themselves of sexist and racist baggage find themselves falling into the trap of behaving in ways that perpetuate this problem. Research has shown that even when teachers are aware of these behaviors and genuinely try to change them within their own classroom, these behaviors persist (Roth 1996). The research reported here was an attempt to test the effect, if any, of behaviors among high-school math teachers that inhibit response by young women.

The idea was to take the choice out of the teachers' hands of which student to call on by forcing the teachers to call on students at random. Central to the idea that all students have the same chance of being called upon each time is the expectation that all students have the potential to answer each question. Since Rosenthal and Jacobson's early work on expectancy (1968), research has continued to show that students live up or down to their teachers' expectations. While other factors also affect students' performance, teacher expectations have been consistently demonstrated to both positively and negatively affect student performance (Brophy 1983; Good and Brophy 1987; Goldenberg 1992, 1989a, 1989b; Wentzel 2002).

Central to this issue as well is the idea of equity vs. equality. It is imperative not only that all students receive the same amount of attention in the classroom but also that they receive the kind of attention that is most appropriate for them. The prevailing view in education is that since all students can go to school, they have the same opportunities for success. We know, however, that women and minority students do not pursue mathematics-related careers to the extent that men do. There is a distinction between equity and equality in education. An equitable educational experience implies that students receive the education appropriate for them to achieve a shared standard of excellence as that of their counterparts (Scott 1988). By explaining and documenting students' participatory strategies, perceptions, and behavior in this setting, we will gain a better understanding of the mathematics classroom dynamic, especially as it relates to the question-and-answer component of mathematics education. This knowledge in turn will enable us to implement institutional reforms that will deliver to students an equitable educational experience and equal opportunity to achieve a standard of excellence.

This project has four objectives: to (1) examine how teachers inadvertently communicate the message to students that female and minority students cannot do math; (2) gain a clearer understanding of the mathematics classroom dynamic in general; (3) determine the strategies used by male and female students to ask and answer questions in the classroom environment; and (4) determine the best practices, behaviors, and attitudes of women and minority students who perform at a high level in mathematics. The research will document students' perceptions of the mathematics classroom, document their strategies for participation or avoidance of participation, and test whether the

removal of inadvertent bias in choosing which students to answer questions improves students' attitudes toward mathematics and their academic performance.

A key question is how teachers communicate to students the cultural idea that women and minority students are destined to perform at a lower level than their white male classmates. Another key element of this research is student behavior. Parents and society in general—not only teachers—communicate to children a socially acceptable mode of behavior. Girls are conditioned to "act like a lady," to quietly wait their turn, and to value their relationships with other people. Girls are often the most well behaved students in the classroom. However, this "good behavior" may disadvantage them with respect to learning. Female students are rarely aggressive in the classroom. They sit quietly and wait their turn. In my experience, seldom does a female student exhibit forceful behavior in order to participate in class. By contrast, male students often exert pressure on the teacher by acting out in the class, waving their hands, calling out, interrupting, and generally drawing attention to themselves. In an effort to maintain order in the classroom, teachers respond to this pressure. I hypothesize that there are significant differences among male and female students in their general perception of the mathematics classroom and in their participation strategies.

In my position as a mathematics educator in the public schools of Oak County, Florida, I was in a position to implement a research program in mathematics classrooms to test my hypotheses. I was able to investigate student perceptions, behaviors, and participation strategies using direct classroom observations and ethnographic interviews. These data yield insight into students' perceptions of the mathematics environment. From the experimental data and the focus groups, I was able to examine closely the

culture of the mathematics classroom and the factors that contribute to some groups of mathematics students becoming marginalized.

In this research project I draw on theory and methods from cultural anthropology, educational psychology, and women's studies to examine the effect of teachers' unintentional communication of negative expectations on female and minority students. Additionally, I investigate students' perceptions of the mathematical environment in general and document student participation strategies and behavior in the mathematics classroom.

- Objective 1: To elicit and document students' perceptions and experiences as students of mathematics in order to gain a clearer understanding of students' participatory behavior in the mathematics classroom.
- Objective 2: To elicit and document the best practices of highly successful women and minority mathematics students and to identify and document the attitudes, behaviors, perceptions, and circumstances that contribute to the mathematical success of these students.
- Objective 3: To measure the effectiveness of a random questioning strategy for increasing academic achievement and improving attitudes toward mathematics for female and minority students in a secondary setting.
- Objective 4: To determine the extent to which gender is the primary factor with respect to ethnicity, class, and age for success in the mathematics curriculum.
- Objective 5: To document the effect that use of the random questioning strategy intervention has on teachers' and students' classroom activities and behaviors.

Applied and Theoretical Significance of the Research

Applied Significance

Mathematics is known to be the gatekeeping course for many college preparatory courses in high school and to high-paying scientific and technical career tracks in college. Mathematics even serves as a gatekeeper for athletic clearinghouse scholarship eligibility. According to Sells (1980, 1975), 75 percent of college majors are out of reach

if a student does not have a full set of high school mathematics skills. This affects men of color and women in particular, who tend to engage in high school mathematics at a lower level than white men.

Theoretical Significance

Gender Gaps (AAUW 1998) documented that teachers receive little or no training (less than 2 hours per semester) in gender equity issues from schools of education. Even less time is spent on issues of cultural and ethnic diversity. Established teachers who were trained prior to the recognition of the need for gender and multicultural teacher education have had no such training unless their individual school districts have provided it. Research over the last decade has shown that males, females, and minorities have different classroom experiences, which in turn influence their future career choices (Schwartz and Hanson 1992).

Research by Ma and Willms (1999), Simpson and Oliver (1990), Lipps (1995), Finley, Lawrenz and Heller (1992), and Kahle and Meece (1994) indicates females and minorities express more negative attitudes toward math and science than do males, regardless of their ability. Not surprisingly, classroom experiences influence students' future choices of science, technology, engineering, and mathematics (STEM) related careers.

Attitudes present in the classroom are typically a reflection of cultural attitudes in general. Education can roughly be described as the means by which a culture acquires, transmits, and produces knowledge for its people to function within that culture and adapt to the given environment in which that culture survives. Education is the process by which culture continually adapts and perpetuates its own existence (Levinson 2000). Culturally, the purpose of school is to impart norms such that young people are taught to

live within cultural expectations. Schools teach children to think and act within the expectations of their culture, since thinking out of the box and beyond cultural boundaries is a threat to cultural preservation. This is done within the school setting via what Jules Henry (1963) described as "noise." Noise consists of the lessons a student learns in school that are not directly related to the subject area at hand; that is, children learn many social rituals to help them in a consumption based culture – to hate, compete, benefit from the failure of others, find the best angle, and so forth. School is a place of mass enculturation that serves to maintain the status quo (Henry 1963).

The present research will address the behaviors that contribute to the notion that women and minority students cannot do math and will document students' cumulative lived experience in mathematics class and best practices of successful women and minority students. By addressing these issues, this research will contribute further understanding to the persistently unanswered question of why women and minority students tend to perform to a lesser standard than that of white males in mathematics.

Research Site and Population

This research took place in Oak Grove High School (OGHS) in Oak County, Florida (OGHS and Oak County are pseudonyms). I am a member of the mathematics department and teach at OGHS. This was convenient in terms of carrying out the research, and it also met the requirements of the study in terms of ethnic composition, class, and gender for the research population. Oak County is a highly heterogeneous community in terms of both ethnicity and socioeconomic status (SES). OGHS is one of the county's larger secondary schools and is the most central of the city high schools in Oak Grove. OGHS is an ESOL (English for Speakers of Other Languages) Center with a very heterogeneous multicultural population. Thus, OGHS was an excellent environment

for a series of focus groups with students about what goes on in the mathematics classroom. It was also a place where I could field a quasi-experiment examining the effects of randomly choosing students to answer questions in the classroom on academic performance and attitudes toward mathematics.

Anthropological research requires a different approach than many of the studies cited in this paper, which have utilized surveys as their primary data collection method. This study is a multi-method approach that includes both qualitative and quantitative methodological and theoretical approaches to examine issues of gender and ethnicity in the mathematics classroom. This multi-method approach provides an interesting and thought-provoking platform from which to carry out this research project. Anthropology mandates that the researcher be personally engaged with the research community (Bernard 2002). In other words, anthropologists use participant observation and spend as much time as possible within the research community. Thus, in addition to survey data, experiment data, and student performance data, this study includes extensive ethnographic, or first hand, interviews, focus groups, and researcher observations. The data collected in this study are examined across gender and ethnic lines for comparative analysis on several levels.

The Cultural Context of Oak Grove High School: A Sense of Place

Oak Grove is the cultural center of its region and is described as one of the most desirable places to live in Florida, with a population of approximately 117,000. OGHS is one of three city high schools in its district. The larger district (county) has six high schools in total, including three rural schools. Of the three city high schools, I would describe Oak Grove as the median high school, situated in between the more affluent Buckhead and the lower income area school, Wilston. All three high schools have magnet

programs attempting to lure choice students to their schools. Oak Grove's magnet programs are the Institute of Health Professions where students are enrolled in a specialized curriculum geared toward the allied health professions such as nursing and other medical technical positions. Wilston hosts an International Baccalaureate (IB) program, while Buckhead hosts an entrepreneurial center. Oak Grove is literally the middle of the road school in this area, but OGHS is in the process of bringing a program similar to the IB in an effort to increase funding and bring back to OGHS the advanced students it has typically lost over the years to the upper level program at Wilston. Oak Grove has many of the characteristics of an inner city school despite the fact that Oak Grove is a small city. The students at OGHS range from poor urban minority students living below the poverty level (including some who are actually homeless), to very affluent high-SES students and everything in between these two extremes. As the ESOL center for the region, any students who arrive and cannot pass an English exam are enrolled in the ESOL center until they learn enough English to successfully function in their zoned school. With a high influx of academic, research, and medical personnel in the area, many students of different ethnicities attend OGHS. Given the full range of SES as well as a wide range of ethnicities at OGHS, there is a multicultural atmosphere with a high degree of inclusion and tolerance for others. It is not unusual to see mixed ethnicity couples together in the hallways and at school social events. The gay and lesbian students are not as open as are the mixed-ethnicity couples. There is an unofficial anti-discrimination club that informs students about different religions, ethnicities, and lifestyles. It encourages open mindedness and embraces diversity. The student population at OGHS is quite diverse and seemingly accepting of each other. There are

occasional fights, but for the most part they are not based on race or ethnicity. Over the years there have been what would I term *gang scares* resulting in dress code changes and the banning of all hats and other headgear from campus to avoid tagging with hat brims or bandanas. However, in my experience at OGHS over the past 14 years, I have noticed little obvious gang-related activity.

I have had students who I know have shot someone, and I have had the children of state politicians in my classroom. This heterogeneous mix of students gives OGHS what feels to me a fairly balanced and authentic atmosphere. There is a small but visible contingent of punk–grunge–metal kids who reject any labels but are usually quite intelligent, thoughtful, pleasant students who express themselves uniquely. OGHS has a large and active athletic program with football, basketball, volleyball, and tennis teams that have won state championships. There are two cheerleading squads, a large and award-winning band, and a chorus program as well. OGHS is a well-rounded school with a little bit of everything, socially, ethnically, politically, and in terms of curriculum. I have observed a strong sense of social justice among the student body as well as many voices in the extremes, but all in all it feels like a well-balanced group of students.

Schools are a reflection of and a mechanism for perpetuating the culture in which they are situated. The social imbalances in the community of Oak Grove are reflected in the population of OGHS. OGHS is the oldest and first high school in its district and, while not in its original building, OGHS has existed as a public high school for over 100 years. The other two high schools were built in the 1970s when the black high school, Washington High, was closed and all the city's high school students were re-zoned to these three schools. I have only heard stories, but apparently there were race riots or

close to that when OGHS was first integrated. A young principal, William Daniels (pseudonym), shepherded OGHS through this time and was its principal for nearly 30 years. I firmly believe that the quiet, comradely leadership style of Dr. Daniels had a significant influence on the character of OGHS that still exists today, though he has not been principal there for nearly a decade. He began his school administrative career at OGHS wearing corduroy suits and hair covering his ears in the 1970s and eventually became the district superintendent.

The faculty at OGHS is fiercely independent and headstrong, but it is a fine faculty. Dr. Daniels was an adroit leader and had the unique ability to bring together the collective identity of a diverse faculty for the good of the students and the school. The academic programs at OGHS range from remedial arithmetic and reading to advanced placement courses in all areas of the curriculum. Like all schools, there are the leaders, the troublemakers, the complainers, the competent, and the not so competent on this faculty. From year to year each of these components ebbs and flows, but in general, the faculty, like the student body, is representative of the wider community ethnically, ideologically, and socially. There is a great love for OGHS from those who have known it for a while. Some people detest it and cannot wait to get another job, but for the most part, people are happy to work here and have a sense of loyalty to OGHS and its students.

While OGHS is a pretty good place for most, the social, economic, and educational inequities in the larger culture are reflected and to some degree perpetuated at OGHS. To the casual observer, the social and economic hierarchy is not readily visible, and in general it is a good place to learn and work, which I think contributes to the equalizing effect at OGHS.

OGHS is a place where students who apply themselves have a good chance of school success. However, OGHS does find the lower SES and ethnic minority students in higher numbers in the lower level classrooms with the upper SES and mostly white middle-class students in the more advanced and prestigious academic environments. Hence, while the opportunity for school success is there for most students, it is not without the cultural and systemic barriers found in most United States educational institutions today.

Data Collected

Field Data

Student perceptions and participation strategies in the mathematics classroom were explored via a series of classroom observations and focus group interviews. These data were analyzed for underlying themes and sub-themes. Several of the focus groups consisted of students identified as high-achieving female and minority students. Data collected in these groups were analyzed and assembled into a list of best practices that contribute to the success of students who often are expected to do less well as a result of their gender or ethnic classifications.

Analytic Data

Three teachers were given a hand-held computer (HHC) with randomly generated lists of the names for each class (with replacement). Whenever the teacher had a question, instead of calling on the students whose hands were raised or choosing the students themselves, the teacher called upon the next student on the random list. Thus, each student had the same opportunity to be called on for each question asked in class. When students were called on, they could either try to answer the question or they could just say “pass” with no penalty. The teacher recorded on the HHC whether the student passed or

attempted to answer the question, and, if the latter, answered it correctly. Similar data were collected by classroom observation in control classrooms. Each class, both experiment and control, was given a pre- and post-battery of previously validated mathematics attitudinal and belief survey items as well as pre- and post-academic tests. Student grades were also used as a measure of academic achievement. In this experiment, there are two types of data being analyzed: attitudinal and performance. These data are meant to test whether the intervention affects students' academic performance, beliefs, and attitudes toward mathematics. The data on participation (pass, attempt, correct-incorrect) are meant to test whether the random questioning strategy (RQS) contributes over time to students participating at different levels. Key measures include whether students choose to pass less over time, whether they attempt more over time to answer, and whether they answer correctly more as time goes on.

The additional post-project questions addressed students' experiences with and perceptions of the RQS. They comprised a series of Likert-type items, with a scale from 1 to 5. Students were also free to give written comments about the RQS.

In combination, the qualitative and the quantitative data contribute more than either would alone. It is through grounding the experimental portion of this study in the actual lived experience of the classroom that the RQS results may be interpreted in context (Burns 1979). By interpreting the results of this study within the context in which it takes place, the quantitative data take on a more personal characteristic and the qualitative data are supported by numerical measures.

Organization of Chapters

The balance of this dissertation is organized as follows:

Chapter 2 presents a focused review of the literature and theoretical framework leading to the objectives and hypotheses. Chapter 3 outlines both the quantitative and qualitative research design and methods for this project. Chapter 4 reports the quantitative data from the RQS experiment. Chapter 5 reports the qualitative data from focus groups, surveys, interviews, and participant observation. Chapter 6 brings the quantitative and qualitative data together in a fashion that illustrates how they inform and enrich each other and provides a deeper and richer understanding of the culture of the mathematics classroom.

CHAPTER 2
LITERATURE REVIEW

Throughout the centuries, women and minority scholars of mathematics have been denied access to knowledge, the privilege of publishing their work as their own, and membership in scientific and mathematical societies; and in general they have been omitted from the historical record, thus denying them credit for their achievements. Despite such obstacles some of these scholars have still risen to the forefront in both mathematics and science. Those recognized are but a few of the many who have excelled and not been acknowledged (Adler 1972; Campbell and Campbell-Wright 1995; Fennema 1990; Fordham 1996). Mathematics and science are like works of art: Without context it is often difficult to understand the artist's intention. Supplying that background often makes it easier to understand the work. Similarly, the context of mathematical and scientific achievement gives that knowledge meaning. The absence of women and minority scholars from the historical record leaves a void for students who are often disenfranchised when it comes to the pursuit of mathematical and scientific knowledge. The lack of meaningful role models in mathematics and science leaves these students feeling little or no connection to the discipline and few role models for them to emulate (Fordham 1996; Swetz 1997). This lack of women and minority mathematicians in the historical record has reinforced the societal-level assumption that women and minorities are not adept at math. If they were adept, the reasoning goes, they would be better known.

The under-representation of female and minority role models in mathematics and science leaves these students feeling no connection to the discipline and with few role

models for them to emulate (Swetz 1997). By providing educators with a system that removes gender and cultural bias from questioning interactions in the classroom, this research study is designed to test whether a more equitable educational experience can be achieved.

There continues to be a real, albeit subtle and often unconscious intimidation that takes place in the classroom which reinforces the cultural perceptions that women and minority students are unable to do math at the same level as their white male counterparts (AAUW 1992; Fordham 1996; Spender 1997). Physicist Sally Ride, the first U.S. woman in space, says that many young women and minorities continue to face “subtle obstacles” that block their paths to math and science careers. These roadblocks include educators who place more credence in answers from young men, and school counselors who discourage young women and minority students from taking advanced mathematical courses (Mervis 2001). Myra and David Sadker (1994) have shown that educators tend to enact these behaviors: (1) they call on white male students more frequently than other students, (2) they respond to their questions and requests for help differently, and (3) they provide them with entirely different experiences in the classroom. This practice is routine across the curriculum but is especially evident in the area of mathematics.

The fact that women and minorities on average perform less well than white males on certain math portions of standardized tests is a well documented phenomenon (AAUW 1998; Fordham 1996, Croom 1997; Fennema 1996; National Center for Educational Statistics (NCES) 1998; Young and Fisler 2000). One consequence is that the retention of women and minorities in math and science-related majors declines as the educational level increases (Gray 1996; Rosser 1997; Boland 1995; Leahey and Guo 2001).

Roth (1996) has shown that even when teachers, who pride themselves on being free of sexist and racist baggage, are aware of these behaviors and genuinely try to remedy them within their own classroom, they still find themselves exhibiting behaviors that perpetuate this problem. Weisbeck (1992) indicated that teachers respond to pressure in their classrooms. By focusing on the concept of teachers responding to pressure in the classroom, rather harsh accusations of teachers being blatantly sexist are redirected. This intimidation, for the most part, is not intentional, but a byproduct of specific cultural presuppositions linked to both the historic and contemporary contexts in which we live.

By taking the choice of which student to call on out of the educator's hands by implementing a computer-generated random questioning strategy, the chance that one group of students will be called upon disproportionately will decrease. Central to the idea that all students have the same chance of being called upon each time is the expectation that all students have both the opportunity and the potential to answer each question. The self-fulfilling prophecy first examined over 30 years ago (Rist 1970; Rosenthal and Jacobson 1968) has become somewhat of a cultural icon (Weinburg 1987). The fundamental premise that students tend to live up to their teachers' positive expectations and down to negative expectancies has been supported in the literature, with the caveat of a strong likelihood of possible spurious correlation(s) between teacher expectations, teacher activity, and other possible underlying factors (Brophy 1983; Good and Brophy 1987; Goldenberg 1992, 1989a, 1989b; Wentzel 2002). More effective schools tend to have faculties that hold higher expectations for their students than faculties in less effective schools, and expectancy effects are often predictable for those

teachers who have firm expectations for their students and whose actions in the classroom are guided by those expectations (Brophy 1985). In his case study of teacher expectations, Claude Goldenberg (1992) concluded that it is not necessarily what teachers expect; it is more what teachers do. Hewett (1984) holds that a more fundamental issue is how a teacher defines a situation because individuals define situations according to their perception and then act according to that definition. Additionally, teachers tend to provide more and better learning opportunities to high-expectancy students, often giving less attention to low-expectancy students (Mitman and Snow 1985).

Another way to think about this is via the results of the 1999 TIMSS Video Study (U.S. Department of Education (USDE) 2002). This research suggests that in the United States, we spend more time reviewing previously covered material than five of the six other nations in the study (Australia, Czech Republic, Hong Kong SAR, Japan, Netherlands, Switzerland), and of those countries, the United States has the second lowest score. Results from this study indicate that in U.S. classrooms in the 8th grade, teachers spend over half of their instructional time reviewing previously covered material. If teachers feel it necessary to review over half the time, it stands to reason that the expectations for students is fairly low. Given these data, it appears that there may exist a lower expectation in this country for mathematical excellence than in the other high-performing countries in this study. The highest-scoring countries spend approximately one-quarter of their time in review, with others spending approximately one-third of their instructional time in review. By spending a majority of their class time in review, teachers communicate the expectation that students cannot move on because they don’t know their mathematics well enough, thus limiting their opportunity to excel

at a more advanced rate due to the amount of time spent covering review rather than new material.

When we look at the content preparation for teachers of mathematics in the high-poverty, low-achieving high schools, it becomes apparent that many teachers in these schools are simply not prepared mathematically to take their students further. Mathematics teachers in high-poverty, low-achieving high schools are much more likely to be under-qualified or out of field than in low-poverty, high-achieving high schools (Nation's Report Card 2004, USDE 2004). This lack of subject area preparation for mathematics teachers offers a plausible explanation for the extensive review in U.S. mathematics classes, as many teachers simply are not prepared to teach higher level material and thus cannot take their students further in the mathematics curriculum. Given that women and minorities are often assumed to have a lowered standard of mathematical excellence in the U.S., this research addresses not only the idea of expectancy, but of what it is that teachers do in the classroom. By giving each student the same chance to participate in class, will indicators of academic success, participation levels, attitudes, and academic performance be affected?

Gender differences seem to be the result of social factors most consistently. Many of these differences are the result of different socialization experiences across gender lines (Harway and Moss 1983). Males are encouraged to exhibit aggressive, independent and dominant behavior from birth. This behavior reveals itself in the classroom as they talk out, raise their hands repeatedly, wave at the teacher, and generally display assertive behavior. Such behavior clearly pressures teachers to direct their attention to the male student. Females, however, have been enculturated to be cooperative, follow the rules,

and value the relationship they have with their teacher. Because of this, girls are less likely to pressure their teacher for attention. They are more inclined to raise their hands and wait quietly for attention. If they do not get that attention after several tries, they are not likely to raise their hands again or be aggressive in their quest for knowledge. By following the rules for "appropriate" female behavior, not pressuring the teacher or displaying assertive behavior, the female student works to preserve her relationship with the teacher by "doing the right thing." Girls' good behavior works against them, while boys' bad behavior works in their favor (AAUW 1998; Goldenberg 1992; Guinier 1997).

Teachers, having been societally conditioned in the same manner (Walden and Walkerdine 1985), often hold male and female students to different standards of behavior. Behavior that is often excused for male students, with the rationale that they are just boys, or boys will be boys, would not be tolerated under normal classroom conditions from girls. Girls out of their seats, yelling across the room, interrupting the teacher or other students would most likely be corrected or told to wait their turn quietly in a classroom setting (AAUW 1998). Our society conditions people to believe that mathematics is a male domain and that women cannot do math as well as men (AAUW 1998; Campbell and Storo 1996; Leder 1990).

A substantial body of literature documents the influence of parental beliefs on children's achievement attitudes and academic performance. Parental beliefs and expectations have been related to the child's performance history (Jacobs 1991; Parsons, Adleter, and Kaczala 1982; Entwisle and Baker 1983; and Entwisle and Hayduke 1978, 1981; and self-perceptions of academic ability and achievement expectations (Hess, Holloway, Dickson, and Price 1984; Parsons et al. 1982; Stevenson and Newman 1986).

Others studies suggest that parents and other adults—especially educators—hold culturally based beliefs about the appropriateness of certain behaviors and proper roles for males and females (Connor and Serbin, 1977; Fagot, 1973, 1974; Jacobs and Eccles 1985; Perloff 1977; Boland 1995). In general, parents and teachers have educational expectations that tend to be lower and often do not include the STEM fields for females, and parents tend to attribute a daughter's success to hard work while they attribute a son's to talent (Boland 1995, Grayson and Martin 1988; Rosser 1997; Sadiker and Sadiker 1994; Stage et al. 1985; Weisbeck 1992). These assumptions about suitable gender roles and stereotypes are likely to influence parental and educator judgments about students' academic abilities (Boland 1995; Eccles 1984; Eccles et al., 1983; Jacobs and Eccles 1985). Girls more than boys tend to respond to parent expectations and aspirations for them (Boland 1995), while boys tend to have higher self-concepts with respect to mathematics, and girls tend to have higher self-concepts in regard to reading (Crain and Bracken 1994).

Stanton-Salizar (2001) and Lopez and Stanton-Salizar (2001) indicate that while the parents of low-status Mexican American students tend to have high goals and expectations for their children, they often lack the resources, skills, social networks, or ability to facilitate their children in achieving these goals. The parents of high-achieving Mexican American children have been shown to be less likely to accept lower grades from their children and to model skills related to school success than the parents of lower achieving Mexican American students. While the parents of the lower achieving students held high expectations for their children, they appeared not to understand that Cs and D's indicated that their children were not performing well in school (Okagaki et al. 1995).

Some research suggests that Hispanic students have lower self-concepts that African American and white children (Wasserman et al. 1990), while earlier research suggests that there is no difference (Healey 1969).

Frisby and Tucker (1993) found that in African American students' concept of self-esteem, academics was not a component by which they evaluated themselves. Comparisons of African American and white American students' self-esteem shows that African American students' self-esteem is either higher than that of white students or that there is no difference (Drury 1980; Tashakkori and Thompson 1991; Wright 1985). African American mothers tend to have higher educational expectations for their daughters than for their sons (Oyserman et al. 1995), which may be the result of differences in gender socialization among African American children.

Women and minority students are often encouraged to choose career tracks that are less rigorous and require fewer science and math courses. Furthermore, female and minority students often take only the mathematics courses that are required of them for their high school diploma or for college entrance (AAUW 1998; Feagin, Vera and Imani. 1996; Feagin and Sikes 1994; Leder 1990; Mervis 2001). This societal perception that girls can't do math and that math is a male domain results in girls electing not to further their mathematical careers because they perceive there is no use for them or they will require too great a sacrifice in terms of femininity and family (Gray 1996). Mathematics is a critical filter for most academic success. Low-income and minority students who take algebra and geometry attend college at rates similar to higher SES whites. However, only about half as many low-income and minority students take these courses. In 2003, over half of the black and Hispanic students in the U.S. attended high-poverty schools

compared to only 5 percent for their white peers; and 40 percent of the black and Hispanic student population attended schools where the enrollment was at least 90 percent minority. In addition, these same high-poverty, high-minority schools' students are more often taught English, math, and science by under-qualified out-of-field instructors than their peers in low-poverty and low-minority schools (The Nation's Report Card 2004).

When girls are exposed to successful women models, they tend to have higher expectations of success and spend more time on school related tasks (Campbell 1984). Unfortunately, many minority students often have few meaningful successful role models to emulate (Fordham 1996) and have little motivation to pursue a career requiring more than the minimal math and science requirements (Fordham 1996; Fordham and Ogbu 1986). According to lack of opportunity and teacher attitudes toward minority students and minority students' response to these attitudes contribute to the poor educational performance of minority students.

The 1995 Trends in International Mathematics and Science Study indicates that gender differences in math and science are virtually nonexistent at the 4th- grade level. At the 8th-grade level, differences in mathematics were still minimal but become apparent in science. By the 12th grade, males had significantly higher achievement in mathematics and science than females. Results from the 1999 TIMSS indicate that there were no changes in math and science achievement for boys and girls; however, there were no comparative high school data between the 1995 TIMSS and the 1999 TIMSS (Ansell and Doerr 2000, USDE 1999). Coinciding with this drop in math and science achievement from 8th to 12th grade, researchers have found that girls experience a drop in self-esteem

in their teenage years (Gilligan 1982) and that gender differences in self-concept include higher self-concept in physical abilities and mathematics for boys with girls having higher self-concepts in reading and English (Harter 1982; Marsh 1987; Marsh and Jackson 1986; Byrne and Shavelson 1987; Marsh et al. 1984; Marsh et al. 1985). However, some research suggests that African American girls do not experience the same drop in self-esteem as white females, but that African American girls as a population have higher self-esteem, more positive body image, and greater social assertiveness than white girls. African American girls also demonstrate higher academic performance than their black male counterparts (AAUW 1991). This difference suggests that while gender is a contributing factor in math and science success, gender differences are not universal across ethnic strata.

Over the last two decades the gender gap between male and female math and science achievement scores has narrowed at the elementary, middle, and high school levels (AAUW 2000, 1998; NSF 1999). While an increasing number of women and minorities are pursuing careers in STEM, this progress has been uneven. Girls now appear to meet the achievement and course requirements necessary to enter STEM majors and fields in numbers equivalent to boys. While enrollment in STEM-related majors for women is increasing, young women who do major in the STEM fields drop out of STEM majors at higher rates than young men with the same grades, thus self-selecting out of the system (Boland 1995; Pattatucci 1998; Rosser 1997). However, the same cannot be said about minority students with the exception of Asian/Pacific Islanders (Campbell and Hoey 2002). Less than 50 percent of African-American and Hispanic students

demonstrate the basic knowledge of science and math skills based upon National Assessment of Educational Progress (NAEP) testing (NSF 1999).

Mathematics is known to be the gatekeeping course for many college preparatory courses in high school and to high-paying scientific and technical career tracks in college. Sells (1980, 1975) illuminated the role that mathematics plays as a filter for entering the highest ranks of mathematics and math oriented majors. Seventy-five percent of college majors are out of reach if a student does not have a full complement of high school mathematics. Since mathematics serves as a bridge to high-paying, secure career choices, the avoidance of mathematics and science careers by women and men of color not only has a negative effect on their career choices but also deprives society of a substantial population of creative contributing mathematicians, scientists, and engineers.

There is no obvious biological evidence for cognitive differences in women and men. In terms of general intelligence, there appear to be no differences. In almost all areas of verbal ability, women have the advantage, but at the highest end of the quantitative spectrum, men hold the advantage. It is important to remember that on the whole, males and females are overwhelmingly alike. In the areas where cognitive differences have been isolated, these conclusions are based on aggregate data and cannot be generalized to any one individual due to within-sex variance (Halpern 2000; Sperling 1999).

Given the absence of any conclusive biological evidence for the gap in women's and men's achievement in mathematics, we must turn to other possible sources of the problem. All cognitive data come from testing instruments of one sort or another. All tests are to some extent biased, reflecting the cultural training and life experiences of

those who develop and administer them (Kottak and Kozaitis 1999). Most aspects of our schools, curricula, courses of study, teaching methods, and the subject matter of mathematics were developed primarily by men and reflect the life experiences and goals of men (Damarin 1990). Furthermore, timed tests and mixed testing situations, which are the primary indicators of gender difference in mathematical achievement, have been shown to be biased against girls and women (AAUW 1998; Inzlicht and Ben-Zeev 2000).

In 1995, women accounted for 55 percent of all the bachelor's degrees awarded, but only 35 percent of the degrees in math and computer science. In 2001, women accounted for 32 percent of the degrees in math, computer science, and engineering. Women account for 22 percent of the science and engineering work force but constitute 46 percent of the total work force. This fact is further evidenced by the continued male\female gap in GRE and SAT scores even after they are adjusted for the number and type of math courses taken. The median income for women in 1998 was 76 percent of that for men. These trends are also reflected in the salaries commanded by women in STEM careers (Halpern 2000; Ansell and Doerr 2000; Margolis 2000; Rosser 1997; Spertus 2004). Despite claims from some, the evidence for the gender gap in mathematics achievement is clear. It still exists, but why?

Work by Belenky et al. (1997, 1986) describes five categories of knowing or how people come to know things. Silent knowers accept what they know without stating it; received knowers attain knowledge from authority figures through listening; subjective knowers listen to their own internal voices. Procedural knowers fall into two categories: separate knowers who learn individually, and connected knowers who learn by access to others' experiences and connection with the material. Finally, constructed knowers judge

evidence within context; this is an integration of both the separated and connected approaches to knowing.

Women and students of color are predisposed to being connected knowers (Belenky et al. 1997, 1986; AAUW 1992), while men are more likely to be separate knowers (Perry 1970). Traditionally, mathematics has been taught and approached from a perspective that is congruent with separate knowing, stressing concepts like deductive proof, absolute truth and certainty, and the use of algorithms; and emphasizing abstraction, logic, and rigor. Textbooks have predominantly contained problems focused on traditionally male activities and often lack any mention of minority and female role models. Some publishers have sought to resolve this issue by inserting pictures of women and people of color in the photographs, inserting short bios of successful women and minority scholars, and using multi-ethnic and gendered names in the problems. However, while a step in the right direction, this is just a band aid approach for correcting a much deeper problem. For the most part, the achievements of black intellectuals are absent from academic texts (Fordham 1996). Simply pasting in a few instances of the achievements of women and people of color does not change the fundamental context of schooling or the existing cultural presuppositions about women and minorities and mathematics in the U.S. today. Because of this separated andro- and Euro-centric focus, mathematics texts often seem foreign, contrived, and incomprehensible to female and minority students (Rosser 1995). Because of their lack of connection to their textbooks, the primary method of communication in the mathematics classroom (USDE 1999), many students are put at a disadvantage when it comes to mathematics education.

Educational equity implies quality education and equal opportunities for all students. Factors such as sex, class, socioeconomic status, race, and ethnicity often contribute to unequal educational outcomes. According to Lee, educational equity is "a concern for unequal educational outcomes by social background" (1998:41). The concept of educational equity leads to these questions: (1) Do students receive the most appropriate education to achieve a shared standard of excellence? (2) Do students have the same opportunities on graduation as a result of their educational experience? (3) Do students need the same educational experiences to achieve those outcomes? and (4) Is the same educational experience for all students an equal educational experience? In U.S. culture, the concept of equity vs. equality is difficult since most of the focus is on equality meaning sameness (Scott 1988). However, if the outcomes of an equal education are not equal, then we have failed in providing an equitable educational experience to our students.

Failure to take into consideration the varied characteristics of students in a heterogeneous society is failure to address the educational needs of the populace as a whole. By explaining and documenting students' participatory strategies, perceptions, and behavior in this setting, this research attempts to gain a better understanding of the mathematics classroom dynamic as it relates to questioning. The goal is for this knowledge to enable institutional reforms that will result in a more equitable educational experience for all students.

Mathematics pedagogy has undergone many changes in the last two decades, including an increase in the kind of collaborative learning strategies that benefit females and ethnic minorities (Pearson and West 1991). When parents and educators understand

that females and minorities can succeed in math, their attitudes may change. If educators understand and respect different learning styles and interests, new curriculum models can be developed that reflect the interests of girls and minorities and emphasize practical, real-life applications. Other changes may include an emphasis on more cooperative learning strategies which focus on the process of solving the problem rather than the answer itself, raising teachers' awareness of culturally and gender biased educational material during textbook development and selection, and convincing females and minorities that they can learn and use advanced mathematics professionally outside of the classroom (Schwartz and Hanson 1992).

Theoretical Framework

Critical Race Theory

Throughout history, schools have been some of the most effective instruments for the enculturation and continued oppression of black people in this country (Allen 1991). During the time of legal segregation (1880–1964), even in segregated schools where black teachers taught black students, they were often not under the control of black educators. In a society where segregation and separatism was the norm, students in segregated schools received the message that white was good and black was bad. In order to be educated, an African American had to be enculturated to the ways of the white American, and at the same time, understand that while they were to take on the ideals, ways and practices of the white American, they could never be white and attain the same status as white Americans (Ogbu 1993; Feagin et al. 1996). Despite the implementation of civil rights laws and legislation against hate crimes, five years into the 21st century, symbols of racial intolerance persist in our schools and in society at large. Along with facing this intolerance, black children are often punished for reacting to such symbolism.

Black students tend to be over-policed and are more likely to be punished for breaking school rules than white students (Skiba 2002; Schwartz 2001; Gregory 1995; McFadden 1992; Shaw and Braden 1990; Wiley 1989). African American children are pressured to become, as one student described it, “Afro-Saxon” or to “pass” for white in terms of their clothing, hairstyles, behavior, and language. They are pressured through the imposition of societal norms to abandon their own identity and culture for that of the white American in order to be successful in the educational system, all the while knowing that they will remain in second class status despite giving up their identity for that of the predominant white middle class (Feagin and Sikes 1994; Fordham 2000; Ogbu 1993).

In a similar vein, Fordham (2000) also focuses on students’ response to systemic and institutionalized racism, but she focuses on the identity politics of the situation where she characterizes black women as doubly oppressed. In an educational or business setting, a system of passing exists whereby women and minorities must pass as white men by adapting their behavior, mannerisms, cultural practices, and ways of functioning in the system in order to be successful and accepted by those in power, be it colleagues or teachers and professors. For white women to be successful in a man’s world, they must pass for white men in a sense. Similarly, black men must also pass for white men by taking on their dress, language practices, mannerisms, and so forth. However, within this system of passing, black women are doubly oppressed, as they have to pass as white women passing as white men. Within the educational system, this results in a doubly oppressive situation where black girls’ identity is threatened and therefore more highly rated among young black women. By refusing to conform to the cultural and institutional

norm, “those loud black girls,” as Fordham has termed them, are maintaining their identity within a system of multiple oppressions (Fordham 2000).

Critical Pedagogy

In *The Pedagogy of the Oppressed*, Freire (1968) conceptualizes oppression in an analysis of the mechanisms of oppression within the context of colonialized Latin-American society. The effects of unequal relationships between those with power and the powerless are deeply rooted. Freire describes this effect as cultural invasion. As a result of cultural invasion, the powerless lose their culture and identity. The invaders are perceived as superior and the oppressed group perceives themselves as inferior. As the oppressed take on the culture of their oppressors, the oppressors do the thinking for them. As a result of the oppressed being overwhelmed with the cultural norms and ideology of the oppressors, they tend to become silenced. One of the tools of cultural invasion that facilitates this process is the cultural myth. Freire defines the cultural myth as a lie promoted by those in power to facilitate their position of authority. The needs, knowledge, wisdom, and experience of the oppressed are not considered important and are therefore ignored, devalued, and considered inferior. Such cultural myths are internalized by the oppressed, and they often come to believe that they are ignorant and dependent on those in power (Freire 1998, 1968; Freire and Macedo 1998; Gadotti 1994; Smith 1997).

One mechanism by which the cultural myth is perpetuated in education is through the self-fulfilling prophecy and lowered expectations for the oppressed group. When the overriding cultural myth is exposed for the lie it is, the way is opened for informed action on the part of the oppressed group or individual. It is by rejecting these cultural myths that the oppressed come to a sense of consciousness. Rather than taking the cultural myth

as truth, they come to see the oppressive cultural myth as a lie. Once this lie is exposed and seen by those it has held back, an enlightenment takes place so that the victims of the cultural myth are now able to see the myth and its power, which enables them to understand it and form meaningful strategies to combat its effects. Freire (1968) uses the term *praxis* to indicate informed action as the integration of reflection and action, practice and theory, thinking and doing. Taking action for oneself is taking freedom. In the Freireian sense, freedom means becoming more human and taking on the position of subject rather than object. Freedom is gained through struggle within the individual by transcending the boundaries, of self, and through struggle with others by transcending boundaries set for them by the oppressor and their myths (Freire 1998, 1968; Freire and Macedo 1998; Gadotti 1994; Smith 1997).

One method by which the oppressed take on the position of subject rather than object is by practicing everyday forms of resistance. James Scott (1986) refers to everyday forms of resistance as the constant struggle between relatively powerless groups and those who seek to extract something from them. This type of struggle is rarely characterized by outright defiance but more often by passive forms of resistance such as slow-compliance or false-compliance, pilfering, sabotage, contrived ignorance, and so forth. This type of everyday resistance is often demonstrated in classrooms where students choose not to participate, vandalize school property, cheat, and generally resist doing what is expected of them in the school setting. Since what is expected of them in many ways is to relinquish their ideals, ways of operating in this world, and their cultural identity, refusing to cooperate or slow cooperation within the school system is their way of gaining freedom.

While Freire's work focuses on the mechanisms of oppression, the work of Ogbu illuminates the reactions of oppressed people to their situation. Ogbu characterizes African Americans, Native American Indians, Mexican Americans (early Mexican Americans who were conquered in the Southwest), and Native Hawaiians as involuntary minorities—people who were brought to the United States (or any other nation) permanently against their will as a result of slavery, conquest, or colonization. Once a group becomes an involuntary minority, membership is more or less permanent and is passed down to future generations. Involuntary minorities differ from voluntary minorities in several ways; mainly, voluntary minorities come to the United States or any other country of their own volition for more and better opportunities than those available in their homeland. As a result of this difference, the dual frames of reference for these two groups differ significantly. The voluntary minority has their homeland to look to for comparison to the present situation. They view discrimination as an obstacle to overcome on the path to a better life. The involuntary minority's referent other is that of the white middle class. They view discrimination and second-class status not as obstacles to overcome but as a permanent insurmountable situation. The involuntary minority perceives the ways of the dominant group as a threat to their cultural identity and selfhood within their group. The dual frame of reference of the involuntary minority is oppositional. To take on the behavior and ideals of the dominant group threatens their membership and status within their own group. This oppositional frame of reference tends to be applied in areas where the criteria of performance, competence, and reward are established and evaluated by the dominant group or their minority representatives. Clearly, school is one of these areas.

The effect of school being situated within the oppositional frame of reference is that schooling is perceived as a process by which the involuntary minority, in this case African Americans, is acculturated and that their own culture is displaced. For this reason, some involuntary minority students tend to regard school as tantamount with to the enemy. To adopt the attitudes and behaviors that contribute to academic success can be perceived as rejecting the culture of their group and taking on the culture of the oppressor. Furthermore, there are many examples of involuntary minority students who have adopted the necessary academic attitudes and behaviors and achieved academic success, yet due to discrimination have been denied access to positions for which they are qualified. So, for some involuntary minority students, to do what is necessary to be successful in school is to reject the attitudes and behaviors of their own cultural group and risk rejection by their own group as well as the dominant group (Ogbu 1993; Stanton-Salazar 2001).

The work of Freire and Ogbu offers additional insight into the relationship between gender and mathematics. Freire's ideas on education come from and reflect his perspective on oppression. According to Freire (1968), there are two views of humankind: the objective, where humans are moldable and adaptable parts of the world; and the subjective, where humans are independent and able to transcend and change their world. Freire chooses the latter. Humans can think, reflect for themselves, and disassociate themselves from the world.

Consciousness, according to Freire (1968) has three distinct levels: magical, naïve, and critical. Magical consciousness is characterized by people accepting the will of a superior force, which means accepting life as it is and injustice as a fact of life. People

operating with magical consciousness are silent and docile. People with naive consciousness have gained some insight into their own problems, but this insight remains personal rather than part of a bigger picture. Those who operate within critical consciousness have made connections with the world outside the individual looking at society and its injustices and have reconfigured these injustices as facts, rather than as myths, which can be changed rather than accepted.

Freire (1968) frames his analysis of oppression with respect to the mechanisms of oppression rather than focusing on class. One of the tools of cultural invasion that facilitate this process is the cultural "myth." As an example of a cultural myth, consider the idea that women are irrational and are not as suited as men to rational pursuits. Historically, reflecting this general societal assumption, activities such as mathematics, science, and philosophy, which supposedly require the use of a "rational mind," were considered inappropriate for women. This myth was and continues to be underwritten by religion, education, and other forces of socialization such as various media. Women, of course, were not instrumental in the development of this myth, but many women support it and it continues to keep women oppressed, silent, and excluded from high-status areas of intellectual activity.

The obverse of the irrational woman myth is that men are expert in areas requiring rationality, which supports the fact of men having power in most matters of consequence. Men continue to dominate the system of socialization that supports the continuation of the irrational woman myth and the exclusion of women from positions of power. Many women in American society believe that they cannot participate at the same level in male-oriented activities due to their irrationality despite no real supporting evidence for this

claim and evidence that in some cases, men have been shown to be less rational than women (Penman 2003). Freire (1968) holds that oppressed groups must initiate "cultural action for freedom" in order to escape the culture of silence. Traditionally the content of culture is defined by the bourgeois class, which holds the definition up as the standard by which all other culture is measured. That is, according to Freire, bourgeois culture is defined as the only real culture; all other cultures are deemed inferior. However, according to Freire, culture is a human construct initiated and created by humans through praxis, or informed action. To transcend boundaries one must address boundary situations imposed either by oneself or society. Both boundaries in my opinion are the result of cultural myths, but the difference is who is the imposing force. For example, a subsidiary of the irrational woman myth is the myth that "girls can't do math." A young female student may simply accept that she can't do math the first time mathematics becomes at all difficult for her and stop trying. This is an example of a self-imposed boundary.

An example of a boundary situation set by others would be a young female student who is very gifted in mathematics and has done well throughout her high school career. She has decided that she wants to be a civil engineer and to design public places that are more people friendly and environmentally kind than those she currently experiences. She goes to her guidance counselor and says that she wants to be an engineer. While not directly telling her that this is a man's profession, the counselor repeatedly suggests other majors that she could choose that would help people or have an environmental focus like psychology, nursing, teaching, botany, and resource recovery.

From Freire's (1968) standpoint, freedom would be achieved by both of these students were they to recognize the boundary situation they are experiencing, engage in thoughtful reflection about the boundary, and take action to transcend it. After action has been taken, further engagement in thoughtful reflection and further action would take place. However to achieve freedom, both the internal and the external boundaries must be overcome. To transcend the external boundaries, however, the internal ones must be addressed (Freire 1998, 1968; Freire and Macedo 1998; Gadotti 1994; Smith 1997).

Again, consider the young woman who wants to be an engineer. She leaves the guidance office unsatisfied with the results of her visit but not quite sure why. She thinks about this herself and discusses it with some of her peers and a mentor. She realizes that she is dissatisfied because she has not been heard. Her wants, desires, and interests have been disregarded. She wants to be a civil engineer, but that issue was not addressed. She makes another appointment with the guidance counselor to discuss the academic requirements, financial options, and schools for her to attend in order to become a civil engineer. The counselor again brings up the alternative, "more suitable" careers, but this time the student politely focuses on civil engineering and is firm about her desires and interests and insists on pursuing the career of *her* choice. The counselor is not at all sure that this is the right choice for the student but does provide her with the information requested. After breaking the stereotypical boundary set for her by the guidance counselor and leaving with what she came there for, the student reflects on the situation and on obstacles she may encounter in the future. This young woman is now looking at her life critically and seeing beyond the myth that "girls can't do math" and its parent myth of "the irrational woman." She has exposed the myth for the falsehood that it is.

Research Objectives, Expectations, and Hypotheses

I have embarked on a research agenda that focuses on the culture of the mathematics classroom and on factors that contribute to the persistent idea that women and minorities can't or don't do math. Through ethnographic interviews and observations, these factors can be identified and then tested for their contribution to math performance and attitudes. By grounding my research questions in the material reality of school, I have an opportunity to identify and examine the factors contributing to the inequitable educational outcomes in mathematics for women and minority students. The following hypotheses have grown out of the literature and my experience as an observing participant.

Objective 1: To elicit and document students' perceptions and experiences as students of mathematics in order to gain a clearer understanding of students' participatory behavior in the mathematics classroom.

H_1: There will be differences in students' participatory strategies in the mathematics classroom across gender and cultural lines.

H_2: There will be differences in students' attitudes toward and beliefs about mathematics across gender and cultural lines.

H_3: There will be differences in the attitudes and practices of highly successful women and minority students compared to those of their group that do not succeed at the same level.

H_4: The experiences and perceptions of students in the research population will vary along gender, ethnic, and socioeconomic lines.

Objective 2: To measure the effectiveness of a random questioning strategy for increasing academic achievement and improving attitudes toward mathematics for female and minority students in a secondary setting.

H_5: Implementation of a random questioning strategy will result in increased academic performance and improved attitudes toward mathematics for female and minority students.

Objective 3: To determine the extent to which gender is the primary factor with respect to ethnicity, class. and age for success in the mathematics curriculum.

H_6: Gender will be a more significant variable than ethnicity, class, or age with respect to academic performance and attitudes toward mathematics in a secondary setting.

H_7: Implementation of the random questioning strategy will have the same directional effect for minority students and women.

Objective 4: To document the effect of the random questioning strategy on teachers' and students' classroom activities and behaviors.

H_8: Teachers' questioning behavior will change: The types of questions asked and encouraging behaviors within their questioning interactions will change as a result of the random questioning strategy.

H_9: Students will be more attentive in class.

H_{10}: Students in RQS treatment classes' levels of participation will increase over time.

H_{11}: Students in RQS treatment classes will have more correct answers over time.

H_{12}: Gender will be a more significant variable than ethnicity, class, or age with respect to students' participatory and question answering behaviors in the RQS experiment.

Objective 5: To document best practices data from high-achieving female and minority students.

H_{13}: Attitudes of high-achieving students will be more positive toward mathematics than those of the general study population.

H_{14}: Classroom practices and behaviors of high-achieving students will be different than those of the general study population.

H_{15}: The attitudes and practices of highly successful women and minority students will be closer to those expressed by white males in the research population.

AAUW (1998) suggests that future researchers in this area should analyze educational data by gender, ethnicity, and socioeconomic status (SES) in order to provide a more detailed picture of the STEM experience of all students. This research answers this challenge by addressing seven main objectives: (1) to examine the messages that

educators inadvertently communicate to students that female and minority students cannot succeed in math; (2) to gain a clearer understanding of the dynamics of the mathematics classroom; (3) to determine the participatory behavior of students when answering questions in the mathematics classroom environment, (4) to identify the best practices, behaviors, and attitudes of female and minority students who are high mathematical achievers; (5) to document students' perceptions of the mathematics classroom; (6) to analyze student participation rates; and (7) to test whether the removal of inadvertent gender and cultural biases from educators' questioning practices improves students' attitudes and academic performance in mathematics. In the following chapter I will examine the quantitative and qualitative research methods employed to address these objectives in this study and the supporting methodology behind them.

CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY

Introduction

This is a multi-method study based on both quantitative and qualitative data. The quantitative data are the result of a quasi-experiment to test the effectiveness of a random questioning strategy (RQS) that takes the decision of whom to call on out of the hands of the teacher in the mathematics classroom. This results in each student having the same chance of being called on for each question in the classroom. The qualitative data come from a series of focus groups with students about the mathematics classroom. The focus groups identified students' experiences, needs, desires, behaviors, and suggestions with respect to mathematics and mathematics education. These two kinds of data inform each other and produce a more complete picture of the mathematics classroom than would be produced with either kind of data alone.

Quantitative Research Design and Methodology: The Random Questioning Strategy Experiment

The central question in this project was: Does removing inadvertent bias in teacher questioning practices affect student participation, attitudes, and academic performance in the mathematics classroom? To answer this question, I designed and implemented the random questioning strategy experiment (RQS). In this experiment, the choice of whom to call on during regular classroom activities was taken out of the teacher's hands and determined by a randomly generated list on a hand-held computer (HHC). Each time the

teacher asked a question, rather than choosing the student to call upon, the teacher chose the next student on the list, removing the possibility of bias in calling on students.

The RQS was implemented at OGHS by three teachers, in 25 classes, over 10 weeks during the spring and fall semesters of 2003. The subject areas for these classes were pre-algebra, Algebra I, Algebra II, and Geometry. Each teacher in the experimental group implemented the RQS strategy in all of their classes. One teacher taught five sections of geometry, another taught two geometry honors and three geometry, and the third intervention teacher taught one algebra I honors and three algebra I. Classes taught by two other teachers were used as controls; one teacher had three sections of algebra IA/pre-algebra and three sections of algebra II; the other had three pre-algebra and two geometry.

Data on math performance and attitudes were collected from 453 students in 25 classrooms. There were 292 students in the 14 treatment classes and 161 students in 11 control classrooms. Table 1 shows the distribution of students by gender, ethnicity, and treatment for performance and attitude measures.

Student participation data were also gathered through direct observation of the students' mathematics classes. As students were called on in class, I recorded whether they chose to pass or answer, and if they answered, whether their responses were correct or incorrect. Participation data were gathered on 497 students in 20 classes: 307 students in 14 treatment classes and 190 students in 6 control classes. Table 2 shows the distribution of students by treatment, gender, and ethnicity for the participation data. Students with incomplete data or in ethnic groups other than the three major categories examined in this experiment were not included in the final analysis.

University of Florida Institutional Review Board Approval # 2003-U-72.

Table 1. Performance and Attitudinal Measures Random Questioning Strategy Experiment—Distribution of Students by Treatment, Gender, and Ethnicity

TREATMENT						CONTROL						
White		Black		Hispanic		White		Black		Hispanic		
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total
73	84	44	71	8	12	27	37	32	52	4	9	453

Table 2. Question Answering Behavior Random Questioning Strategy Experiment—Distribution of Students by Treatment, Gender, and Ethnicity

TREATMENT						CONTROL						
White		Black		Hispanic		White		Black		Hispanic		
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total
74	81	48	76	9	12	58	53	26	24	10	10	481

The experimental design was a classic two-group comparison, without randomization. Each of two groups is compared pre- and post-intervention, with control groups receiving no treatment. The National Proficiency Survey in the appropriate subject area and course grades served as measures of knowledge, while the attitudes toward math were measured using two previously validated scales, the Innovative Math Assessment Project (IMAP) (Telese 1993; Dossey et al. 1986) and the Mathematics Attitude Inventory (MAI) (Resnick 1985; Schmid 1985; Sandman 1979; Tapia 1996).

In the classes selected to receive the RQS, teachers were provided with a pre-programmed HHC that had a random list (with replacement) of names for each class for each day. In each class, teachers were asked to carry on their lessons and classroom activities as usual but to select students to call on by consulting the HHC. That is, each time a teacher asked a question, instead of calling on students who raised their hands, or allowing students to call out answers, teachers worked their way through the random name list. For this experiment, students were told that they could choose to pass on any question, with no penalty. Data were collected from the HHCs weekly.

Teachers in control classes were asked to change nothing about their standard classroom method except for giving the pre- and post-test performance and attitude instruments and collecting informed consent forms. Given the resources available for this research, a choice had to be made between having uncontrolled teacher effects and uncontrolled treatment effects. Since the focus of this experiment was to test the effect of the RQS, it was more important to control for treatment effects than teacher. I assigned different teachers to treatment and control classes to avoid diffusion of treatments. However, without further experiments, I cannot assess the effects of this choice.

In the following sections I examine the three different types of data gathered in this experiment: (1) students' academic performance measures as determined by the National Proficiency Survey in Mathematics and by the grades they earned in their respective math classes, (2) level of students' participation as determined by their responses to the RQS and classroom questions, and (3) attitudes and beliefs about mathematics from survey items on the IMAP and MAI.

Performance Measures

- National Proficiency Survey Series
- Student Grades

Student performance was assessed both pre- and post-intervention with the National Proficiency Survey Series (NPSS) in mathematics. Each class was administered the form of the NPSS (Lehmann 1992; Riverside 1989) most appropriate for that course. Students in pre-algebra took the general math test while students in algebra I and II and geometry took the test specifically designed for those respective courses. Students' first and second semester grades, as reported by their teachers, were also compared and

evaluated for change as a pre- and post-experimental evaluation measure of student academic performance.

Participation

Participation was measured for each question event during the RQS by the teacher noting whether or not a student answered a question correctly, attempted to answer the question at all, or chose to pass on a hand held computer. The same data was tallied for control classes by observation using a modified focal individual group scan method (Fragaszy, Boinski et.al. 1992). These data were examined to determine if students were more likely over time to attempt to answer a question rather than to pass. These data were also examined for differences along gender and ethnic lines.

Attitudinal Measures

Attitudinal measures were taken pre- and post-intervention to assess changes in students' attitudes toward and beliefs about mathematics and whether these changed as a result of the RQS intervention. Student feedback regarding the RQS experiment was also collected and evaluated. The post-RQS survey had an additional ten questions pertaining to students' perceptions about the use of the hand-held computer and the RQS.

The scales

Seven scales from two attitudinal and beliefs assessment instruments were used for this portion of the study. Five scales from MAI and two from the IMAP were used to assess student beliefs and attitudes toward mathematics. Mathematics attitudes are conceived as a multidimensional phenomenon; thus, differing scales measuring specific aspects of mathematics attitudes are required (Sandman 1980). The Anxiety Toward Mathematics Scale measures the uneasiness a student feels in situations involving mathematics. The Value of Mathematics in Society Scale measures a student's view

regarding the usefulness of mathematical knowledge. The Self-Concept in Mathematics Scale measures students' perceptions of their own competence in mathematics. The Enjoyment of Mathematics Scale measures the pleasure a student derives from engaging in mathematical activities. The Motivation in Mathematics Scale measures students' desire to increase their knowledge and understanding of mathematics beyond classroom requirements. The Beliefs Scale measures students' beliefs and ideas about mathematics. The Attitudes Scale measures students' attitudes toward mathematics.

The MAI was developed in connection with a large-scale evaluation project supported by the National Science Foundation to measure the attitudes toward mathematics and changes in these attitudes for secondary school students grades 7 through 12. The construct validity of these scales has been supported by extensive field testing. The Cronbach's Alpha coefficients for these scales range from a minimum of .76 to a maximum score of .86, thus establishing factorial validity (Sandman 1980; Schmid 1985).

To insure validity of all scales from the IMAP, all items paralleled questions on the National Assessment of Educational Progress instrument dealing with students' perceptions of mathematics (Telese 1993; Dossey et al. 1988). All forms were coded with the pertinent demographic and group information, scanned, and scored.

Implementation and administration of the scales

Items from the IMAP and the MAI were combined into one pre- and post-survey instrument. All questions were scored on a five point Likert-type scale, with 1 being *strongly agree* and 5 being *strongly disagree*. All items were adjusted to a common format with appropriate items being reverse-scored. Pre-test surveys were administered to treatment and control groups before any implementation of the intervention. Post-test

surveys were administered approximately nine weeks later, at the conclusion of the experiment, for all groups.

Teacher Perceptions and Feed Back

Teachers implementing the RQS were asked to share their experiences with the RQS, their thoughts, feelings, and opinions about the study. How teachers perceive this intervention is critical as they determine the educational methods practiced in their classroom.

Teacher Compensation

Participating teachers were paid time and a half for their participation, up to $700 for teachers in the RQS and $400 for teachers in the control classes. Funds were disbursed only to those who remained with the project until its completion and all data and equipment had been turned in and accounted for. The teachers recruited for this project were colleagues known to me who indicated a willingness and desire to participate in this study.

Validity and Confounds

There are potential confounds in the experiment caused by a number of factors. Intentional and unintentional verbal and non-verbal behaviors by the teacher who used the RQS could affect the study. Clearly, certain inflections of voice or body language could communicate teachers' attitudes, cultural biases, and expected responses. Verbal cues and nonverbal communication are a fact of life in experiments involving human subjects. Certainly, both intentional and unintentional nonverbal and verbal cues occur in such a setting. To avoid a diffusion of treatments confound, the decision was made that teachers would have either treatment or control classes, but not both. Since all students

in the study did not have the same teacher, there is the possibility of an instrumentation (teacher) confound. However, teacher effects may offset each other.

The maturation confound is another possibility. Over the period of the experiment, students surely came to understand the experiment better. They also learned more of their subject than they knew at the beginning of the experiment—a simple function of schooling. This can be accounted for with control classrooms.

Mortality was also an issue in this study, as there were both student and teacher participants who chose not to remain a part of the study to completion. Every effort was made to isolate these effects in the data analysis.

The focus of this study was on the one thing that was feasible to control: which student gets called on to answer a question. The hypotheses are sufficiently robust and the data and analysis rigorous enough to overcome these classroom subtleties.

Limitations

Field research is complex and messy, and performing such research in a public high school, with its many bureaucratic impediments, can be a challenge. Although consent and approval of the school district was obtained for this research project, it involved working with minors, which requires permission slips signed by parents to use each child's data in the analysis. This was much more difficult to achieve than anticipated. The original project design was for approximately 750 students. However, signed informed consent forms were obtained for only about 500 students. This is a sufficiently large sample for data analysis, but there is no way to determine if there is any systematic bias in non-responders.

The original timetable for this study called for initial implementation in late January. However, actual implementation did not get under way until early March. This

pushed the experiment out to the end of the school year—a time when students may not have taken the assessment instruments as seriously as they would have earlier in the year. Also, the original two teachers with control classes failed to complete the study, making it necessary to collect the control data in the fall of the following year.

The original design called for using free and reduced lunch data as a proxy for SES. However, the SES and ethnicity data were too similar to make a distinction between them.

The accuracy of data collection was not as consistent as it needed to be to provide unequivocal answers to the research questions. Some teachers were much more diligent than others in collecting the demographic information and informed consent forms and in administering the pre- and post-evaluation instruments. In replications of this research, I would have a research assistant go into each classroom to give uniform directions on filling out the consent forms and demographic information forms and to maintain a uniform testing environment for all instruments.

Finally, this research took place in one Florida high school with 5 teachers and approximately 750 students over a period of ten weeks. Generalization beyond this context is inappropriate. However, the results reported in the following chapters indicate that further studies of this nature are clearly in order.

Qualitative Research Design and Methodology: The Focus Groups

Introduction

High schools are complex organizations, where the students, teachers, administrators, and staff often have conflicting needs and demands (Burns 1979). The results of the RQS experiment must be interpreted within the complex reality of the setting in which it took place.

One of the great contributions of anthropology to the social sciences is the insistence that researchers be engaged with the research community through participant observation and cultural immersion. As a researcher who is also a member of the culture being studied, I bring certain insights to the analysis of the RQS experiment that would not necessarily be apparent to an outside researcher. On the other hand, being a member of the culture has its liabilities: It is easy to miss important behavioral cues because they seem so ordinary, and it is easy for colleagues in the school to take the experiment less seriously than they might if the researcher were a stranger. Anthropologists often work directly with people as both advocate and researcher (Burns 1993). In the ongoing dialogue over equity in public education, the voices of many stakeholders are heard. However, perhaps the most important voice, that of the student, is often over looked. Both Burns (1989, 1993) and Emihovich (1999) address the importance of giving voice to the stakeholders in a given situation. Competing interests and differing perspectives require that as many voices as possible be heard. Transformation, collaboration, and policy reform occur through testing groups' different meanings against each other until consensus is achieved. Through these focus groups, not only have I attempted to illuminate the culture of the mathematics classroom from the students' perspective, but I have attempted to give an often unheard population—the population mostly affected by educational policy—a voice. To gather as much information from as many students as possible with the least disruption to students, teachers, and classroom schedules, formal focus groups were implemented for this part of the study.

Methodology

It has been my experience, as an educational anthropologist who has done many ethnographic interviews with students, that while they are usually willing to answer my

questions, they often don't feel totally free to express themselves. Students were with their peers in the focus groups conducted for this project, and they appeared to feel much more at ease expressing themselves and volunteering information that they thought would help me understand the mathematics classroom than student informants with whom I had previously conducted individual interviews.

Focus groups are interviews with a small group of people covering a specific topic. They usually consist of six to eight relatively homogenous people who are asked to speak to questions asked by the interviewer over a period of time ranging from one to two hours. Focus group participants not only answer questions with their own individual responses; they are also exposed to others' responses and can make additional comments based on what others say, often enriching their initial response or that of another group member. The focus group interview technique was initially developed for market research in the 1950s with the understanding that consumer decisions are often made in a social context (Merton 1990). Similarly, the act of schooling takes place in a social context, making the focus group a fitting and highly efficient qualitative data collection technique appropriate for gathering the desired data.

Focus groups also provide some quality control in the data collection process because they come together on the most important topics and issues at hand, weeding out inaccurate and extreme views. Furthermore, focus groups tend to be fun and enjoyable for the participants. Focus groups have many advantages, but they also have some weaknesses. The number of questions that can be asked is limited due the large number of responses. Differing personality types require that the facilitator be skilled in managing the interview so that it is not dominated by a few people and so that less verbal

participants get a chance to speak. There may also be personality conflicts and diversions as well as threats to confidentiality if people know each other in the group. However, a skilled interviewer can usually redirect the conversation back to topic and remind participants that all comments are to remain confidential. If someone is uncomfortable with the possible lack of confidentiality, that person may choose not to participate. When focus groups are implemented carefully and in an appropriate and respectful manner, they are efficient and provide an interview setting that lies within the social context of schooling, allowing for the gathering of perceptions, outcomes, and the impact of those outcomes as students experience them in the mathematics classroom (Patton 1990).

Ethnographic Methods

There were 13 focus groups about students' experiences in the classroom with a total of 89 students participating. Students ranged in age from 14 through 19 and were enrolled in the 9th through 12th grades at OGHS. The focus groups were held on three topics: general experiences in the mathematics classroom (G), best practices (BP), and white males (WM). There were three BP focus groups with a total of 22 students who were identified by their teachers as high-achieving minority and white female students. There were seven G focus groups, with a total of 54 minority and white female students. These students came from both the general and honors curriculum and had indicated that they would be willing to participate in a focus group about mathematics. There were two (WM) focus groups with a total of 13 students from the general and honors curriculum who had indicated their willingness to participate in a mathematics focus group. There were a total of 27 black females, 13 black males, 6 Hispanic females, 1 Hispanic male, 29 white females, and 13 white males. All racial/ethnic categorizations are reported as the

students' self identified race/ethnicity or are from school records when self-identification data were not available.

The BP comprised students who traditionally have lower math scores than their white male counterparts: white females, and black and Hispanic females and males. This group was specifically selected to identify the behaviors, practices, and attitudes that contribute to the success of these groups of students that are generally expected to do less well. The general group (G) consists of the same groups of students as the BP group; however, these students are not high achievers in math. This group was selected in order to get better insight into their experiences in the mathematics classroom. The white male (WM) group is typically the most academically successful group and the group to which all less academically successful groups are compared and to which white females, and black and Hispanic females and males are considered "others." Table 3 indicates the make up of each of the focus groups.

Table 3. Student Focus Groups: Perceptions and Experiences In the Math Classroom
Distribution of Students by Group, Gender, and Ethnicity

Date	**Category**	**BF**	**BM**	**HF**	**HM**	**WF**	**WM**	**Total**
4/30	BP	1	1	1		2		**5**
5/1	BP	4				4		**8**
5/2	G	1	1	3		2		**7**
5/6	G	1	3			3		**7**
5/7	G	4		1	1	3		**9**
5/8	G	2	2			4		**8**
5/13	BP	3	2			4		**9**
5/14	G	5	1	1		2		**9**
5/15	G	2	2			3		**7**
5/16	G	4	1			2		**7**
5/19	WM						4	**4**
5/21	WM						8	**8**
5/22	WM						1	**1**
Totals		**27**	**13**	**6**	**1**	**29**	**13**	**89**

B = Black H = Hispanic W = White F = Female M = Male
BP = Best Practices G = General WM = White Male

Focus groups involve from 5 to 15 participants from a pre-identified group of people. Under the leadership of a facilitator, focus group members are asked to respond

to a pre-determined set of questions on a specific topic during approximately 90 minutes. Participants are usually given an incentive of some sort to encourage participation and to compensate them for their time and contributions (Schensul 1999). Students who were identified as either high-achieving minority or female students and students from the general student population who were willing to participate in focus groups on math were given a slip of paper by their mathematics teacher inviting them to a free pizza and soda luncheon that would take place during an extended lunch period. All students responding favorably and returning informed consent forms were given a free lunch of pizza and soda as they participated in the focus group process. All focus groups were conducted by trained anthropologists with specific objectives, procedures and practices for conducting and evaluating the focus groups in a uniform manner. I directed most of the focus groups. Four focus groups that contained students in my classes were directed by a fellow anthropologist and co-researcher who is trained in ethnographic field methods. The idea was to create an environment in which all students would feel free to express themselves honestly. All focus groups were initiated with the leaders identifying themselves and asking participants to identify themselves and give verbal assent to participate in the focus groups. This was followed by a brief description of the purpose of this research project and how the focus groups would work. Students were assured of their confidentiality and anonymity. After all the students had settled in with their lunches, the interview began with a grand tour question (Spradley 1979) on what it is like to be in their math classes. They were asked to think not just about the classes they were currently enrolled in but also about their experiences with mathematics over the years they had been in school. Students were asked to talk about practices and procedures that

they liked and didn't like, things that helped them to learn and things that made it more difficult to learn, and anything they felt pertinent to helping me understand the culture of the mathematics classroom from their perspective. The list of questions for the focus groups is shown in the Appendix. Students were initially encouraged to begin the conversation after the grand tour question with a prompt such as, "What do you like about your math classes?" and letting the conversation go on from there with the group leader facilitating the flow of information and allowing the participants to speak freely as well as including the specific questions for the interviews. This process allowed for the gathering of specific data of interest as well as letting the students bring up their own topics, interests, concerns, and complaints, giving a more in-depth look into the mathematics classroom from their perspective.

Variables

The focus groups were not intended to provide data for quantitative analysis. Nevertheless, the same three major variables are important for both the focus groups and the RQS: gender, ethnicity, and success in the mathematics classroom. By comparing data from across the three focus groups, we can illuminate the practices of those minority and female students who perform at the highest levels in mathematics.

Limitations

Implementation of the focus groups went very smoothly except for the day that only one student showed up, and that focus group became an individual interview. Most of the focus groups had students from different classes so that few students in a group had the same teacher. In a few of the focus groups, most of the students did have the same teacher for the same subject. There were times in these interviews where it turned into a free-for-all against their teacher. The students in these groups who did not have the same

teacher were shouted over as the others used the safe atmosphere of the focus group to vent about their teacher. The data gathered in these groups were valuable for the study, but these groups were more difficult to handle and the tapes were more difficult to transcribe because it was often difficult to tell who was speaking. Having either a second group facilitator take notes or having the facilitator insist that all informants give their names or some identifying information before speaking each and every time would help to avoid this difficulty. Doing this, however, could easily interfere with the easy conversational flow of the focus group.

An in-depth examination and analysis of the RQS and focus group data gathered in this project appears in the following two chapters.

CHAPTER 4
RESULTS FROM QUANTITATIVE PORTION OF THE STUDY: THE RANDOM QUESTIONING STRATEGY EXPERIMENT

Introduction

This chapter addresses the analysis of the quantitative data generated in the RQS experiment. Here I will look at the academic, attitudinal, and participation data from the pre- and post-academic tests, student grades, attitudinal scales, and question answering data from RQS experiment. These data will directly address the following hypotheses:

H_2: There will be differences in students' attitudes and beliefs toward mathematics across gender and cultural lines.

H_4: The experiences and perceptions of students in the research population will vary along gender, ethnic, and socioeconomic lines.

H_5: Implementation of a random questioning strategy will result in increased academic performance and improved attitudes toward mathematics for female and minority students.

H_6: Gender will be a more significant variable than ethnicity, class, or age with respect to academic performance and attitudes toward mathematics in a secondary setting.

H_7: Implementation of the random questioning strategy will have the same directional effect for minority students and women.

H_{10}: Students in RQS treatment classes' levels of participation will increase over time.

H_{11}: Students in RQS treatment classes will have more correct answers over time.

H_{12}: Gender will be a more significant variable than ethnicity, class, or age with respect to students' participatory and question answering behaviors in RQS treatment classes.

Academic performance and attitudinal data were analyzed in a series of ANOVAs and t-tests to determine the effect of the RQS on student achievement and attitudes toward mathematics. Participatory data were analyzed using odds ratios and backwards stepwise regression to determine the effect of the RQS on student questioning behavior. As mentioned in the previous chapter, performance and attitudinal data were gathered from 453 students in 25 classes, including 292 in the 14 treatment classes and 161 in the 11 control classes. Table 4 shows the distribution of students by treatment, gender, and ethnicity of performance and attitudinal measures in the RQS experiment. Participation data was based on student participation in the classroom to determine whether students' participation patterns changed as a result of the RQS. Participatory question answering behavior data consisted of 497 students in 20 classes, including 307 in the 14 treatment classes and 190 students in the 6 control classes. Table 5 shows the distribution of students by treatment, gender, and ethnicity for participatory behavior data.

Table 4. Performance and Attitudinal Measures Random Questioning Strategy Experiment—Distribution of Students by Treatment, Gender, and Ethnicity

TREATMENT						CONTROL					
White		Black		Hispanic		White		Black		Hispanic	
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
73	84	44	71	8	12	27	37	32	52	4	9

Table 5. Question Answering Behavior Random Questioning Strategy Experiment—Distribution of Students by Treatment, Gender, and Ethnicity

TREATMENT						CONTROL					
White		Black		Hispanic		White		Black		Hispanic	
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
74	81	48	76	9	12	58	53	26	24	10	10

Data Classification and Variables

Three types of data were gathered in the RQS experiment: academic performance, attitudes toward math, and response by each student (pass, answer correctly, or answer incorrectly) when called upon in class.

The classification variables are treatment, teacher, course, ethnicity, gender, age, grade, and SES. The variable treatment is whether or not a student received the RQS. *Teacher* is the instructor each student was assigned. *Course* was the math course that the student was enrolled in at the time of the experiment. *Gender, ethnicity, age,* and *grade* were all determined by student reports unless this information was missing or unclear, in which case these data were gathered from school records. Free and reduced lunch status was used as a proxy for *SES*. Students on free and reduced lunch were categorized as lower SES than those on full pay lunch. Age, grade and course are all highly intercorrelated, so I used course to represent this grouping. Course may comprise mixed grades (an advanced 9th grader can be in a class that has mostly 11th and 12th graders in it, while a 9th grade class can have lower level 12th graders in it trying to make up credit deficits), but since math knowledge is cumulative, I chose course as my measure of development as it is a less variable way of classifying students than age or grade. Outcome variables are repeated measures Time 1 (T1) and Time 2 (T2), and pre- and post-test, measures for academic performance (NPSS), class grades, and seven attitudinal and belief scales with respect to mathematics. The scales measured anxiety toward mathematics, the value of math in society, self-concept in mathematics, enjoyment of mathematics, motivation in mathematics, beliefs about mathematics, and attitudes toward mathematics.

The most appropriate statistical tests for these data are paired sample t-tests for bivariate analyses and analysis of variance (ANOVA). Both are part of a family of tests that seek to determine how much of a measurement for individuals can be attributed to the particular sub-groups they are in. These tests compare mean scores across groups and determine if they are statistically different when group variances are taken into consideration. Analysis of RQS participatory data was accomplished using odds ratios and multivariate logistic regression in an effort to develop a main effects model. All analysis here takes *p*-values less than or equal to .05 as significant. Analysis was done with SPSS 10.0.5 (1999) and SYSTAT 10.2.1 (2002).

Inherent in the design of this experiment are three basic confounds. First is the interaction between teacher and treatment. I chose not to assign the same teacher both treatment and control classes to avoid a diffusion-of-treatments confound. Unfortunately, it is difficult to separate teacher effect from treatment/control effect. To minimize this confound as much as possible, several assumptions about the data and research design were made for this part of the analysis. While we know that the attitude and belief scales are probably intercorrelated since they were administered on one instrument, all analysis is done under the assumption that the scales are independent of each other. These assumptions affect the Type I experiment-wide error rate, the likelihood of incorrectly rejecting the null hypothesis, but these assumptions will allow a clearer picture of this situation and guide future research. The first step in this analysis was to determine if there is a significant difference in scores for treatment and control groups.

Academic Performance Measures

National Proficiency Survey—Mathematics

Using paired sample t-tests, assuming different group variances, students' scores on the National Proficiency Survey in Mathematics were significantly higher from T1 to T2 for both the treatment and control groups. This change is to be expected, as learning is the point of schooling. For the treatment group, $t = 3.387$ and $p = 0.001$ with 234 degrees of freedom. For the control group, $t = 3.203$ and $p = 0.002$ with 130 degrees of freedom. Comparing the data on test score change *between* treatment and controls, however, reveals that there is no significant difference in performance scores. (The t-statistic comparing treatment and control groups is -0.36, $p = 0.718$ with 309 degrees of freedom.)

Variation as a result of treatment, ethnicity, and gender may have been obscured in the t-tests, so all of these classification variables were entered into an analysis of variance. The ANOVA results confirm that none of the factors (ethnicity, treatment, gender) accounts for change in test score from T1 to T2.

Student Grades

ANOVA also confirms that treatment, SES, gender, and ethnicity had no effect on change in semester grade, and there are no significant interaction effects on grade changes.

Discussion of Academic Performance Measures

In summary, none of the predictor variables (treatment, SES, ethnicity, and gender) either alone or in any combination, was a significant predictor of academic outcomes as measured by the NPSS Mathematics or in student grades.

Participatory Measures

Data on individuals' participation in RQS and control classrooms were analyzed using odds ratios with logistic regression to investigate two questions: Are students in the treatment group more likely to participate than those in control groups? and Are students who participate more likely to answer correctly over time? The logistic regression approach is the most appropriate and powerful statistical method for answering these questions. It also allows us to determine what the key predictors of participation and answering correctly are and it eliminates the need for simpler univariate analyses.

Results of this multivariate model indicate that none of the key predictors—gender, ethnicity, class, grade, treatment, or control—individually or in any combination—were significant in predicting the outcome participation variables. Based on the data collected in these classrooms and using this statistical approach, it is impossible to determine if students in RQS classrooms perform any better than students in control classrooms. The main effects model did not fit the data well enough to make any determinations. At this point, these data do not suggest any particular characteristics that may help to predict classroom participation. In other words, there is no clear evidence that the RQS increases participation. There is also no evidence that the RQS increases the number of students' correct answers.

Discussion of RQS Data: The results of the RQS data indicate that we cannot determine what individual characteristics may contribute to participation in these classrooms. In other words, there is no evidence that a particular gender, ethnicity, or grade level participates more or less in either the RQS classrooms or the control classrooms. This suggests that the bias suspected in control classrooms may not be

present. Teachers may have some means of moderating possible biases with pedagogical approaches and techniques that are not readily apparent.

Attitudinal and Belief Measures

Each class was administered a pre- and post-attitudinal survey with seven scales measuring students' attitudes, beliefs, and ideas with respect to mathematics. The scales were (1) anxiety toward mathematics, (2) the value of math in society, (3) self-concept in mathematics, (4) enjoyment of mathematics, (5) motivation in mathematics, (6) beliefs toward mathematics, and (7) attitudes toward mathematics. The post survey had an additional ten questions pertaining to students perceptions of the hand-held computer random questioning strategy that was administered only to treatment groups to gather additional information on how the students felt about the intervention. These data are addressed in the next chapter.

Evaluation of Survey Data

All analysis for survey data was performed in the same manner as the performance measures using ANOVA in order to determine which variables or combination of variables had a significant effect on attitudinal scale scores between T1 and T2.

Anxiety

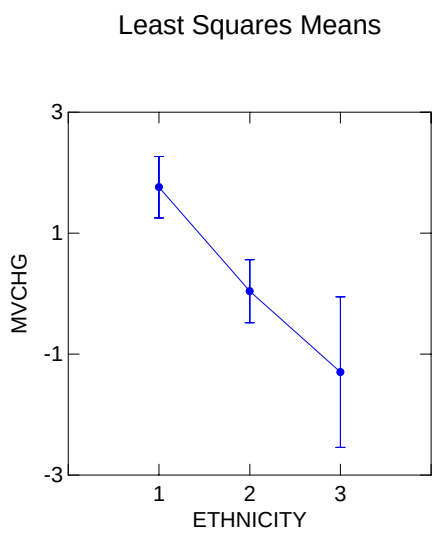
The Anxiety Toward Mathematics Scale measures the uneasiness a student feels in situations involving mathematics. Neither ethnicity, treatment, nor gender significantly account for change in anxiety; nor were there any significant two- or three-way interactions.

Math Value

The Value of Mathematics in Society Scale measures a student's view regarding the usefulness of mathematical knowledge. Variation in math value change is accounted

for by ethnicity (F= 4.59 and p= 0.011 with two degrees of freedom). The F-statistic reveals that ethnicity has a significant effect on the change in math value scale scores between pre and post surveys. The average change for white students' scores is approximately 1.5 scale points, with black students' mean scale change at or near 0, and Hispanic students' mean scale change was approximately -1 scale points. Treatment/control and gender were not significant factors for this scale; nor were there any two- or three-way significant interactions.

In the graph shown in Figure 1, ethnicity is on the horizontal axis with 1 for White, 2 for Black, and 3 Hispanic. On the vertical axis is change in math value scores. Examining this graph, we see that white students' math values changed positively, black students' math values hardly changed at all, and Hispanic students' math value scores changed negatively.



1–White 2–Black 3–Hispanic

Mean Change in The Value of Mathematics Scale

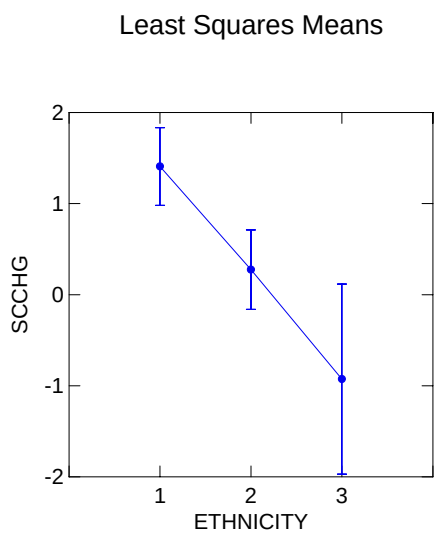
White	Black	Hispanic
1.5	±0	-1

Figure 1. ANOVA—The Value of Mathematics Scale By Ethnicity

Self-Concept

The Self-Concept in Mathematics Scale measures students' perception of their own competence in mathematics. Variation in self-concept is accounted for by ethnicity. F = 3.288, and p = 0.039 with two degrees of freedom. The average change for white students' scores is approximately 1.5 scale points, with black students' mean scale change positive, but at or near 0, and Hispanic students' mean scale change was approximately -1 scale points. Treatment/control and gender were not significant factors for this scale, nor were there any two- or three-way significant interactions.

In Figure 2, ethnicity is on the horizontal axis of the graph, with 1 for white, 2 for black, and 3 Hispanic. On the vertical axis is change in self-concept scores. Examining this graph one can see that white students' math values changed positively, black students' math values had a positive change, but near 0, and Hispanic students' math value scores changed negatively.



1–White 2–Black 3–Hispanic

Mean Change in The Self-Concept in Mathematics Scale

White	Black	Hispanic
1.5	±0	-1

Figure 2. ANOVA—The Self-concept in Mathematics Scale By Ethnicity

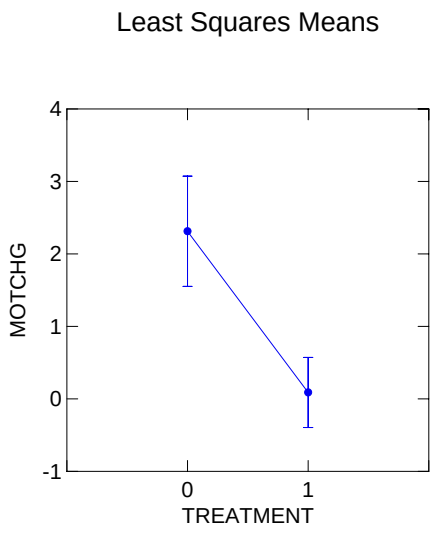
Enjoyment

The Enjoyment of Mathematics Scale measures the pleasure a student derives from engaging in mathematical activities. Neither ethnicity, treatment/control, nor gender significantly account for change in enjoyment; nor were there any significant two or three way interactions

Motivation

The Motivation in Mathematics Scale measures students' desire to increase their knowledge and understanding of mathematics. Three of the four questions on this scale that factor load the highest have to do with the desire to do some mathematical work beyond classroom requirements (Welch and Gullickson 1973). Hence, the motivational construct of this scale must be interpreted within this limited meaning. Variation in motivational change is accounted for by treatment. $F = 4.50$ and $p = 0.035$ with one degree of freedom. Ethnicity and gender were not significant factors for this scale. The average change for treatment students' scores was near zero scale points, with control students having a mean scale change of approximately 2.3 scale points. There were no two- or three-way significant interactions.

In the graph shown in Figure 3, motivational change is on the vertical axis and treatment/control on the horizontal axis, with treatment being 1 and control 0. Note that for motivation change, the treatment group has almost no change, while the control group's motivation increased. These results appear to indicate that the RQS had a negative motivational effect on students. This could also be due to the possibly confounding effects of teacher or timing as mentioned previously.



1 = Treatment 0 = Control

Mean Change in Motivational Scale Scores

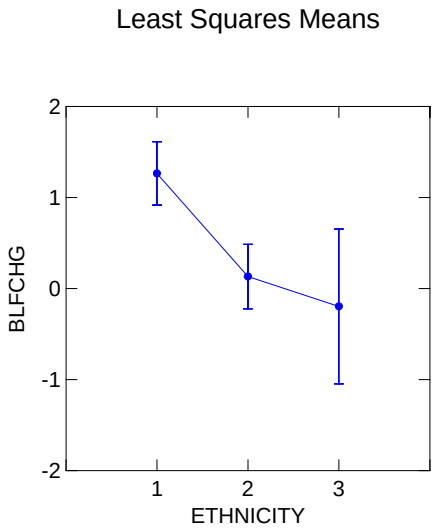
Treatment	Control
±0	2.3

Figure 3. ANOVA—Motivation in Mathematics Scale Treatment vs. Control

Beliefs

The Beliefs Scale measures a student's beliefs and ideas about mathematics. Variation in change in beliefs is accounted for by ethnicity. F = 3.397, and p = 0.035 with two degrees of freedom. The average change for white students' scores is approximately 1.25 scale points, with black students' mean scale change being positive, but at or near 0, and Hispanic students' mean scale score negative, but also at or near 0. Treatment/control and gender were not significant factors for this scale; nor were there any two- or three-way significant interactions.

In Figure 4, we see change in beliefs with respect to ethnicity. Beliefs is on the vertical axis while ethnicity is on the horizontal axis with 1–White, 2–Black, 3–Hispanic. For white students, the change is positive, for black and Hispanic students the change is zero or negative but nearly zero.



1–White 2–Black 3–Hispanic

Mean Change in The Beliefs About Mathematics Scale

White	Black	Hispanic
1.25	±0	±0

Figure 4. ANOVA—Beliefs About Mathematics Scale by Ethnicity

Attitudes

The Attitudes Scale measures students' attitudes toward mathematics. Neither ethnicity, treatment, nor gender significantly account for change in attitudes toward mathematics; nor were there any significant two- or three-way interactions.

Discussion of Survey Data

Gender did not significantly account for change, as expected, on any of the scales. However, in all scales that did show significant change, ethnicity was a significant factor, accounting for that change in all but one. These were the math value, self-concept, and beliefs scales. Treatment accounted for significant change on only one scale: motivation.

Ethnicity accounted for significant change on the Math Value, Self-Concept, and Beliefs scales. The changes between T1 and T2 shown on these scales were positive for white students, near 0 or negative for blacks, and in each case negative for Hispanics.

The aim of this portion of the study was to test whether or not an intervention such as the RQS, which gives all students equal access to participate in the question asking and answering process in the classroom, would increase performance and improve attitudes of women and minority students. These results indicate that this is not the case. Gender did not emerge as a significant factor associated with changes in beliefs and attitudes about mathematics, as expected. These results show that change between T1 and T2 are very similar for females and males, indicating that no gender-related differences are apparent in these data. However, ethnicity was a significant factor for several scales, as was expected, and this indicates that changes in T1 and T2 scores are very likely related to ethnicity for those scales.

Change on the Motivation Scale is accounted for by treatment. Motivation for the treatment group has very little change, while motivational change for the control group increased. Regardless of these circumstances, motivational change is accounted for by treatment, indicating that either the RQS had no effect on motivational scores or those scores were a function of timing, teacher, or any number of other factors. However, one can conclude that the RQS did not have a significant effect on motivational change. In future research, implementing controls for the timing and teacher confounds will give us a clearer picture of this situation.

Between-Group Comparisons

After analyzing the pre- and post-test and survey data for change as a result of the intervention, it became clear that knowing the differences between gender and ethnic groups at T1 and T2 would be informative to this analysis. Pre- and post-comparisons between all groups, white, black, and Hispanic by gender were compared to get a better

picture of how each of the groups compared with each other at T1 and T2. In this section I will give a brief report of the results with interpretation to follow.

A series of t-tests shows that on both T1 and T2 data for all groups, females had significantly higher academic performance than males. On the attitudinal and beliefs items, females scored higher than males on the self-concept scale on the pre-survey. However, there was no significant difference in scores by gender on the post-survey for self-concept. On the enjoyment, motivation, beliefs, and attitudes scale, there were no significant differences related to gender. The t-tests were supported by a series of ANOVAs. All analysis is by ethnicity and gender, comparing mean rankings for each group.

Looking at the between-group comparisons, the change in ranking and comparison of certain rankings leave some interesting questions to be addressed. On most of the items it appears that white and black students' score rankings showed little change from T1 to T2. while Hispanic males' score rankings tended to increase and Hispanic females scores tending to decrease over time.

Mathematical performance—NPSS mathematics

On the subject area tests, as illustrated in Figure 5 below, white students performed the best both pre-and post-test, with black students having very little change in their standing. However, from T1 to T2, Hispanic females' rankings decreased dramatically and Hispanic males' rankings improved. Looking at these scores strictly by ethnicity, they are as expected, but when we examine the effect of gender within ethnicity, the dimension of gender emerges. While one could speculate as to what is affecting Hispanic females' scores from T1 to T2, something is contributing to their decreased performance

that is different from white and black students and Hispanic males whose rankings remained relatively the same or improved.

Examining the graph below, note that on the pre-test for all ethnic groups, female scores were higher than male scores, but on the post-test, one can see that that while all scores increased, the increase in Hispanic males' scores was much greater than that of Hispanic females.

Pre-Post Subject Area Test		
Ranking	**Pre**	**Post**
1	WF	WF
2	WM	WM
3	HF	HM
4	BF	BF
5	HM	BM
6	BM	HF

Key: B=Black W = White H = Hispanic
M = Male F = Female

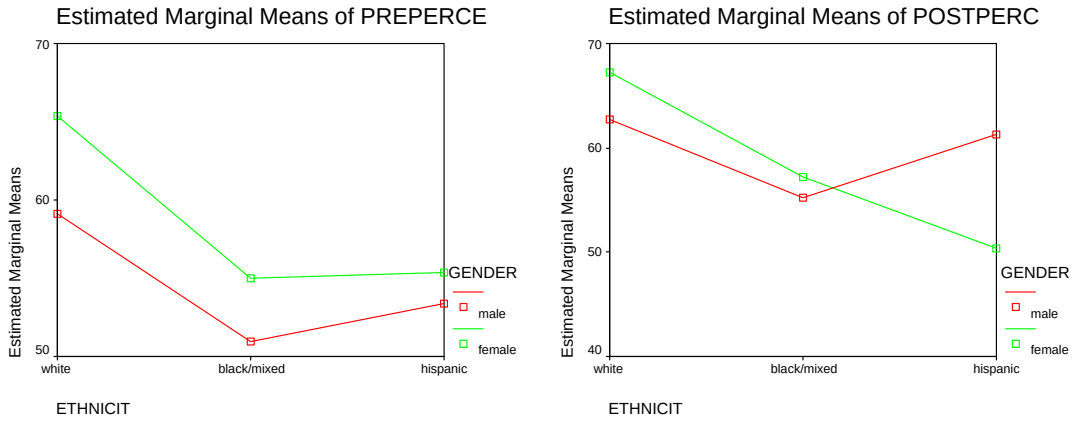


Figure 5. Between Groups Pre- and Post-Test Rankings National Proficiency Survey—Mathematics

Math anxiety

As shown in Figure 6 below, this trend continues on the anxiety scale, with very little change in the ranking of black and white students, but Hispanic females' anxiety ranking went from the lowest score on the pre-survey to the highest on the post-survey.

Pre-Post Anxiety Scale		
Ranking	**Pre**	**Post**
1	WM	HF
2	BF	BF
3	WF	WM
4	BM	WF
5	HM	BM
6	HF	HM

Key: B=Black W = White H = Hispanic
M = Male F = Female

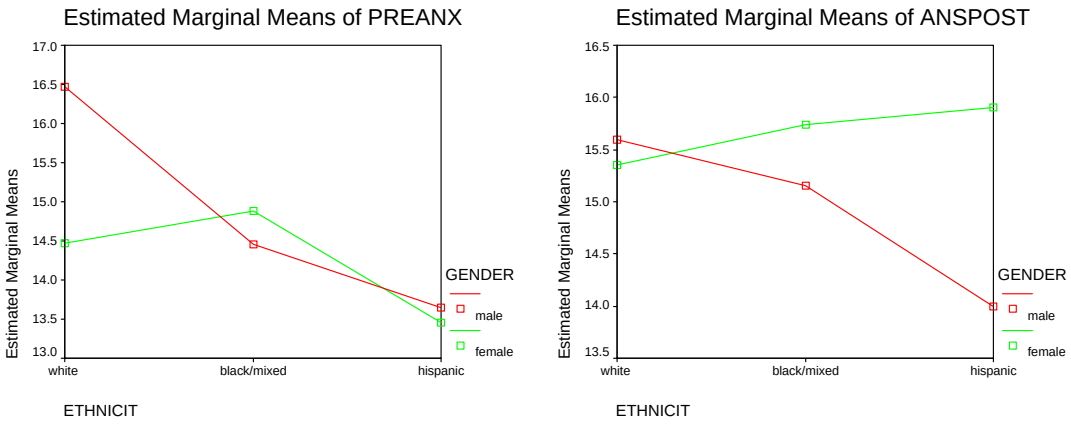


Figure 6. Between Groups Pre- and Post-Test Rankings
Mathematics Anxiety Scale

Examination of the graphs in Figure 6 illustrates that on the pre-anxiety scale, white males had the highest anxiety rankings and Hispanic females the lowest, but on the post-anxiety scale, white males' anxiety dropped, with white females' anxiety increasing. However, the most drastic change is the change in Hispanic females' anxiety rating, which went from the lowest on the pre-survey to the highest anxiety ranking on the post-survey.

Value of mathematics

For math value, illustrated in Figure 7, Hispanic students ranked the highest with no change pre- to post- survey, with very little change in the other groups with the exception of black females' math value ranking, which fell from third to sixth in the rankings.

Pre-Post Mathematical Value		
Ranking	**Pre**	**Post**
1	HM	HM
2	HF	HF
3	BM	BM
4	BF	WF
5	WF	WM
6	WM	BF

Key: B=Black W = White H = Hispanic
M = Male F = Female

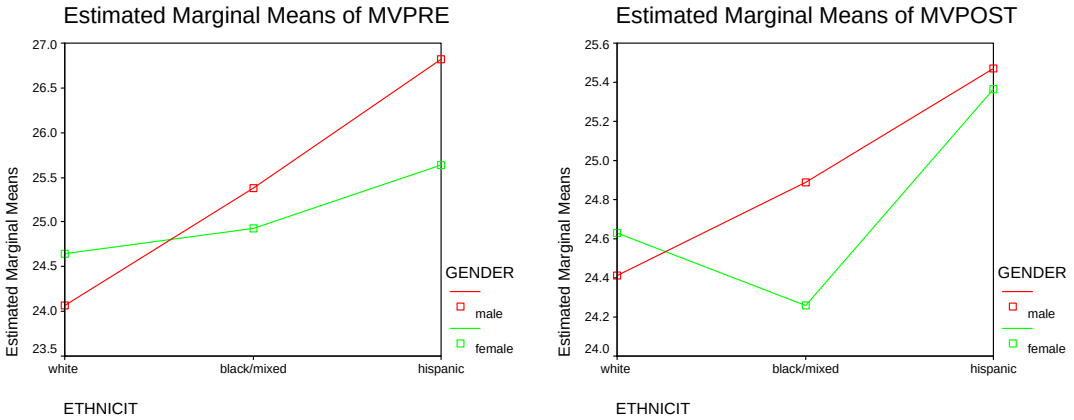


Figure 7. Between Groups Pre- and Post-Test Rankings
Mathematical Value Scale

In the graphs in Figure 7, note that on both pre- and post-surveys, not only were Hispanic students' math value scores the highest, but the Hispanic females' scores got closer to those of their male counterparts over time. Also, note the drop in black females' scores, illustrating their drop from fourth to sixth place in the rankings from T1 to T2.

Self-Concept in mathematics

The sizeable drop for Hispanic females was again apparent on the self-concept scale (Figure 8), with white females ranking the highest both pre and post and white males having among the lowest math self-concepts. Black students' rankings had very little change.

Pre-Post Self-Concept		
Ranking	**Pre**	**Post**
1	WF	WF
2	HF	HM
3	HM	BF
4	BF	WM
5	BM	BM
6	WM	HF

Key: B=Black W = White H = Hispanic
M = Male F = Female

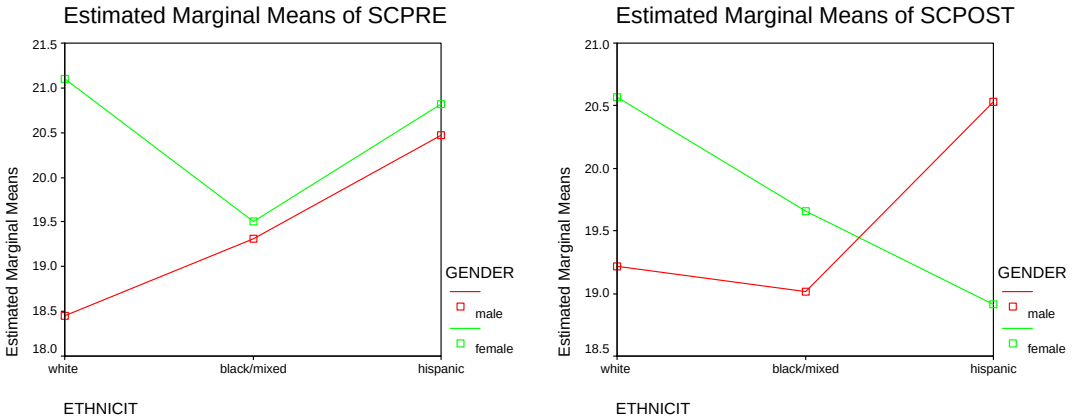


Figure 8. Between Groups Pre- and Post-Test Rankings Self-Concept in Mathematics Scale

Examining the graphs in Figure 8, note that at T1, Hispanic students' scores were among the highest of all the groups, but at T2 Hispanic females' scores dropped to the lowest of all groups and the gap between black students' self-concept scores in mathematics increased over time. Also note that white males' self-concept in mathematics scores is among the lowest at both T1 and T2.

Enjoyment of mathematics

Black students scored the highest on the math enjoyment scale both pre- and post- with white students' rankings among the lowest on both implementations with Hispanic students showing very little change from T1 to T2, as evidenced in Figure 9.

Between Groups Pre- and Post-Rankings
Enjoyment of Mathematics Scale

Pre-Post Enjoyment		
Ranking	**Pre**	**Post**
1	BF	BF
2	BM	BM
3	HM	HM
4	WF	HF
5	HF	WM
6	WM	WF

Key: B=Black W = White H = Hispanic
M = Male F = Female

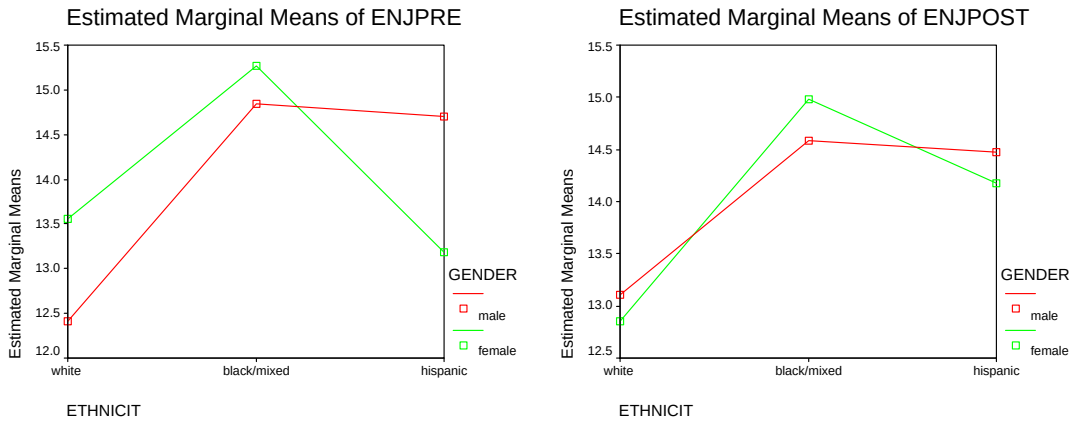


Figure 9. Between Groups Pre- and Post-Test Rankings Enjoyment of Mathematics Scale

Examining the graphs in Figure 9, note that their shapes have very little change from T1 to T2 except for white females' scores dropping below those of white males and Hispanic females' scores rising closer to their male counterparts. Also note that from T1 to T2, black students' enjoyment scores remained consistently higher than all other groups.

Mathematical motivation

Mathematical motivation scores shown in Figure 10 indicate that white students had the lowest mathematical motivation both pre and post, with black females' motivational ranking remaining among the highest. Hispanic students' motivational rankings had very little change.

Pre-Post Mathematical Motivation		
Ranking	**Pre**	**Post**
1	BM	BF
2	BF	HM
3	HM	BM
4	HF	HF
5	WF	WM
6	WM	WF

Key: B=Black W = White H = Hispanic
M = Male F = Female

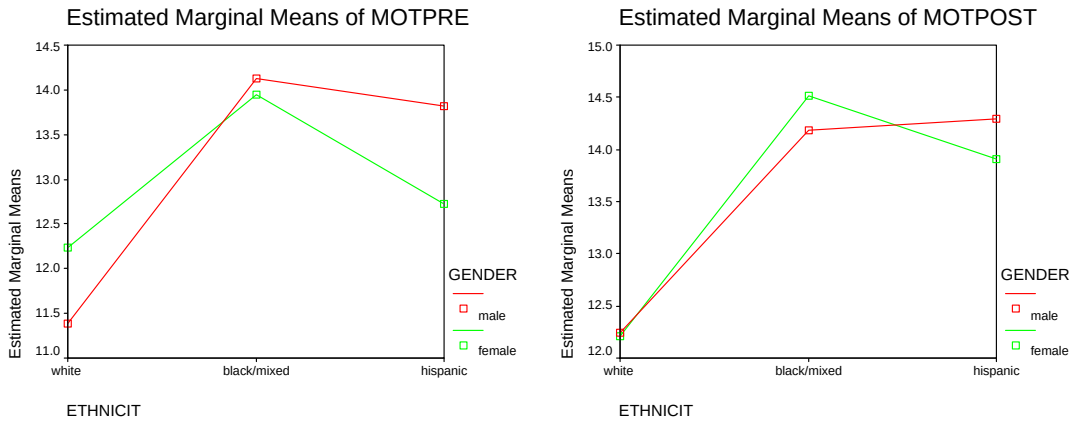


Figure 10. Between Groups Pre- and Post-Test Rankings Mathematical Motivation Scale

Examining the mathematical motivation scales in Figure 10, note that the white males' scores increased to the level of white females from T1 to T2. Nevertheless, white students' scores remained the lowest of all groups. Black students' scores also remained relatively the same, with black females surpassing males at T2. Hispanic students' scores also remained relatively the same from T1 to T2.

Beliefs about mathematics

There was a substantial drop in black males' beliefs about mathematics from the highest most positive in first place to fifth place from T1 to T2. Hispanic females had the most negative beliefs about mathematics both pre and post, with Hispanic males' beliefs about mathematics increasing from fifth place to second (Figure 11).

Pre-Post Beliefs		
Ranking	**Pre**	**Post**
1	BM	WF
2	WF	HM
3	WM	BF
4	BF	WM
5	HM	BM
6	HF	HF

Key: B=Black W = White H = Hispanic
M = Male F = Female

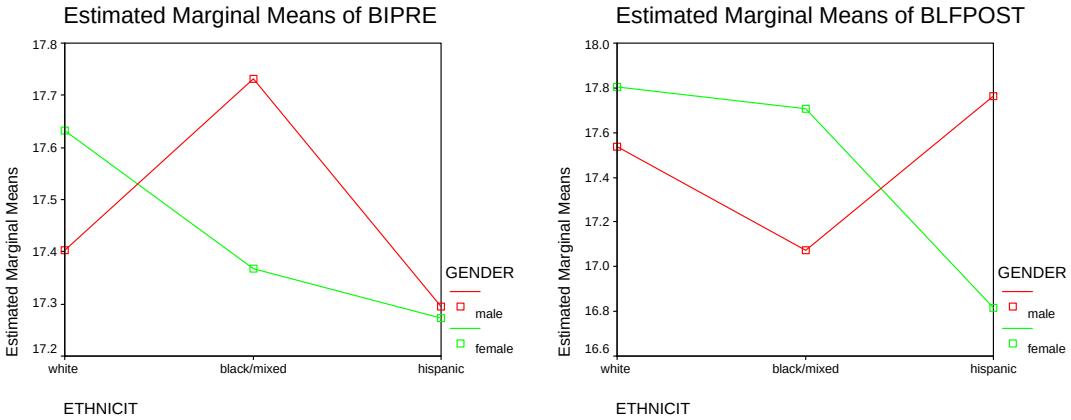


Figure 11. Between Groups Pre- and Post-Test Rankings Beliefs About Mathematics Scale

Note the relative change in position of black females and males from T1 to T2, with black males having the most positive beliefs about mathematics at T1 to very low at T2 with Hispanic females having the lowest beliefs scores consistently. Also notice the increase in Hispanic males' scores from T1 to T2.

Attitudes toward mathematics

For attitudes toward mathematics (Figure 12), white students again were among the lowest ranks in both pre- and post-surveys, with Hispanic males and black females consistently ranking in the top positions.

Pre-Post Attitudes		
Ranking	**Pre**	**Post**
1	HM	HM
2	BF	BF
3	BM	HF
4	WF	BM
5	HF	WM
6	WM	WF

Key: B=Black W = White H = Hispanic
M = Male F = Female

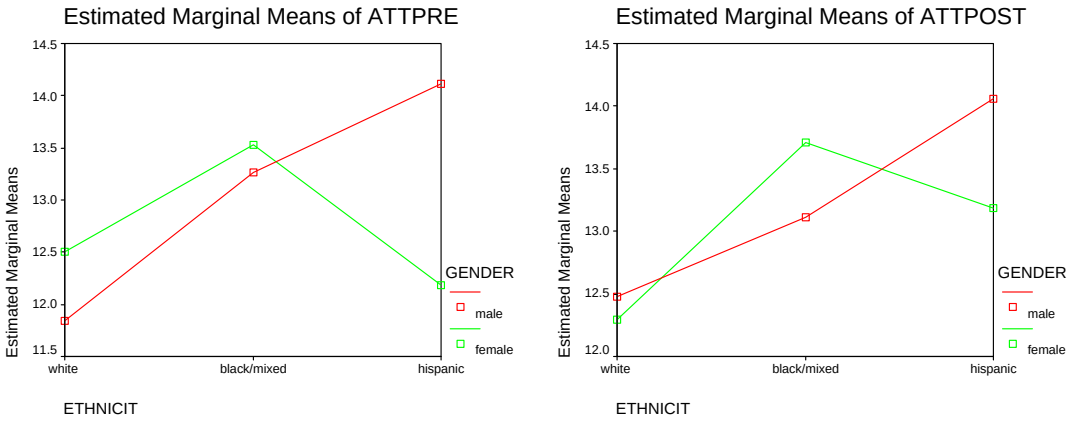


Figure 12. Between Groups Pre- and Post-Test Rankings Attitudes About Mathematics Scale

Examining these graphs, we can clearly see that white students' scores remain among the lowest from T1 to T2, and black females' and Hispanic males' attitudes toward mathematics are consistently among the highest.

Discussion of Between-Group Comparisons

These between-group T1 and T2 rankings yield some very interesting and surprising findings, many in contrast to what one might expect: Academically, white

students are performing at the highest levels with black males consistently ranking near the bottom. The considerable drop in Hispanic females' scores accompanied by a considerable increase in Hispanic males' scores points to some factor or factors affecting Hispanic student's academic scores, beliefs, and attitudes differently than white and black students' scores, as illustrated in Figure 5. This trend continues when we examine the anxiety scores of Hispanic students. From T1 to T2, Hispanic females' math anxiety increased from the lowest at T1 to the highest at T2. Black females have the second highest math anxiety ranking at both T1 and T2, with very little change for white students and black males (Figure 6). Contrasting with the performance and anxiety scores (Figures 5 and 6), Hispanic students' had the highest math value score rankings (Figure 7) for both T1 and T2. Black females' math value ranking dropped to the lowest at T2, yet black females have some of the highest scores on enjoyment, beliefs, and attitudes toward mathematics (Figures 9, 11, and 12). This trend of dropping scores for Hispanic females along with rising scores for Hispanic males continues to be apparent on the self-concept scale (Figure 8). Interestingly here, white males' self-concept in mathematics ranking is among the lowest, while white females' self-concept in mathematics is the highest both T1 and T2 with black students' rankings having very little change over time. On the enjoyment scale (Figure 9), black students have the highest-ranking scores, with Hispanic males ranking 3rd for both T1 and T2. White students' math enjoyment scales are consistently ranked among the lowest, with white females ranking the lowest of all at T2. In terms of mathematical motivation (Figure 10), black females consistently rank near the top with white students consistently ranking at the bottom and Hispanic males ranking just slightly higher than Hispanic females for both T1 and T2. Continuing this

trend in Hispanic females' scores, Hispanic women exhibit the most negative beliefs about mathematics, while Hispanic males' beliefs scores substantially increase from fifth to second place from T1 to T2. Beliefs about mathematics (Figure 11) are consistently the highest for white females. While there was little change in black females' and white males' beliefs about mathematics, black males' beliefs scores dropped from first to fifth place over time. Similar to their motivational scores (Figure 10), white students' attitudes toward mathematics scores ranked among the lowest for both T1 and T2. Hispanic males and black females consistently ranked the highest scores for attitudes toward mathematics, yet Hispanic females and black males have among the lowest post-test scores on the beliefs (Figure 11), self-concept (Figure 8), and academic scales (Figure 5). Black female and Hispanic male students' scores are consistently similar for performance, enjoyment, motivation, attitudes, beliefs, and math value (Figures 5, 7, 9, 10, 11, 12). Hispanic females display some of the highest levels of anxiety about mathematics (Figure 6). These trends indicate that within ethnic groups, gender plays an important role in student attitudes, beliefs, and academic performance.

Comparing academic performance with attitudes and beliefs over time yields an interesting picture, and often it is not what one would expect. While white students tend to have the highest academic scores (Figure 5), their math enjoyment (Figure 9), mathematical motivation (Figure 10), and attitudes toward mathematics (Figure 12) are among the lowest of all six groups. Gender comes into play for white students, with the sizeable differences in female and male for self-concept in mathematics (Figure 8) and beliefs about mathematics (Figure 11), with white females' consistently scoring higher than white males. Academically (Figure 5), white female and male students are

performing at the highest levels, but their high academic scores are situated in the lowest levels of enjoyment (Figure 9), motivation (Figure 10), and attitudes (Figure 12) toward mathematics with respect to their peers. This indicates that white students, females particularly, are successfully struggling for mathematical success in an environment that is highly anxious for them; yet, they perceive the value (Figure 7) of what they are doing as fairly low. However, despite those obstacles, they are continuing to perform. Gender is a significant variable among white students, with white males having higher anxiety (Figure 6), lower self-concept (Figure 8), and less positive beliefs about mathematics (Figure 11) than those of their white female counterparts.

Similarly, gender differences are apparent in black students' rankings. Academically, black males' scores are ranked among the lowest, with black females consistently ranking higher than their male counterparts near the middle of all groups (Figure 5). These academic standings are situated in a student population where the females have the second highest math anxiety (Figure 6) rating and their perception of the value of mathematics (Figure 7) is among the lowest. In contrast, black students consistently have the highest scores for mathematical enjoyment (Figure 9), with female scores higher than male. Black students' mathematical motivation scores (Figure 10) are steadily among the highest of all groups. While there was very little difference in belief scores (Figure 11) for black females, black males' beliefs about mathematics scores dropped drastically from the highest at T1 to fifth place at T2. Examining these rankings indicates that while black students are academically among the lowest, black females are consistently performing at higher levels than their black male counterparts, but with a very high level of anxiety and with a low perception of the value of mathematics.

Despite the high anxiety and low perception of the value of mathematics, black students report that they are enjoying mathematics more than their white and Hispanic peers, with black females reporting higher enjoyment levels than black males. Another surprising contrast here is the contrast between performance and motivation. Black students have some of the highest motivational scores and some of the lowest academic scores in contrast to white students, who have the highest academic scores but the lowest motivational scores.

Gender appears to be a significant factor in both academic performance and attitudes and beliefs toward mathematics for black students. Black females are in a similar situation to that of white females; they are performing at higher levels than their male counterparts but with very high levels of anxiety and a low perception of the value of mathematics. Similarly, there is a clear differential between mathematical motivation and academic performance for black students, which indicates a discontinuity between attitudes and performance that is related to both gender and ethnicity.

As evidenced for both black and white students, gender appears to be a considerable factor within ethnic/racial groups. Gender also appears to have a sizeable effect on attitudes, beliefs, and academic performance for Hispanic students. However, within the Hispanic group of students there is an interesting gender dynamic that does not appear to be the case for the black and white groups. Academically, a considerable drop in Hispanic females' scores is accompanied by a similarly considerable increase in Hispanic male's scores from T1 to T2. Likewise, on the self-concept scale, Hispanic females' scores dropped drastically while the Hispanic males' scores rose over time. Hispanic females had the most negative beliefs about mathematics while Hispanic males'

beliefs scores rose substantially from near the lowest at T1 to near the highest at T2. Hispanic females' math anxiety increased similarly, from the lowest anxiety levels to the highest anxiety levels of all groups from T1 to T2. Hispanic males' math enjoyment and motivation scores are consistently higher than those of their Hispanic female counterparts. Hispanic males along with black females had the highest attitude toward mathematics rankings for both T1 and T2. Thus, for the Hispanic students in this study, gender is evident as a significant factor in terms of academic performance, attitudes, and beliefs about mathematics.

Within the black and white groups, females seem to be outperforming their male counterparts despite the fact that this superior academic performance is often accompanied by attitudes and beliefs that would not seem to support such performance. However, within the Hispanic group, the male students are outperforming their female counterparts and tend to have more positive attitudes and beliefs associated with this better academic performance. Hispanic females are consistently ranking lower from T1 to T2 both academically and in terms of attitudes and beliefs toward mathematics. For Hispanic students, males seem to be out performing females, and this better performance is associated with more positive beliefs and attitudes about mathematics. Not only are Hispanic males outperforming their female counterparts, but, Hispanic females' academic, attitudinal, and beliefs scores in general have a notable decrease over time which is different from others in both their same gender and ethnic groups.

These findings would support the idea that black and white females realize the necessity of success in the mathematics classroom, and despite this discomfort or dislike, they are performing to a higher standard than their male counterparts. In the Euro-

American and African American culture in the United States, women are both encouraged and finding it necessary to increase their earning potential. Mathematics is a requirement for successful completion of high school and any college major (Sells 1980, 1975). In order for these women to be successful in the world of work, there is an implicit understanding that whether or not they like mathematics or are uncomfortable with it, math is key to their academic success. It seems that women are accepting this fact and taking the steps necessary for their achievement in mathematics. However, for Hispanic students, it is quite possible that more traditional feminine roles and expectations are still the norm. It seems that Hispanic students understand the value of mathematics as evidenced by their math value scores, but only the males are demonstrating the academic success and accompanying positive attitudes and beliefs about mathematics. These results are supported in the research by which indicates that Hispanic students and their families indicate that they value education and have an understanding of the role that education plays in bettering their situation in life, but these beliefs are often accompanied by a lack of resources, knowledge, and ability to actually realize the potential benefits of education.

At this point it is fitting to note that of all ethnic groups in this study, the lowest numbers were of Hispanic students. There were only 20 in the treatment and 13 in the control group for the attitudinal and performance measures parts of this study. While the overall sample size is sufficient for purposes of statistical analysis, it is very possible that given the low number of Hispanic students and the diversity of the Hispanic population at OGHS (Brazilian, Columbian, Guatemalan, Mexican, Puerto Rican, and Spanish), it is

entirely possible that these trends could be a pattern or artifact of some other aspect of these students' personal lives, history, and experience.

Clearly, both gender and ethnicity are significant variables in academic performance, beliefs, and attitudes toward mathematics as evidenced by these comparisons. The trends illustrated here are interesting and call for more in-depth investigation into the factors influencing this variance along gender and ethnic lines.

Summary

In this chapter we examined data from the RQS experiment. These data include academic measures, attitudinal and beliefs measures, and participatory measures. The resulting analysis did not support six of the eight hypotheses addressed in this portion of the study. Neither my hypothesis that the RQS would result in increased academic performance and improved attitudes toward mathematics for female and minority students (H_5) nor my hypothesis stating that implementation of the RQS would have the same directional effect for minority students and women (H_7) was supported by the data. Additionally, the RQS survey and test data analysis of change over time did not support the hypothesis stating that gender will be a more significant variable than ethnicity, class, or age with respect to academic performance and attitudes toward mathematics in a secondary setting (H_6). Analysis of the RQS survey and test data indicated that in no case was gender a more significant variable than any other for change in academic and attitudinal scores. However, ethnicity did appear to be a significant factor on several of the beliefs and attitudes scales. Additionally, examination of the rankings of T1 and T2 scores by gender and ethnicity did indicate that within ethnic groups, gender was an important factor effecting student scores. Hypotheses addressing participatory RQS data

indicating that students in RQS treatment classes will have more correct answers over time (H_{11}), that gender would be a more significant variable than ethnicity, class or age with respect to students' participatory behavior in the RQS experiment (H_{12}), and students' in RQS treatment classes levels of participation will increase over time (H_{10}) were not supported by the participatory data.

Hypotheses H_2: There will be differences in students' attitudes and beliefs toward mathematics across gender and cultural lines, and H_4: The experiences and perceptions of students in the research population will vary along gender, ethnic, and socioeconomic lines, were supported by both the RQS analysis of variance for change over time and by the examination of the rankings of T1 and T2 scores by gender and ethnicity.

One of the key questions of this research was, Will the RQS have a significant effect on students' academic performance, attitudes, and beliefs about mathematics? The answer to that question is no. Another question was whether or not gender or ethnicity were significant variables in terms of students' academic performance, attitudes, and beliefs about mathematics. The answer to this question is yes. A third question was, If given the opportunity to participate in class using the RQS will students participate at higher levels than under their usual teacher student question asking/answering routine? The answer to this question was no. In the next chapter these data will be situated within extensive qualitative data from students, teachers, and administrators, further illuminating the culture of the mathematics classroom.

Key Findings

RQS

- Contrary to expectations, giving all students the same opportunity to participate in the question asking and answering process through the RQS did not increase academic performance or improve attitudes for any group.

- Contrary to expectations, giving all students the same opportunity to participate in the question asking and answering process through the RQS did not increase students' participation in class and did not increase the number of correct answers that students got when called on in class.

- Contrary to expectations, gender did not significantly account for change in academic performance from T1 to T2 or for changes in attitudes and beliefs about mathematics.

- Contrary to expectations, neither gender nor ethnicity accounted for differences in classroom participation for students in either the treatment or the control RQS classes, indicating that suspected bias in the questioning process might not be present.

- Ethnicity does account for change from T1 to T2 on the following scales: math value, self-concept, and beliefs about mathematics.

T1 and T2 Between-Group Comparisons

- Comparison of T1 and T2 rankings for gender indicates that female students had higher academic performance rankings than did male students at T1 and T2 and higher self-concepts with respect to math at T1.

- Within ethnic groups, gender is a significant variable for both academic performance and beliefs and attitude measures.

- Academically, black and white female students consistently outperform their male counterparts.

- Academic scores of Hispanic male students increase substantially from T1 to T2. Hispanic female students' academic scores decrease from T1 to T2.

- White students have the lowest scores on math value, enjoyment of mathematics, motivation, and attitudes about mathematics, yet they have the highest academic scores.

- White female students have the highest scores for beliefs about mathematics, self-concept, and academic performance.

- Black students have the highest scores for enjoyment of mathematics and motivation.

- Hispanic students have the highest math value scores.

- The scores for black female students on the performance, enjoyment, motivation, attitudes, beliefs, and math value scales are consistently similar to those of Hispanic male students.

- There is a consistent similarity in score change for Hispanic students from T1 to T2, with Hispanic males' scores improving and Hispanic females' scores worsening, or male scores remaining steady with females' scores dropping or females' scores remaining low and male scores improving. This trend is evident for academic performance, anxiety, self-concept, beliefs, and mathematical motivation.

- Black female students consistently have among the highest math anxiety scores of all groups. Black and Hispanic male students consistently have among the lowest math anxiety scores. Black male students' anxiety levels are consistently lower than those of their female counterparts. White male students' anxiety levels are consistently higher than those of their female counterparts.

- Hispanic students have the highest math value scores, followed by black students and then white students. Black and white female students' math value scores are consistently higher than those of their male counterparts. The opposite is true for Hispanic students.

- White female students consistently have the highest math self-concept rankings of all groups. Black and white female students' math self-concept scores consistently outrank those of their male counterparts. Black male students consistently have the lowest math self-concept rankings.

- Black students have the highest math enjoyment rankings, with females outranking males consistently. Hispanic male students have the highest enjoyment rankings after black students. White students consistently rank among the lowest math enjoyment scores.

- Black students and Hispanic males have the highest motivation rankings. White students rankings for mathematical motivation are consistently the lowest.

- White female students have the highest beliefs about mathematics scores. Black female students consistently rank in the middle and Hispanic females the lowest.

- White students' attitudes about mathematics scores are among the lowest. Hispanic male and black female students respectively have the highest scores.

CHAPTER 5
RESULTS FROM QUALITATIVE PORTION OF THE STUDY

The Focus Groups

Objectives and Questions

One of my objectives was to elicit and document perceptions and experiences of students of mathematics in order to gain a clearer understanding of students' participatory behavior in the mathematics classroom. The questions related to this objective are:

> What are differences in the attitudes and practices of highly successful female and minority students of both genders as contrasted with those of their group that do not succeed at the same level?
>
> Do the experiences and perceptions of students in the research population vary along gender, ethnic, and socio-economic lines? If so, how do they differ?

A second objective relevant to this portion of the study was to document the effect that the use of the random questioning strategy intervention had on teachers' and students' classroom activities and behaviors. The questions related to this objective are:

> Will teachers' questioning behavior change? Will the types of questions asked and encouraging behaviors within their questioning interactions change as a result of the random questioning strategy?
>
> Will students be more attentive in class?

The third objective relevant to this portion of the study was to document best practices data from high-achieving female and minority students. The questions related to this objective are:

> Will attitudes of high-achieving students be more positive toward mathematics than those of the general study population?
>
> Will classroom practices and behaviors of high-achieving students be different than those of the general study population?

Will the attitudes and practices of highly successful women and minority students be closer to those expressed by white men in the research population?

Data Analysis

All 13 focus groups were recorded on audio tape. Nine tapes were selected at random for full transcription and coding. ATLAS.ti 4.2 was used as an electronic note pad and organizational tool and the data was coded in a combined inductive and deductive approach, as suggested by Miles and Huberman (1994). An inductive grounded theory approach was informed by general themes in the literature (Bernard 2000; LeCompte and Schensul 1999; Spradley 1979). The interviews were analyzed for repeated events, topics, activities, concepts, thoughts, feelings, emotions, outcomes, suggestions, and behaviors, as communicated by the students, as well as incidences of common themes in the literature. Transcription began with open coding of the most obvious themes. As the coding progressed, additional emerging themes were added eventually eventually resulting in the identification of some 160 themes. After coding the nine transcripts in random order and concluding that theoretical saturation had been attained, the remaining 4 tapes of the 13 total were hand coded using audio review.

After all coding was complete, repeated pile sorts of the themes were performed to isolate larger themes, or domains (Bernard 2000; Schensul et al. 1999). There is no ideal single set of themes in a corpus of text, and there can be multiple ways of interpreting data. In the end, the decision about the themes in a set of text is controlled by the researcher. This makes the organization of ethnographic data potentially mysterious, but by making my methods transparent establishment of validity is possible through repeated efforts (Bernard 2000; Ryan and Bernard 2003; LeCompte and Schensul 1999). Drawing on my immersion in the data and on my experience with the focus groups and in the

classroom as an observing participant, the consistency of the repeated pile sorts is indicative that an exhaustive and thorough job of sorting and compiling these data took place. After three pile sorts, most of the initial codes were categorized the same way all three times with a few falling in the same category twice which, after careful review, were determined to be sufficient for that code to belong to that particular category. The few that were not consistent were reviewed and assigned to the category that was determined most appropriate for the context of the comments and the themes that were appearing in the data. After arriving at 14 general categories, similar codes were collapsed such that codes identifying virtually the same or similar things were all collected together under one common heading. A final report of all categories was loaded into a spreadsheet and collapsed into the main 14 categories and the main sub-categories within each area. After further analysis, the nine most salient themes with their most pertinent sub-themes were identified, including best practices as reported by those highly successful minority and female students, and the most common suggested improvements for math class as reported by students.

The Focus Groups

The focus groups were divided into three main categories: best practices (BP), general (G), and white male (WM). The best practices groups consisted of minority and white female students identified by their teachers as high-achieving students of mathematics. Most of these students were either in honors or AP classes or in the higher levels of the regular mathematics curriculum. The general group consisted of minority and white female students not identified as high performers who indicated that they would be willing to participate in focus groups about their mathematical experiences. The third group consisted of white male students who volunteered to participate in focus

groups about their experiences in mathematics. There were 22 students in the three best-practices groups constituting 25 percent of the participants, 54 students in the seven general focus groups accounting for 59 percent of the participants, and 13 participants in the three white male groups making up 15 percent of the participants. Analysis of these data is done with respect to gender, ethnicity, and group membership. The numerical data give the percentages of responses on a particular topic and then disaggregate the data by group comparing the percentage of responses to each group's proportional representation of the whole, looking for consistencies and inconsistencies in these proportions. If one group has a much higher or lower proportion of the incidences of a particular theme than their group's proportional makeup, this can be indicative of differing experiences and perceptions of similar phenomena for different groups of students and warrants further investigation. In all of the quotes, I have given as much information as possible as to gender, ethnicity and group status.

Major Themes and Sub-Themes

Examination of the totals and patterns of the data in each of the primarily identified categories showed the following themes to be the most salient as illustrated in Table 6.

Table 6. Focus Group Interviews: Major themes and sub-themes.

Theme	**Sub-Theme**
Teaching/Instruction	
	Student/Teacher Relationship
	Positive
	Negative
	General
	Teaching Methods
	Positive
	Specific + Practices
	Explains Well
	Extra Help from Tchr
	Repetition/Work Prblms

Table 6. Continued.

Theme	**Sub-Theme**
Teaching/Instruction	Teaching Methods (continued)
	Negative
	Specific Neg Practices
Student Effort	
	In School
	Classroom Participation
	Off Task (In Class)
	Out of School
	Homework/Study
	Engaged in HW & Study
	Avoids HW & Study
	Value of Education
Student Behavior	
	Student Behavior Problems
Curriculum	Math Rating
	Positive
	Negative
Classes	
	Class Size
	Large
	Small
	Classes
	Good
	Bad
Unfair Treatment	
Ethnicity & Gender	
	Ethnicity
	Gender
	Bias
	Gate Keeping
Questions	
Classroom	
	Ask
	Ask Questions
	Not Ask Questions
	Answer
	Answer Questions Voluntarily
	Called On (+)
	Called On (-)
Student Feelings	
	Stress/Frustration
	Positive/Confidant/Adequate
RQS	
	RQS Positive(+)
	RQS Negative(-)
	RQS General Comments

Examination of the nine most salient themes reveals that there are three major themes apparent in these data: what teachers do, what students do, and what

administrators do. Teachers, administrators, and students (and their advocates) are the major stakeholders in this situation, with both common and conflicting goals, needs, desires, and resources. These themes will be addressed in this section along with the most pertinent sub-themes, and listings of both best practices as reported by the high-achieving group and suggested improvements for the mathematics classroom as reported by all groups.

All of the nine themes will be illustrated by student quotes; however, not all sub-themes will include quotational data, as it would simply be too much, and in many instances students simply indicated their assent or general agreement with a statement with a yes, uh huh, or the like. Thus for this presentation, illustrative quotes will be used as much as possible. It should be noted here that all identifying information has been deleted from the quotes to protect the identity of informants and school personnel. Complete counts and proportional data are given for all of the nine main themes and sub-themes in Table 27.

What Teachers Do

Teaching and instruction

The first of the major themes addressed here is what the teacher does that both positively and negatively affects student learning. These factors include student–teacher relationship, teaching methods and instruction, and what students perceive to be unfair treatment. Of the nine main themes, teaching and instruction was by far the most salient, with 517 instances across all groups. Within the topic of teaching and instruction were student–teacher relationship and teaching methods. The first of these to be examined is student–teacher relationship.

Student–teacher relationship: Student–teacher relationship was mentioned in 12 of the 13 focus groups with the significance of a positive student–teacher relationship mentioned in 10 of those 12. There were 101 responses mentioning the teacher–student relationship, with 57 percent emphasizing the significance of a positive student–teacher relationship; 21 percent of these were from the best practices group, 69 percent from the general group, and 9 percent from the white male group. The incidences of the importance of a positive student–teacher relationship (Table 7) is higher than their group proportional make up for the general group and lower for both the best practices and white male groups, indicating that a good teacher–student relationship may be of more importance to the general group than the other two. Similarly, for the negative and general comments regarding teacher–student relationship, the general group had the highest percentage of instances, and in all cases it was well above their group proportional makeup. The white male group was lower than their group proportional makeup in all categories, reporting no incidences of negative student–teacher relationship and having very few comments in general regarding student–teacher relationship.

Table 7. Focus Groups: Positive Student-Teacher Relationship

BP (25%)	**G (59%)**	**WM (15%)**
21%	69%	9%

The following excerpts illustrate the importance of the student–teacher relationship to these informants:

> WF: Your success as a student is totally dependent on your teacher and if your learning style works with they way they teach.

> L: We're just talking in general about how we feel about math.
> S: It all depends on what kind of teacher you have.
> S2: It really does, true.

> BM: It’s like when you can get along with your teacher, it makes it more easier for you to go to them ‘cause if you and that teacher are bumping heads you’re not going to want to go to them.
>
> BF: It's a partnership, the students that want to learn have to come to the teacher. And then if the teacher doesn't want to do anything then [the students] have to try something else.
>
> L: If you think back to your favorite math teacher, or the place where you feel like you learned the most–what did that person do or how was it that it made it good for you?
> WF: Teachers you could have a relationship with . . . [someone] you can go[to] and you can talk, you can go after class and actually talk to them.
> HF: This year for some reason I like . . . has taught me a lot this year. . . . If I don't understand . . . always at the end of the period . . . always ask me if I get it. If I don't . . . sits with me and do it. If I need a pass, . . . just gives me one and I go to my other period, but . . . always helps me and goes step by step with me. . . . It used to be hard . . . it's easier for me now. . . . It makes me feel better now for some reason. Like it makes me more talk to the teachers now a little more and they won't like shut me down or something.
>
> BM: Yeah. [Teacher G] cares, like you can't sit there and talk to yourself, like everybody just writing, playing around, doing whatever, talking to hear yourself talk, like . . . makes us pay attention.
> WF: [Teacher G] makes us pay attention to the board.
> WF: [Teacher G] cares.
>
> WM (Honors): One way that I can really like, learn a lot from a teacher, and understand what they're trying to tell me is if I like talk to 'em on a personal level. I know them, like they're a person. . . . Not them just being in a teacher to student relationship 24/7, you know, being able to actually have a conversation.

These quotes are illustrative of the importance of a positive student–teacher relationship to student learning. The higher incidence of both positive and negative student–teacher relationship responses from the general group than their group proportional makeup may be indicative that this group has experienced a positive student–teacher relationship less often than the BP or WM groups and thus expresses the need for a positive student–teacher relationship at a higher level than other groups because they have had more experience with negative student–teacher relationships.

Teaching methods: After student–teacher relationship, teaching methods and instruction was one of the most frequently mentioned sub-themes in the focus group data.

Positive teaching methods: When students were asked to talk about what worked for them in math class, there was an abundance of information volunteered on positive teaching methods in every group, with a total of 259 responses. Of those 259 responses, 17 percent were from the best practices groups, 70 percent were from the general group, and 13 percent were the white male group. The responses for both best practices and white males were below their proportional group composition, while mentions of the importance of positive teaching practices in the general group were more than expected.

There were 184 instances of specific positive teaching practices, and the following were the most significant: explains well, extra help available from teacher, repetition–working problems in class, students doing class work, answers to homework problems available to check their work, and teacher attitude, in that order.

Explains well: Of the 184 mentions of positive teaching practices, 37 percent were in the category explains well. Of those, 15 percent were from the best practices group, with 72 percent from the general group and 12 percent from the white male group (Table 8). These percentages indicate that explaining well is more significant in the general group and less significant in the best practices and white male groups than is expected from proportional group size.

Table 8. Focus Groups: Explains Well

BP (25%)	**G (59%)**	**WM (15%)**
15%	72%	12%

The significance of good explanation is illustrated in the following quotations:

> S2: Don't you hate when they just write on the board and just write and don't stop and explain? I hate it.

S: Yeah .
S3: [They] just wrote on the board.
S2: Non stop.

S: It would be like here's a work sheet do it. And . . . would not show us anything.
L: Could you go to your teacher and ask questions?
S: Yeah I did and like if you ask them . . . wouldn't explain it . . . would just write it down and it would be like that's how you do it.
L: Then while they were writing they didn't say “here I'm doing this and this is”?
S: No they'll write it they won't say why.
S2: They won't explain it and like . . . would never like wait up for anybody . . . would just keep going like at a really fast pace. . . . Whoever is left behind stays behind.
BF: Yeah, you ask . . . a question and . . . [it’s] like, well I don't get what you're saying. We try to break it down . . . but [the teacher] don't know how to break it down to our level and . . . always works at a fast pace like, we're going to do this one day, do this the next day. Like now we're learning something new and me, I don't know what [the teacher is] talking about.
BM: I think the teachers know it better, like they don't break it down, so we don't understand it, like "what don't you understand?" But then you're like, "okay, you been doing this for how long?". . . You have to understand that we just learning this and it take more than a day just to figure out how to do it.

WF: Yeah, [I like] how they have every single step laid out for you so you see what they did.

BM (Honors): Most teachers they don't [use] the whole 50 minutes . . . they will take like 20–30 minutes at the most and go over the homework is going to be on and then they will give you homework and they will give you time to do it. But [our teacher] . . . would go like the whole 50 minutes give out homework like right before the bell and . . . [say] OK try it and if you don't understand it, if we need to we'll spend like the whole class period [tomorrow] working on it and going over it and making sure that you understand.

Extra help from teacher: After explains well, the ability of students to get extra help from the teacher was the next most significant positive teaching practice mentioned, at 18 percent. The best practices group accounted for 18 percent of those responses with 67 percent from the general group and 15 percent from the white male group (Table 9). These percentages are a little higher than expected for the general groups, lower for the best practices group, and equal to expected proportion for the white male group.

Table 9. Focus Groups: Extra Help

BP (25%)	G (59%)	WM (15%)
18%	67%	15%

The importance of extra help to students is illustrated in the following quote:

> S (Best Practices): [The teacher is] . . . available like it seems like a lot of teachers. . . are not offering that tutoring anymore.

Repetition – multiple examples: Repetition or the working of multiple examples was mentioned in 14 percent of the instances of positive teaching methods. Thirty-five percent of these instances were from the best practices group, 65 percent were from the general group, and 4 percent from the white male group (Table 10). Clearly here, the importance of repetition and working many examples is of more significance to both the best practices and general sub groups than the white male group.

Table 10. Focus Groups: Repetition/Works Problems

BP (25%)	G (59%)	WM (15%)
35%	65%	4%

The importance of working problems is illustrated in the following quotation:

> S: [The teacher will] show us how to do all the odd problems which is the same thing as the even problems so when we do our homework we could see how we did the other problems and it's a lot easier to do the other ones.

Negative teaching methods: When students identified particular practices that they found to be negative, there were 114 instances of students mentioning negative teaching practices, with 100 of those listing specific practices that they deemed to be negative or detrimental to their learning. In my analysis, all of these 100 instances fall under the category of teachers who either cannot or will not teach and explain the material such that the students can understand it. Of the 100 instances mentioned in this classification, 22 percent were mentioned by the best practices group, 58 percent by the general group, and 20 percent from the white male group (Table 11). These percentages

are close to the proportional makeup of each group, with reports of negative teaching methods being a little higher than their makeup for white males.

Table 11. Focus Groups: Explains Poorly or Not at All

BP (25%)	**G (59%)**	**WM (15%)**
22%	58%	20%

The difficulty students encounter when a teacher either cannot explain the material so that they can understand it or will not explain the material to them is evident in the following examples:

> S2: Don't you hate when they just write on the board and just write and don't stop and explain? I hate it.
> S: Yeah.
> S2: Cause that happened to me last year . . . that's why I had to take Algebra 1 this year like half semester.
> S3: [The teacher] just wrote on the board.
> S2: Non stop.
>
> S: Like last year [the teacher] never stopped and explained anything. And if [the teacher] did . . . be talking too fast and you're like “Can you say it again?” I just didn't get it.

Based upon the frequency with which it was mentioned in the focus group interviews, student–teacher relationship as well as positive teaching methods appear to be of more importance to the general group than the best practices and white male groups. For all positive practices mentioned except for repetition/work problems, the general group’s responses were higher than their group’s proportional makeup. For working problems/repetition, both the best practices and general group’s frequency was higher than their group proportional makeup, with the best practices group being significantly higher, indicating that this is of major importance to them.

These data indicate that the need for good teaching practices as identified in the focus group interviews is more significant for the general group than others. This could

be a function of the general group feeling a need for better teaching or the best practices and white male groups either not experiencing the need, that is, they are satisfied with their instruction, or that the quality of instruction is not as necessary to them, which is doubtful. The best practices students and many of the white male students are in advanced courses and tend to have the best teachers in the school. The lower frequency is likely a result of them not experiencing a lack of quality instruction. Additionally, the general education student may not understand mathematics as easily as the advanced student such that positive teaching practices would be more important to the general education students' success in the mathematics classroom.

These data regarding the kind, quality, and availability of instruction and the lack thereof is supported in the literature indicating that schools with higher minority and lower SES populations have some of the least qualified math faculties. This trend in my observation is often continued within schools with the least capable and least qualified teachers being assigned to teach the lower level high minority enrollment classes.

Unfair treatment: All focus groups included mentions of unfair treatment by the teacher, and five included mentions of unfair treatment by the system in terms of tracking or misplacement within the curriculum. Unfair treatment was mentioned 94 times out of 89 total participants, and its occurrence in all of the focus groups indicates the pervasiveness of the experience of unfair treatment with students either experiencing it themselves or observing unfair treatment of another student. About 14 percent of the comments about unfair treatment came from the students in the best practices groups, with nearly 75 percent of the mentions of unfair treatment from the seven general focus groups of minority and female students, while only about 12 percent of the instances of

report of unfair treatment occurred in the white male groups (Table 12). The incidences of unfair treatment are significantly higher than their group proportional makeup for the general group and less for both the best practices and white male groups. These figures indicate the possibility that women and minorities in the general curriculum may be having experiences that they perceive to be unfair more often than their counterparts in the best practices or white male groups.

Table 12. Focus Groups: Unfair Treatment

BP (25%)	**G (59%)**	**WM (15%)**
14%	75%	12%

The following quotes from students illustrate some of the main topics of discussion in the focus groups around unfair treatment. Students often complained about being belittled, blamed for others' misbehavior, embarrassed by the teacher in front of the class, being shut down, criticized for not knowing what they are asking about, picked on, and baited into misbehavior and then getting in trouble.

> BF: A lot of people don't try as hard because they see a lot of teachers they don't purposely do it but they make a person feel low if they don't know the answer or they are not getting it right away. I didn't do as well in Geometry because [of] my teacher. I began to feel if I didn't know the answer if I didn't get everything right then and there, that I was stupid and I wouldn't ask . . . to help because I was afraid of the fact that I felt that . . . was belittling me because I didn't access the information as well as the students around me.

> BF: The teacher . . . [will] be so busy trying to concentrate on trying to get the class quiet or whatever then . . . takes it out on the people who like [are] paying attention and they only ask a question because they don't understand it then they get that taken out on them, and that's not fair.

> WF: If you ask like a real dumb question . . . Teacher A would embarrass you right in front of the whole class . . . by cracking jokes on you.

> BM: Shut me down. . . . Sometimes teachers you ask them something and they say out loud or like, "Oh I just explained this" and tell everybody you weren't listening or something. Like embarrass you in front of everybody.

BM: I asked . . . for help. Instead of like helping me, they were like criticizing . . . "you should have been did this," or "why are you in this class?"

BF: Teacher B eggs things on . . . looks for trouble, basically, in my opinion. Like put people out, like, in the middle of the class, like, "Oh, did you go see the dean yet?"

WM (Honors): [In] eighth grade . . . minorities got the brunt of the teacher's aggression. . . . I just noticed that teachers would generally single out people who they believed would be problems. Even if they generally weren't . . . [they singled] them out essentially . . . feed into them. Get them aggressive to where they were able to write them up.
L: So would it be fair to say that you felt that they were maybe being baited?
WM: Yeah.
Some of the unfair practices students mentioned were often the outcome of their own actions, but they didn't perceive it that way. They clearly felt that they were treated wrongly by the system.

L: So you felt you should have been in Honors.
WF: Yes it's pretty easy and in Honors they just go a little bit faster.
L: You felt you didn't get there because. . .
WF: My teacher didn't like me and I made bad grades last year.
BM: See when I was in middle school I got in trouble 'cause I got in a fight and then I got suspended for the rest of the year.
L: So if you hadn't been suspended in Middle School are you saying that you'd be in a different math class now? What do you think you'd be in?
BM: Algebra 2.
L: So you'd be a whole year ahead in your math if you hadn't been suspended?
BM: Yes.

Ethnicity and gender – teacher

In all focus groups, students were asked if they were aware of any experiences they may have had or observed where they or another person was treated differently than other students as a result of their gender, race, or ethnicity in their mathematics classes. While there were some mentions and indications of these types of instances, the conspicuous nature of the few mentions of such activity lead me to look at this category more closely. Missing data or the failure of informants to discuss a certain topic can be an indicator of a cultural theme that the informants either assume you already understand and of which

you are aware and does not need mentioning; students also may not be comfortable discussing the topic (Ryan and Bernard 2003; Lecompte and Schensul 1999; Spradley 1979). While it is understood that gender and ethnicity are common underlying themes in the U.S. culture, the paucity of data in this category points to it being a salient theme. Every focus group was queried in several ways about the existence and their experiences with the effects of gender, race, and ethnicity and asked if they had experienced or observed any such bias. The majority, 85 percent of these students, were minority and white female students; yet there were very few mentions: 71 instances of experiences or observations of bias regarding ethnicity or gender. Of these 71 responses, 51 percent pertained to ethnicity, with 19 percent of the instances coming from the best practices group, 45 percent from the general group, and 35 percent from the white male group. Forty-one percent of the responses on gender and ethnicity were about gender, with 10 percent coming from the best practices groups, 55 percent from a *single* general group, and 34 percent from the white male group as shown in Tables 13 and 14 below.

Table 13. Focus Groups: Ethnicity

BP (25%)	**G (59%)**	**WM (15%)**
19%	45%	35%

Table 14. Focus Groups: Gender

BP (25%)	**G (59%)**	**WM (15%)**
10%	55%	34%

The lack of data in this category points to the necessity of a close examination of the students' comments in accordance with the data on gender and ethnicity collected in other parts of this study to gain a clearer picture of gender and ethnicity in this setting. It is also interesting to note the high percentages of observations of ethnic and gender bias reported by the white male sub-group that is much higher than their group proportional

makeup. While there were a few instances of white males experiencing what they perceived to be gender bias against themselves, the large majority of these reports were of white males observing either gender or ethnic bias happening to their classmates.

The two sets of key players in a classroom environment are teachers and students. Since all players are members of U.S. culture, they bring with them their cultural pre-suppositions, biases, and lifetime experiences when they enter the classroom. Thus, analysis of gender and ethnicity will take place in two separate parts of this chapter. Ethnicity and gender with respect to teachers and their actions will be addressed here, with ethnicity and gender from the perspective of the student addressed in the section entitled *What Students Do*.

Ethnicity: The following passages are examples of students' experience with ethnic bias in the classroom. While instances of ethnic bias are not apparent to one white male, others seem to have observed some rather obvious targeting of black students in class. Even the high performing minority females are experiencing bias, as evidenced by the fact that they feel they always have to prove themselves.

> PL: You said before that you feel as a young black woman that you have to work twice as hard to prove yourself because you're black. Do you think you're discriminated against because you're women, do you think you have to prove how smart you are?
> F (Best Practices): [voices] Yes, oh yes, a lot, yeah.
> L: Have you ever noticed any times in your classes when you felt that, girls or minority students were picked out or picked on or treated differently than you? Any time about anything?
> WM: Ah, eighth grade . . . minorities got the brunt of the teacher's aggression. . . . I just noticed that teachers would generally single out people who they believed would be problems. Even if they generally weren't. . . . [They] just [singled] them out essentially . . . feed into them. Get them aggressive to where they were able to write them up.
> L: What about like, according to gender or race? Have you seen any bias that way?
> WM: Not really. It's been pretty fair that way.

These passages illustrate that while the minority students are seemingly not readily mentioning their experiences of ethnic bias in the classroom, white students are observing these instances. Also in evidence here is the double oppression of the black females who are experiencing the need to prove themselves both as minority students and as women.

Gender: In the following passage a student describes a well intended but misguided attempt of a teacher to correct for past cultural gender bias in the classroom by focusing primarily on female students. Unfortunately, this well intended effort to give girls an equal opportunity came across to this informant as the teacher being against the boys and for the girls.

> WM: Yeah, in the beginning of this year our teacher was sort of sexist . . . was against the guys and all the girls had all the easy answers. . . .[T]he guys were receiving all the harsh . . . but now [it has] gotten better.
> L: You say they were receiving the "harsh"?
> WM: The really extremely hard questions, and they were the ones being sent out. But now it's more evened out and everything.
> L: Guys were getting asked harder questions than the girls?
> WM: Uh huh.
> L: And the guys were being sent out?
> WM: Uh huh. Referrals and all that stuff, but it was sort of the guys asked for it what they was doing.
> L: What were they doing?
> WM: They were just like yelling at the teacher and stuff. And then the teacher got mad and sent them out. But I can't, I don't know if it's baiting or not, what was going on in there.
> L: You did feel that the teacher asked the girls easier questions and the boys harder questions?
> WM: [The teacher] even said that [they were] sexist in the beginning of the year because . . . everyone in [their] family . . . don't have any male . . . has a female cat, a whole bunch of females and stuff because . . . in the past it was like the guys always got all the easy stuff and all that. And the girls were like, in the past . . . they can't go to work and all that junk. So now . . . [they are] on the girls' side now. But now [it has] evened out again.
> L: So now it's gotten to be more balanced?
> WM: Yeah.

This teacher's well meaning but unbalanced attempt to correct gender inequity of the past in their classroom seems to have made the boys in their class act out in a negative way toward the teacher. In a classroom setting, one must strive to give students an equitable experience. It seems that in this case the teacher took their application of reverse privilege to the females in class to the extreme to a point that the male students appear to have rebelled against them.

A similar response from white males was that in the qualitative response to the RQS, white males were the only group to indicate that they felt that the RQS was unfair. They felt that they were not being called on in a fair manner. It is possible that if white males are accustomed to being called on more than other groups in their classes that being in a situation where they have the same chance of being called on as everyone else may feel to them as if they are being ignored.

These passages are clear illustrations of students' experiences with both gender and ethnic bias in the classroom. The students' response to being treated unfairly resulted in their negative reactions toward the teacher. Similarly minority students' responses to being picked on and baited resulted in them responding in a way that got them into trouble. Ogbu (1994) holds that lack of opportunity, teacher attitudes toward minority students, and students' response to teachers' attitudes toward them often results in less than positive outcomes for many minority students. Ethnicity often influences the way people organize themselves in work or analogous school settings. Similarly, school officials may have different expectations and perceptions of students based on ethnicity. Differing perceptions of cultural forces such as ethnicity can contribute to the effectiveness or ineffectiveness of existing policy (Burns 1989) which translates to school

practices. What a white student perceives as school success, community acceptance, positive learning experiences and the like may be very different for the black or Hispanic student.

Ethnicity as identity has meaning when there is contrast with other ethnic groups. Thus, ethnicity is often used as a labeling system in mixed society. These labels are applied boty internally and externally thus affecting the way different ethnic groups are seen by others and the way people see themselves (Burns 1993). These differing perceptions, views and labels can easily lead to miscommunication and misinterpretation often resulting in well meaning actions having an effect opposite of that which was originally intended. Interestingly, when the usually privileged white male students perceived themselves being treated unfairly by not being called on or only given the hard questions, they applied pressure to the teacher (Weisbeck 1992) by either acting out or communicating that they didn't like what was going. Some of these male students' responses were such that they resulted in disciplinary action from the teacher. When students feel that they are not being treated fairly, regardless of gender and ethnicity, their reactions to teacher attitudes toward them clearly affect their classroom behavior and thus their success.

What Students Do

The second of the three main themes evident in the focus group data is what students do and don't do that contributes to their academic success or failure and that of their fellow classmates. The sub-themes in this section include student effort, student behavior, student feelings, and students' perceptions of mathematics.

Student effort

Student effort was mentioned in all focus groups. Student effort is divided into in-school effort in and out of school. The following sub-themes are present; classroom participation, and homework/out-of-school work.

In-school student effort: The effort one makes during class is often more deterministic of one's success in school than out-of-school efforts. Participating in the activities of schooling both in and out of school are important to a student's success, but failure to participate in the activities of schooling while in school is often detrimental to one's success as being able to do one's math homework is usually dependent upon whether or not students paid attention and took notes in class so that they could do their homework later.

Classroom participation: Classroom participation accounted for 88/274 or 32 percent of the student effort responses and consisted of attendance, note taking, paying attention, participating in classroom activities, and having a book in class. Of these responses, 16 percent were from the best practices group with 73 percent from the general groups, and 11 percent from the white male groups (Table 15). These percentages are high for the general group and lower than their group proportional representation for both the best practices and white male groups.

Table 15. Focus Groups: Classroom Participation

BP (25%)	**G (59%)**	**WM (15%)**
16%	73%	1%

Off-task activity: Off-task activity was mentioned in 25 percent of the student effort responses and consisted of not taking notes, unwillingness to participate, not paying attention, sleeping, and not prepared with book, etc. for class. Of those responses,

31 percent were from the best practices group, with 61 percent from the general group, and 7 percent from the white male group (Table 16). These percentages are slightly high for the best practices group, close for the general group, and low for the white male group compared to their proportional group representation.

Table 16. Focus Groups: Off-Task Activity

BP (25%)	**G (59%)**	**WM (15%)**
31%	61%	7%

The benefits of classroom participation and the effects of off-task activity are exemplified in the following quotes:

> S: There's a lot of people who just come in, they don't have their [books and supplies], and they'll go to sleep.
>
> S2: If I pay just more attention . . . ask more questions or stay after school ask for more help . . . I could do a lot better.
> L: So are those things that you are just not willing to do or are they not available for you or what?
> S: I just feel like not doing it
> S2: I kind of agree with her. If you like put more into it you'll get more out you know what I'm saying like if you pay more attention and you're not as lazy . . . if you have a good teacher you need to take advantage of it . . . so you could get a better grade.

Out-of-school work–study: Of the total responses under student effort, 34 percent were specifically related to out-of-school work and study. Of these responses, 72 percent involved participating in out-of-school work–study activities, with 28 percent pertaining to avoidance or the failure to engage in outside school work–study activities.

Engaging in out-of-school work–study: Of the responses pertaining to out-of-school homework–study, 22 percent were from the best practices group, 53 percent from the general group, and 25 percent from the white male group (17). These percentages were lower for the general group and the best practices group and higher for the white male group than their proportional group representation.

Table 17. Focus Groups: Out-of-School Work–Study

BP (25%)	G (59%)	WM (15%)
22%	53%	25%

Failure to engage in out of school work/study: Of the responses pertaining to not doing out of school work, 18 percent were from the best practices group, 54 percent were from the general group, and 25 percent were from the white male group (Table 18). These figures are low for both the general group and best practices group and high for the white male group. It is interesting to note here that the white male group is higher in frequency on both engaged in homework and study and avoidance of homework and study by 10 percentage points for both response groupings.

Table 18. Focus Groups: Failure to Engage in Out-of-School Work–Study

BP (25%)	G (59%)	WM (15%)
18%	54%	25%

The following quote illustrates how one young man knew he could have been successful in algebra but just was not willing to put in the effort required to be successful until his fourth attempt at the course.

> L: Would it be fair for me to say that you failed algebra 3 or 4 times because you didn't do the work you needed to do, or did you fail algebra because you couldn't do it?
>
> WM: Two of the years I failed because I didn't show up, and one of the years I failed because I didn't try, and the fourth year, I passed it. I could do it every year, I'm sure I could've done it. I'm sure I could've done it my first year, but . . .

The value of education

As a part of the theme of student effort, there were several mentions of the value of education. They were not numerically large, but the comments the students made were quite pertinent to this topic and deserve mention here. There were 12 instances of students mentioning the value of education, 8 from the best practices groups and 3 from

the general groups and 1 from the white male group, which translates to 67 percent of the responses regarding the value of education coming from the best practices group, 25 percent from the general group, and 8 percent of the instances of the value of education mentioned by the white male participants (Table 19).

Table 19. Focus Groups: The Value of Education

BP (25%)	**G (59%)**	**WM (15%)**
67%	25%	8%

The following exemplar illustrates one student's ideas on the importance of realizing the value of education.

> WM: I don't think kids really understand the consequences, the importance of a good education these days. I mean it's fun to come and goof off in class and you know you're cool, because you have fun and make fun of people, but those people who are not cool who are sitting there doing their stuff, making good grades . . . look at them in about 7 or 8 years . . . and the people who are goofing off are probably going to be working for the people who are sitting there doing their stuff. They just don't know the importance of a good education, what options it gives you in life. I think the teacher really needs to try to get them to realize what they are here for. Not just to see their friends and goof off, you know.

Future plans

When students were asked about their future plans, there were a total of 61 responses from 9 of the 13 focus groups. Thirty-four percent of the responses came from the best practices group, 52 percent from the general groups, and 13 percenet from the white male groups. These percentages are close for the white male and general groups to their group proportional makeup but nearly 10 percent higher for the best practices students. Of the offered comments about future plans, 77 percent of the responses indicated plans for future college career work, with approximately 30 percent of those indicating that they may be interested in pursuing a math-related career.

Student feelings and stress

In 12 of the 13 focus groups, there was at least one mention of student stress, frustration, difficulty or feelings of inadequacy with a total of 59 incidences. Only four, less than 7 percent of the incidences of student stress/frustration, occurred in the best practices group, yet they make up about 25 percent of the interview population. The general group accounts for about 59 percent of the mentions of stress/frustration while they constitute 57 percent of the focus group participants. The white males accounted for about 34 percent of the indications of stress/frustration, yet they make up only about 15 percent of those participating (Table 20).

Table 20. Focus Groups: Student Stress/Frustration

BP (25%)	**G (59%)**	**WM (15%)**
7%	59%	34%

Of all the 12 focus groups and 89 students, there were only nine, approximately 13 percent, of the incidences in three groups of students indicating that they felt positive, confident, or adequate with respect to math. Over half of these (56 percent) came from best practices groups which constitute less than 25 percent of the focus groups. In two-thirds of the focus groups, there were no mentions of positive, confident, or adequate feelings about math whatsoever. These feelings are illustrated in the quotes below:

> WM: We'll have jokes in class . . . it gives us a time to sort of relieve the stress, cause we're sorta worried about like the class [AP Calculus & AP Statistics], and it's also not as intense that way. I like that . . . by the time you're in high school people are mature enough to know when it's funny. . . . Sometimes, when things are just getting really rough, and tests are coming up or something, but, still, everyone's there to learn.
> L: So, in your class when the jokes happen . . . it's just like a quick stress reliever?
> WM: Yeah.
> WF: [The teacher has] every single step laid out for you so you see what they did, and [I'm] thinking, "How in the world? That's not anywhere close to mine!"
> BM: Yeah! I get like that a lot. [I]t's like if you put a number in the wrong spot, it will mess up the whole answer . . . you have to go all the way back to the top.

WF: And you just get so frustrated and you're like . . .
BM: I don't want to do it any more!
WF: It's just like, "Oh, well, whatever!"

BF: I guess teachers get frustrated cause we supposed to know it. But if people keep on telling you, "Why don't you know this?" you know you get. . . . That puts you down and you like, whoa!

WF: I think that's one of the problems, like a lot of the teachers, they're rushing to get through the book instead of taking quality, it's quantity to them. Okay, we have to finish, hurry, hurry.
BM: I heard one teacher say that yeah, they had to go through a certain amount that's in the book. . . . Which I don't think that's right, because you really don't have time, like . . .
WF: To actually learn . . .
BM: Yeah. It's like you're rushing.

BF: And then you say cram up for the FCAT [Florida Comprehensive Assessment Test] . . . and if you haven't passed it. . . . Like I know there's a lot of fears in our class that, it's quite a few that didn't pass.
L: What happens if you don't pass the FCAT?
Chorus: You don't graduate! You don't get a diploma with your friends, that's right!
BF: They really do try hard and they go to the classes and they do everything. You be like 2 points away [from passing], and they can't even, you know, get it.
BF: You already got enough stress trying to figure out how to do the [math], then you gotta go back and learn all this [for FCAT and SAT (college entrance exam)], and that's so much!
WF: So much for all their credits!
WF: There's different instructions for taking them [FCAT, SAT and ACT (college entrance exam)] too, it's like don't guess on this test, but guess on this test.
BM: Yeah. . . .
WF: If you have like a senior, and they have all their credits, like all we're saying, maybe it's just that, it's like, FCAT is like you know, not working out for them, and they can't graduate because of it. It puts a lot of stress on them.
WF: It's just like, it downgrades you, if you can't graduate just because of a simple test.
BM: There's a girl on the news, and she made like straight A's, and boy, she could not pass the FCAT!
WM: [Math is] frustrating. . . . I never understood it quite as well as other kids . . . it just doesn't make much sense to me. . . . I've never made high grades in math.

WM: Teacher E would sometimes . . . messes up a lot and do something then erase the whole thing and say, “Oh, I messed up.” And keep going. And it seems like [the teacher] doesn't even know what . . . doing. So it's kind of hard to learn from someone who keeps erasing and starting over.

> WM: In my past, all the math teachers I've had have always taught it their way and one teacher proves the other one wrong. . . . And then, I had to learn a whole new thing and then, those teachers finally doing what my old one did, they connected.
>
> WM: [When teachers] teach tricks to essentially get around the math and get an answer and then you're actually taught the true mechanics of the it's hard for you to comprehend.
> WM: Yeah, if you're taught a way that isn't proper by a teacher who doesn't want to go to the trouble of teaching you the right way, and then you actually have to learn the right way, it's hard to assimilate.
> WM: In the book they over word the theorems waaay too much.
> WM: Yeah.
> WM: And sometimes like the teacher will try and explain it and they'll over word it even more. It's really really confusing sometimes.

These quotes illustrate some of the stresses, frustrations, and feelings of students in terms of their self-confidence, fears, hindrances, and pressures as they encounter high school mathematics. These feelings have been expressed by all groups, sometimes in different contexts, but are fairly common for all groups. However, it is interesting to note that in terms of stress and frustration the white male group reported 34 percent of the stress and frustration, while they constitute only 15 percent of those interviewed; add to this that there were no indications of feeling positive, confident, or adequate with respect to math from the white male group. This is contrary to the commonly held cultural pre-supposition that math is easy and comes naturally for many white males. These figures point to the possibility of a high level of stress and anxiety for white males with respect to math. Similarly, over half of all comments that indicated a positive self concept with respect to math came from best practices groups comprised of minority students and white females which is supported in the between-groups comparisons from the RQS (figure 8).

Student behavior

By far, both in my experience as an educator and from the focus group responses, student behavior is one of the most important factors that affect student success both from

the individuals' own personal behavior to the effect that their behavior has on their fellow classmates. As a classroom teacher, maintaining a positive learning atmosphere and not allowing some students' inappropriate behavior to deter from the educational environment of the classroom is one of my most important duties. The data in this section illustrate the affects of classroom behavior on the learning atmosphere.

In every focus group there were negative mentions of student behavior in class, with a total of 215 instances. Given 215 mentions out of 89 participants, this is nearly 2.5 mentions per student, making it one of the most salient themes in this portion of the study. Fifteen percent of them were from best practices groups, with 61 percent from the general groups and 23 percent from the white male groups (21). These percentages are in line with the proportional makeup of the groups for the general group, but less for the best practices and more for the white male sections. Classroom behavior was clearly something that the students felt very strongly about and found to be a real impediment to learning and the classroom environment.

Table 21. Focus Groups: Student Behavior

BP (25%)	**G (59%)**	**WM (15%)**
15%	61%	23%

As illustrated in these passages, both students and teachers are frustrated when disruptive student behavior interferes with learning in the classroom.

> BF: My fourth period class . . . talk talk talk talk talk, they be on my nerves [the teacher don't say nothing. . . . Sometimes . . . they talk so loud [and I think,] "Shut up 'cause I'm trying to learn." Geometry's not really an easy thing to comprehend for me so I try to learn . . . but they just be on my nerves.
> BF: Like in Teacher F's class (honors), . . . don't put up with that crap. That's the difference between those two.
> BM: Teacher B, . . . got certain students in second period that act up a lot.
> F: A lot of people like to talk.
> F: And they can't talk quiet, either. They have to be really loud.
> BF: The whole class, just be outrageous, just be talkin' out loud, outrageous.

F: It makes it harder for us to do our work in class . . . when everybody gets loud like that. I know there's a few people who actually are tryin' to do their work and can't concentrate.

WF: I moved here about a month ago from New York and in my old class my teacher was really strict about behavior and she'd give a lot of detentions and stuff when people fool around. And when I came here I was so shocked 'cause in my math class there's people sitting next to me listening to a CD player and just sitting there and sleeping on their desk. And people bring cards and some people play afterwards and they get all their homework done, but people that just sit there and play cards while the teacher's teaching and they don't do anything at all, and it just shocked me so much that [the teacher] didn't even care, . . . didn't even yell at them or give them trouble or anything.

WF: Like last year I had Teacher G and it was their first year teaching. . . . I was in an Algebra 1 class and most of the kids in there . . . had failed and weren't really paying attention and the whole school year they were just messing up, like we didn't learn anything.
WF: [They] ha[ve] no control.
WF: [They] didn't really teach like . . . couldn't teach . . . was too much into being [nice] . . . never write referrals . . . never got anything done.

BF: I'm a student, but some students come to the teachers with an attitude. [General assent.] And I feel that if a student comes to a teacher with attitude they should get attitude back with them, or write 'em up.

L: O.K. And why does . . . put your class on silence?
VOICES: 'Cause . . . gets annoyed 'cause they talk too much.
F: Very. They get rude.
L: Do you have disruptive students in the class?
VOICES: Yes! Yes!
BF: And I just sit there and laugh at the whole thing.
L: And you don't think that's disrespectful?
F: It is! . . . It's disrespectful to the teacher.
BF: You have to sit there, and you might as well be asleep because you can't do anything else or else you get in trouble for that, too.
BM: Sometimes . . . needs to feel . . . in control. If . . . doesn't then, . . . gonna puts us on silence.
BF: [They] spends more time getting on to people and writing referrals than . . . on teaching math.
BM: Yeah, I can't count straight . . . ‘cause there be people talkin' while . . . tryin' to teach . . . yeah, it's really hard.

BM: I think we look like we want, more discipline, but then again, we gonna act out even more if have too much discipline.
WF: Once you put restrictions on us or whatever, or you tell us something to do, we have the tendency to just go the opposite way.

> WF: Our education depends on other people sitting right next to us or in our class or whatever, because that's what forces the teacher to stop, and like "Okay, why are you talking now?"
>
> L: When the teacher writes up referrals does it help?
> WM: Usually not, 95 percent of the time, no.
> WM: Kids nowadays don't really care.
> WM: Students have to learn like to respect those around them, and their teachers. . . . People are always focused on like, now, and don't think about where like the education can get them.
>
> WF: Parents like to think that their kids want to learn. . . . So they send them to school and hope their report cards will get better.
>
> BM: This one guy, Loren, [laughter] . . . he should be on Ritalin or something, like he's really out of control, and so he had his own personal tutor just so he would get out of class [and leave the teacher alone].
> BM: He's loud and stuff, but he usually do pretty good [academically], in class. . . . You know, it's not a day care center . . . a tutor supposed to be for someone who need the help.
> WF: And that's basically what the tutor was to him [a day care center].
>
> F (Best Practices): My geometry class is like a kindergarten class. There's this group of boys and they always play [they throw] paper and they talk and when they're done with their notes they're running around the class.

As illustrated in these quotes, often the success of a student depends on that student's teacher's ability to maintain a positive learning environment in the classroom. Students that are off task and disruptive to the learning environment rob those conscientious students of their opportunity to learn and detract from the teacher's ability to carry on class. As mentioned by one student, it is the tendency for students to respond negatively to too much control, but at the same time there is a clear desire expressed by these students for more control and a better learning environment. These comments point to the need for teachers and administrators to work with each other and students to maintain a classroom atmosphere that is conducive to teaching and learning at all levels of the curriculum.

Throughout the focus group interviews, there was a general consensus that behavior was better in the honors and higher level classes from both students in those classes and among the general student population. In my observations and experiences and those of student informants, the degree and frequency of disruptive behavior in honors and advanced classes is much less than in the general education curriculum. The higher the class, the better the behavior tends to be, as the students at higher levels are more focused on their academic success, and the teachers assigned to teach these courses tend to be the best and most experienced on the faculty. In the general curriculum, many students are less school identified and are more focused on the social rather than the academic aspects of schooling. The following exemplar illustrates these ideas.

> F (Best Practices): I think one difference between like lower classes and higher classes is the behavior. If you are in a class with a bunch of bad behaved kids the teacher is focusing on like discipline and stuff and not on teaching.

As is evidenced by these passages, students perceive classroom discipline as a big problem and as a clear impediment to their learning. It is also apparent here that many students want their learning atmosphere to be more controlled and less disrupted by these students they refer to. Additionally, they make it clear that even if the teacher takes action and refers the student for disciplinary action, often, if there are no follow-up consequences at home, or if the school's consequences are not effective, the disruptive behavior continues and those who want to learn are deprived of an effective and appropriate learning experience.

In my experience as a mathematics educator, classroom discipline is one of the biggest challenges. Finding that balance between keeping order, maintaining a positive atmosphere, and being so strict and stern so that the students rebel against the teacher is not always an easy task. I have found that if I make it clear from the start that an orderly

quiet classroom is my first priority and that this is important so that those who want to learn can, and then I enforce this strictly by not allowing disruptive students to get away with bad behavior, then they soon learn that as long as they are quiet and let me teach to those that want to learn, things work out nicely. Those who don't want to participate learn to be quiet; those who want to learn tend to move closer to where I work and pay attention. After a while I find that most of the students who want to learn have very little patience for the jokers. I feel that it is part of my prime directive as a teacher to maintain an atmosphere that is conducive to learning. If I don't do this, those who are not taking school seriously and come to school to play deprive those who want to learn. Teachers have to enforce the rules by giving students consequences and discipline referrals if they are disruptive, even if they really don't want to. Not setting and enforcing boundaries for students allows a few disruptive students to ruin the entire class for everyone else. In order for teachers to be effective, they have to find a way to maintain a classroom environment that allows those who want to, to learn. As a practicing teacher, I have found that I can teach more effectively this way and that in the long run, my students appreciate it. Often it is those very jokers who come back to me years later and thank me for putting up with them or apologizing for their bad behavior.

Math rating

When students were asked how they felt about mathematics, there were positive responses in all focus groups and negative responses in all but three focus groups. Fifty-nine percent of all mentions of math ratings or attitudes toward math were positive. The best practices groups accounted for 27 percent of the positive responses, with 52 percent of the positive responses coming from the general group and 21 percent from the white male group (Table 22). These percentages are pretty much in line with the group

proportions, with the white male group having a slightly higher percentage of positive feelings about math than their representative proportion of respondents.

Table 22. Focus Groups: Math Rating—Positive

BP (25%)	**G (59%)**	**WM (15%)**
25%	52%	21%

Approximately 41 percent of students responded that they felt negatively about mathematics with 21 percent of those responses coming from the best practices group, 65 percent from the general group, and 14 percent from the white males (Table 23). These proportions are slightly lower than the group makeup for the best practices and the white male and slightly higher for the general groups.

Table 23. Focus Groups: Math Rating—Negative

BP (25%)	**G (59%)**	**WM (15%)**
21%	65%	14%

As illustrated by the following quotes, statements indicating a positive rating of math were very often qualified by the notion of it being easy. If students indicated they liked math, they liked it only if it was easy or math in general was easy for them.

> BM:I think math can be fun sometimes a little, but only sometimes like when you get it. . . . Now if you don't get it it's very frustrating.
>
> WF (Best Practices): It just depends on whether it's something like I can comprehend real easy or not. . . . It just depends on whether I understand it.
>
> WM: It's not my favorite, but I have a pretty good teacher that'll, you know, sit down and really explain it. And if I can understand it and have an easy time doing it, then I, everything's good. I don't really hate math, you know, some people do.

Of the students who gave a negative rating of math, the reverse was not necessarily the case. Several students who indicated that they were successful with their math simply didn’t like it. Students indicated that they didn’t like it because it was hard or frustrating, or because of the cumulative nature of mathematics, its exactness and restrictions which

made it scary, boring, and not free and exciting. These expressions are illustrated in the following exemplars:

> WF (Best Practices): Well math is straightforward unlike English where you have to get into it. And it can mean one thing or another math is just straightforward and it's just there and it's always going to be there. . . . I like that.
> WF: That's what I don't like about math.
> F (Best Practices):I don't know I just don't like formulas and it is just like boring It's not exciting.
> F (Best Practices): I don't enjoy math particularly I just kind of do it. I'm just like OK whatever because I don't like math. I just don't like it a lot.
> BM (Best Practices): Yeah, I just take it as a challenge though. . . . I've never liked math . . . Yeah. I'm pretty good at it but I don't care too much for it.
> S: I 'd be terrified. . . . I was scared of math classes. . . . Now I'm not as cause I just sit in class and just be quiet.
> L: So what do you mean, you used to be terrified of math.
> S: When you get your name called out . . . I hated it I hated it. . . . [I would] just duck in the chair, so no one could see me.
> WF: That part of my brain doesn't work.
> WF: Like you come in class and it's just like. . .
> BM: Freeze!
> BF: Very boring.
> BF: I prefer writing to math.
> WF: Yeah.
> BF: Yeah, me too.
> L: You like math over writing?
> BM: No.
> Several Voices: No.
> BM: Me too.
> L: Why do you like to write? What is it that's fun about that?
> BM: It's easier to do that.
> WF: There's no rules—you just put on paper like what you want [laughter]. In math you can't put your thoughts into like a [parallelogram], it's just numbers and letters.
> BF: It's not really practicing, you can just start writing whatever's on your mind.
> WF: You can express yourself, you can just let it fly .
> BF: It's just flowing. . . . You just write what falls on the paper.
> WF: I think math is also like, it's just like with the guidelines, you have to sit and do something exactly right, and there's some ways you can do it and it still being right.
>
> BF: And you have to think like way back, into like two years ago to something you forgot, then you have to learn it all over again.
>
> BM: One thing about math I don't like is if you get the problem wrong, it's wrong. Like you know with English or something, you might put a verb in the wrong place

> or something like that, you know just get a little point off, for some things a half a point, where with math, if it's wrong, it's . . .
> Chorus: WRONG!
> BM: There's no turning back [laughter].

Textbooks

While there were not a tremendously large number of comments about textbooks, the comments were informative for this analysis. Of the 39 comments regarding textbooks, the only positive responses—31 percent with respect to the usefulness of the textbooks—came from the best practices group and from one white male who was a high honors student. The general education students seemed to be very dissatisfied with their books and did not find them to be very helpful. However, my observations as a teacher indicate that the general education students don't attempt to, or have not developed the skills necessary, to use their books properly. More often than not, students don't read the book or the explanation or attempt to follow the examples; typically they just turn to the problems and try to work them, seemingly unwilling to read and study the text to enhance their understanding. The general education math student typically depends on the teacher for all explanation. In my experience, it is the exception to the rule if much actual book study takes place within this group of students. This unwillingness to read and study may also be a function of lower reading levels associated with lower level classes. In general, the lower the level of the class at OGHS, the higher the number of students with reading scores below grade level on the FCAT. If students are lacking the requisite reading skills, then it stands to reason that they wouldn't find their textbooks very helpful.

Best Practices

When we examine traditionally disenfranchised groups, it is important to look at the members of these groups who succeed at the highest levels. By determining the

factors, attitudes, and behaviors that contribute to their success, we isolate another piece of the puzzle that may help others become successful as well. One of the sub-groupings within the focus groups consisted of students identified by their math teachers as high-achieving minority and female students. When students in these groups and highly successful students in other groups were asked what they did that helped them to be successful in math classes, a total of 52 instances were identified as best practices. Following is a list of the most frequently mentioned best practices to which high-achieving minority and female students attribute their mathematical success.

Of all the practices listed in the best practices groups, taking notes in class was the most important and most often mentioned. Students indicated that they copied down all the problems that the teacher worked in class, and if the teacher explained things verbally or said things that made the material more clear, they also wrote this down. Students also indicated that not only did they take notes in class, but also that they studied their notes and reviewed them when doing homework and studying for tests.

> L: Most of you all write down what the teacher does?
> S: [General Assent] [Yes].
> L: And do you go back and review them at home usually?
> S: [General Assent] [Yes].
> S1: I may practice with the [notes], like if we're having a test or something and it's reviewing or something, . . . I'll actually look back in my notebook and take problems and put them on it and then just give myself a quiz and then grade myself afterward.
> L So you actually make your own self a practice quiz? Does anybody else do anything like that, or something similar?
> S: [General Assent] [Yes].
>
> L: So is it fair to say that you ladies pretty much write down everything that happens in class all period?
> S: [General Assent] [Yes].
> L Do you go home and do homework every day?
> S: [General Assent] If we don't finish it in class.

All of the best practices indicated that they did their homework nightly, came to class prepared with a book and the appropriate supplies, and paid attention while in class. Asking questions when they were not sure of how to do a problem and checking their homework for correctness and asking for help were also common practices among these students. Several students indicated that having a certain degree of self-confidence and believing in yourself was important to their success, which makes sense because if you don't believe that you can be successful in mathematics, then why bother? So a positive can-do attitude is also a vital element in the tools and practices that these high-achieving minority and female students implement in their successful mathematical practices. The following quotes exemplify these practices:

> L: What is it that you do that helps you be successful in your math classes?
> S: I guess it's believe in yourself.
> BM: That's it right there.
> L: Do you all agree to that?
> S: [General Assent] [Yes].
>
> L: Does it make you feels stupid to ask questions?
> F: No.
> M: No.
> F: If you don't get it, you don't get it. And you've got to know.
> F2: [Our teacher] is a really good teacher, so asking questions, you are most likely to learn a lot better than you would if you read the book because the book is really confusing.
> F3: I think everybody asks questions.
> F: Yeah.
> F: I can't think of one person who hasn't asked like a couple of questions throughout the year.
> S: My every night before like I go to class or whatever . . . every night it 's like a routine for me I spend like about 3 hours a night on homework.
>
> S4: I bring my book to class and I take notes.
> S: I always take notes every day.
> S: I do my homework with my notes and everything. . . . That helps me a lot.
>
> S: When the teacher's actually teaching something, all my friends, we all want to do good on the tests so we actually pay attention.

L: So you and your friends all have the same goal? So are you saying that your friends are doing the same thing you are, in having their book and taking notes and paying attention?
S: Yes.
L: So, in that way, friends are not a distraction.
S: Yes.
L: And you're all on the same page, doing the same stuff in class?
S: Yes.

As a teacher, I have had many students come to me over the years and say, “I can’t do it!” When my children were in kindergarten, the first homework assignment for both of them was to bring home a piece of paper with the word “can’t” written on it and bury it in the yard. A parent had to sign a form stating that they had done this. I have adopted this little ritual for my students or anyone, for that matter, who tells me that they can’t do something. I have people write, “I can’t do math” or the pertinent phrase on a piece of paper and then have them go home and get a spoon, as if they were small children, and bury it in the yard. I have them promise not to dig it up. I also explain to them that forevermore they are not to use the word “can’t.” They may say, “Math is difficult for me” or “Math is hard” or “I hate math” or “Math sucks,” but they may no longer say “I can’t do math.” I then explain to them that if they will engage in those same practices that are on the best practices list, they will be successful in mathematics.

I remember giving this speech to a clerk in a convenience store in a town where our family vacations annually. Two years later, when we were on vacation I ran into this young woman in WalMart. She recognized me and told me that she had done what I told her, and she had passed her math, graduated high school, and was now doing very well in college.

As a teacher, I have struggled with students to get them to take notes and just do the things that we all know are required to be successful in school. Pay attention, take notes, do your homework and study. Teachers usually set it up so that if students do these things, they will most likely learn the material and pass. However, getting students to actively engage in these practices continues to be one of the greatest struggles for teachers. Usually, there is not much difficulty in getting high-achieving school-identified students to engage in these practices, but for the general and lower level courses, it is often an uphill battle.

Ethnicity and gender – student

Ethnicity and gender affect all parties in the mathematics classroom. When we enter the room both students and teachers bring in their pre-existing notions, experiences, and reaction patterns. Following is the second part of the analysis of ethnicity and gender, from the perspective of the student.

Ethnicity: Of the comments regarding ethnicity, the following reflect upon stereotypes of Asian superiority in mathematics, the value of education and the cultural discontinuity that is experienced by many African American students in a Eurocentric educational system, the refusal of one Hispanic female to submit to such oppressive values, and the invisibility of such ethnic bias in the white male groups.

> BF: It seems like with minority students, it seems like we have to work so much harder just to make it.
>
> L: What about like, according to gender or race? Have you seen any bias that way?
> WM: Not really. It's been pretty fair that way.
> WM: this year I sorta got roped into joining the math team, [and] pretty much everyone there is like Asian or foreign in some way, it's just part of their culture, that their parents have instilled on them the importance of education. And that's something they're always gonna like. And we in America, we like the education and stuff, but I think we also have a more realistic approach, where it's like it's not always about that, it's also about enjoying your life. . . . As far as like Afro-

> Americans go, one thing I have noticed in my AP classes that there aren't as many, and it does make me like sort of sad, and I know a lot of students who could probably be in a class like that and there are only a couple who actually are in AP classes, but I think, in a way it is sort of their culture that school isn't something they're gonna care that much about, it's, it's more about athletics. And achieving in other ways, and I think it makes it even harder for the students who are trying to achieve [in school], because they're more isolated from their own cultural group. In a way they're sort of pigeon-holed, because other students, outside their group, would automatically expect them to be good in basketball, or party animals or something. And then people within their own group are not as interested in that type of education, it's more like an education on the streets type thing, that the kids see on the shirts and stuff, and that's what is held up as, the example, and I think that, like, a good way to see the difference is like, I don't know, music and sports and everything. And it's not a bad thing, it, I think it just shows why there is such a difference, in the enrollment.
>
> HF (Best Practices): I guess just like being Hispanic has just never been a problem to me. Because I 've just always felt like people are people and the color of your skin or your gender shouldn't affect the way that you can deal with something. And I mean yeah I can understand that you feel like you have to represent, but I just feel like all people are equal to begin with so it's like less something to prove.
> L: So you didn't feel the pressure because you already walked in there with this base of your own internal knowledge that we are all the same and whatever the rest of it is just is not relevant for me? And you're saying that's how you felt?
> HF: Emhm . . .
> WM (Honors): It would take a monumental effort, really, to make the differences, to stop it, and I don't think that will happen in our lifetime, quite honestly. I mean, I wish it would, but.
> L: So what is "it"?
> WM (Honors): I wish that the integration of education would occur, but it's not something that we're gonna have catch phrases, or like shirts and designs, or commercials like we have for anti-tobacco, it's just not going to happen like that. it's going to have to be like, everyone appreciating what an education can get you.

It is interesting to compare the invisibility of many cultural barriers for minority students to one white male with the refusal of the Hispanic female to submit to those same barriers. That which we have not experienced we often do not perceive, but when we become aware of oppressive factors within a situation, we are able to use that awareness of such cultural myths to rise above them so that they lose their power. This appears to have happened with this Hispanic female.

The complex interaction between the invisibility of ethnic bias in school to one white male student with an understanding that allows a Hispanic female to free herself of the cultural myth that oppresses her is exemplified in the comments of a third student, a white male, who seems to have a rather deep understanding of the inequities in education and the non-triviality of a solution. He realizes that education is valuable and that making things equitable in school won't be as easy as wearing t-shirts and advertising campaigns with catchy slogans on television and billboards and that it is not likely that these educational inequities will be remedied in his lifetime.

Gender: There were several instances of underlying cultural presuppositions about gender and math, such as math not being relevant and a lack of female role models as well as an awareness of some research about gender bias. Additionally, there were several mentions of the differences in the ways males interact and bond and their general gendered lifetime experiences being different than those of women. Several males felt that females were more focused on their grades, and they had the perception that girls had more difficulty emotionally dealing with a "bad" grade than boys; because of this, girls often got "grade boosts" from the teacher that a male wouldn't even ask for, because males "can take [a bad grade]."

> WF: You have a lot of like men who teach mathematics, so it's like running through your head, "Oh, well, I can't do that cause it's a guy thing."
> WF: Yeah.
> WF: I think it clicks with guys better. . .
> WF: They always play a lot of, you know, the video games and stuff, and so they can see stuff, abstractly, out there. And we, like, psychology doesn't believe that's what we're about.
> L: So I heard you say that you think boys are more analytical, and women less analytical. Does that mean that women can't do that?
> WF: It's more like facts, facts, facts, and we're more like we can make up stuff, more creativity.
> BM: Yeah.

BF: I don't think that guys are smarter than girls on that, maybe cause I'm just stubborn [laughter]. No, cause I mean if you look at them and they kinda crazy, and they interact. . . . I think the thing with us is that maybe we don't interact so much, like if we had our own set up as a classroom the way we want it, I think if we interact with one another, we probably could do just as smart.
WF: We were doing a thing on psychology, [we learned that] teachers are more likely to call on boys than they are on girls.
BM: I think it would be girls, I think girls pay attention more, I never paid attention to that.
BM: My dad has a little like, like, boys are not good in English and all, which is probably true, but like not always.
L: It is—why do you think that's true?
BM: Like I'm good in like English and stuff like that. What I'm not good at . . . I think math, 'cause boys are more into sports, you know they have to know they numbers and a little more like in football and stuff. And maybe like the little angles and . . .
BF: Boys like to figure out stuff, figure out, like curious . . .
WF: I think that's how your brain works. They're like really focused on mostly numbers, and we're on the other half of the brain. [Laughter.]
BM: The movie Like Mike, when he was teaching them how to do geometry, through basketball, like up two angles, and acute like, and I guess when the coaches teach them how to set up in their different plays, it's more of an angle, you know what I'm saying, you have to be in a certain spot, maybe that's why [males] understand math a little more.
BM: Yeah, and sewing . . . but the classes are so small it's hard to get to sew, like . . . I'm still trying to sew on a [button].
WF: There are so many like guys in our class who are like "Ooo, sewing, no, no, oh yuck!"
WM [Honors]: Another thing that's pretty frustrating is, not all females, but I have seen females like can beg themselves into a certain grade. Like they get 79 or 78 or something on a test and they're the type of people that can't make worse than and A or a B, so they go to the teacher and just basically whine themselves into an 81 or an 82. And I've seen it happen and it just gets frustrating. Sometimes the teacher can be a really nice person and everything. . . . I guess some girls just have a knack for that kind of stuff, but . . .
L: But you don't observe guys whining themselves into a grade?
WM: No, because guys can naturally take it better than females.
L: Take what?
WM: Like bad grades. Guys can, not being sexist or anything, but guys can take a C and say move on, it just bounces off or you can go get another A. Whereas girls, they may get a low B, high C and just completely freak out and not be able to recover from it for a good amount of time.

The comments above regarding female students being more sensitive to lower grades than males is supported in Pattatucci (1998), indicating that women with better

grades than their male counterparts tend to drop out of STEM-related classes in college while males with worse grades stay in. Often women who make “bad grades” feel like they don’t “get it” and that they just don’t have what it takes to be successful in a STEM major; consequently, they quit. On the other hand, males will just keep on chipping away, often repeating the same course until they get the grade needed to meet their major requirements.

White Males: The focus of this study is primarily on the best practices and perceptions of minority and female students in the mathematics classroom. However, in order to offer some contrast to those who traditionally do well in mathematics, focus groups were held with white male informants as well. Excerpts from these interviews serve to illustrate contrast with the minority and female students as well as to confirm some of the more common theory on the differences in male and female behavior in education. The following excerpts are supportive of the literature indicating that males tend to attribute their failure to not working hard enough, while females often attribute their failure to a lack of ability.

> WM: [In] the 9th grade failing was probably from the lack of trying hard. 'Cause I'm lazy.
> WM: Same with me.
> L: Why do you think you had such a hard time getting algebra?
> WM: Well, partially cause I'm lazy and I didn't try . . . I was lazy so I didn't pass because of that.
> WM: That's similar to me, except I'm just too lazy to do my homework, so I don't want to.
>
> WM: I think it was a little bit of everything. Like at the point that I didn't . . . like I wasn't getting what I should be getting, I didn't take the initiative to try to get it myself.

These quotes have the commonality of male students taking responsibility for their failure with the explanation that they didn’t work hard enough. None of the white male

comments regarding failure indicated that their failure was a result of their inability to do the work.

The pervasiveness of cultural norms and gender roles that still attribute the innate ability to perform well in mathematics to males, leaving the language-oriented and creative pursuits to females, is illustrated in these passages. However, among these clearly evident cultural patterns, there are instances of both female and minority students rejecting gender stereotypes and succeeding in areas in which they are supposedly not going to do well. Examples include the black male who is good in English and who wants to be in sewing class and the Hispanic and black females who are successful and not willing to let the stereotypical deficiencies apply to them. Even though one female says that she doesn't think boys are better than girls, she qualifies it by saying that she is hardheaded or going against the way things are. The idea that girls can succeed in mathematics is clear here, but the underlying gender assumptions are still clearly present in the comments of these students.

Classroom Questions and the Random Questioning Strategy (RQS)

Classroom questions

The question asking and answering process is one of the main vehicles for teacher student interaction and learning in the mathematics classroom. In addition to the RQS (Random Questioning Strategy Experiment), a more in-depth examination of this process from the student perspective is informative. When students were asked if they asked questions in class, 47 percent indicated that they did ask questions in class, while 53 percent indicated that they either didn't ask questions in class or that there was no opportunity to do so. Of those that indicated that they asked questions in class, 36 percent were from the best practices groups, 44 percent were from the general groups,

and 20 percent were from the white male groups (Table 24). Both the best practices and white male rates of reported question asking is higher than their proportional group representation, while the general group's indicated question asking behavior is nearly 15 percent less than their proportional group representation.

Table 24. Focus Groups: Ask Questions

BP (25%)	**G (59%)**	**WM (15%)**
36%	44%	20%

Interestingly, students indicated that they rarely answered questions in class. Only 11 percent of the responses regarding questions pertained to answering questions voluntarily in class. None of these responses was from the best practices group. Twenty-five percent of the positive responses came from one white male focus group, and the other 75 percent were from the general group (Table 25). Only two students, 2 percent, indicated that they liked being called on in class, while 10 percent indicated that they did not like being called upon. This leaves approximately 88 percent of the participants who gave no opinions on whether or not they liked being called upon in class. Given that this dynamic is often related to a students' understanding of the material, further examination of this topic is in order.

Table 25. Focus Groups: Answer Questions

BP (25%)	**G (59%)**	**WM (15%)**
0%	75%	25%

The following exemplars illustrate how some students feel about asking and answering questions in class:

Asking questions:

HF: When you ask the teacher questions then they can help you out too. Because before I wasn't asking questions or anything. I was just sitting up there and letting everything go along letting everybody else do all the work and I would sit there [and I didn't understand].

BM: If you ask them . . . wouldn't explain it . . . would just write it down and it would be like that's how you do it.

Answering questions:

L: Do you volunteer to answer questions in class?
WM: Yes sometimes. If I'm sure of the answer I do.
L: What if you're not sure?
WM: Then I usually don't. . . . I just don't want to get it wrong before everyone else.
L: So what do you mean you used to be terrified of math?
WF: When you get your name called out . . . I hated it.
BM Oh just duck in the chair, so no one could see me.
L: So you duck in the chair. Why did you hate that?
BM: ‘Cause I was always scared for every time I get called up I panicked and I knew the answer but I panicked and everybody is looking at me and so I was scared that if I get it wrong they would laugh.
L: Does that happen a lot in your classes when people get the answer wrong the rest of the class laughs at you?
WF: They'll giggle or they'll just be quiet.
L: And that makes you feel?
BM: It don't matter no more.
L: But it used to make you feel?
BM: Mad like.
L: But now I notice you said that if you don't duck and try and hide from the class it works out better. Could you talk about that a little bit more?
BM: Yes it's like if you don't hide from it then. If you duck or whatever that's when teachers call on you.
S: [General Assent] Emhm.
L: So what happens if you get called on and you don't know the answer? How do you feel?
WF: Well the first time you feel bad.
BM: Oh, man, you feel sorry.
BM: Definitely when the class is quiet and everybody like looking at you and you don't know it [laughter] . . . and they always have a little kinda "Oh, you don't know that."
L: And then how do you feel when you answer the question correctly?
BM: Oh, powerful [laughter] Powerful.
BF: I like when I can answer a question, cause I feel really good. I'm smart! A pat on the back, a good day today!
BM: Yeah, like I'm proud of myself!
BM: It's good when you understand. You just understand it there and then. That's good.
L: How does it make you feel when you understand?
F: Good 'cause you know you can get it done.
BM: Like you're super smart, and you just feel good.

Focus groups RQS

There were several students in the focus groups who were also in treatment groups for the RQS experiment. During several of the focus groups students shared their thoughts about the RQS. Of the 33 mentions of the RQS in the focus groups, 28 percent were positive, 62 percent were negative, and 10 percent were neither negative, or positive. All but one of the positive comments were from the best practices and white male groups, while the negative responses came from the best practices and general groups.

> L: Are you in a class where they are doing a little hand-held thing?
> WF: Yes.
> L: OK. So do you like that?
> WF: Yeah I like it now cause I pay more attention I understand it I used to hate it but now I like it cause I understand it .
> L: So just since the little hand-held thing's been in your class you pay more attention because . . .
> WF: I'm scared I'm gonna be called on so I pay attention.
> L: OK and before the little hand-held thing you weren't scared you'd be called on?
> BF: She didn't call on nobody. She'll say does anybody know?
> L: You didn't get called on so you could just sink back there in your chair and not worry about having to answer!
> WF: Emhm.
> L: But if you don't know the answer how do you feel about the pass thing?
> WF: I'll pass or I'll just say I don't know how to do it can you show me.
> L: Is that comfortable for you to be able to say "Pass"?
> WF: Emhm.
> L: And so you like that little thing?
> WF: Emhm.
>
> L: [The] kids don't' laugh at you? Why do you think they don't laugh at you when you say "Pass" but they would laugh at you before?
> WF: They don't laugh at you just like “Oh she got it wrong" that was like laugh or just giggle now it's like . . .
> L: And now they don't do that?
> WF: [Right.]
>
> L: Do you feel like you pay more attention now that there is the hand-held thing in class?
> BM: Uh huh.
> F: Uh huh. You never know when you are going to get called.

L: Do you think having that hand-held in the class has changed any of [the disruptive behavior] at all? Have the disruptive students paid more attention, do you think?
F: They've sort of improved it.
BM: But as long as you follow along, everybody should know the answer when they call on you.
L: And when, when that little computer thing finally calls on you, and you're unsure of the answer, what do you do? Do you pass? Or do you attempt if you can?
BM: Yeah.
F: If you can.
BM: I try.
F: I pass.
F: I think you should try.
BM: [The teacher will] help you out if you try. And if you're following along in the book, the answer is usually right there in the book.
F: If you pass the question, it's like, you'll never get it. But if you, like, if you're kind of unsure and partially know the answer, then, after, after you say what you know, and then . . . tell you whether it's right or wrong. And then . . . go and do the work on the board, and then you'll finally get it.
L: So what about those times that you pass the questions? Are you then able to figure things out on your own afterwards?
F: [The teacher will] ask somebody else, and then you get it from them. And finally . . . 'cause then [the teacher] works it out for somebody else, and you can see how it's done.
L: For those of you who are in classes where your teacher is using a hand-held computer, how do you feel about that?
BM:. Like, if someone gets asked a question, and they don't know the answer, and you do, it is kind of frustrating.
F: It seems like, you know, when you know the answer, [the teacher] calls on other people. But when you don't know it, like that's when [the teacher]decides to like call you.
S: [General Assent] O.K. . . . yeah.
F: That's always the way it is.
S: [General Assent] Uh huh. Yeah.
F: When you don't know the answer, you're being called on.
S: [General Assent] Yeah. Yeah.
F: When you know the answer the . . . thing never picks your name. [I]t drives me so crazy.

The preceding excerpts indicate that while some students do express a little frustration with the RQS, it does seem to have a positive effect in that students pay attention more. Also, they have to learn to be patient and give others a chance. Often teachers fall into the habit of depending on the students with the answers to answer

simply because it is easier. However, by giving everyone a chance, those who usually do not participate are encouraged to; and those who don't pay very close attention are motivated to pay closer attention as they may be called on at any time; and those who answer all the time now have to learn to give others a chance. While it may be a little uncomfortable for some students who don't know the answer or those who have the answer but it is not their turn, the knowledge that there is the same chance for each student to be called upon for every question does seem to have a positive effect on classroom attention and participation as reflected in these students' responses.

Teacher perceptions and feedback – surveys and comments RQS

Teachers' beliefs and conceptions affect their classroom practices (Adams and Hsu 1998) and the implementation of change in the mathematics classroom (Merseth 1993). Fundamental to the implementation of any intervention is the teacher's perception of the intervention's usefulness and effectiveness. If a teacher feels that an intervention is both useful and practical, it is more likely to be used in daily teaching practice. However, if a teacher finds that an intervention is too troublesome, it is not likely to be incorporated into the daily educational routine. When the RQS experiment was implemented, teachers were asked to keep notes on their perceptions of the project and its usefulness. They were also asked to record their observations about themselves and their students.

All teachers participating in the RQS experiment indicated that getting used to using the hand-held computer and incorporating it into their daily questioning routine was awkward and a bit cumbersome. However, they also indicated that they would like to continue to use such a system and offered suggestions as to how to improve the RQS system. Two of the teachers suggested changes in the software interface to make it easier to use and more transparent in the teaching process. The hand-held data collection was

done in Excel with a randomly generated list of names for each day. As a teacher asked a question, that teacher chose the next name on the list and then recorded the outcome by placing a 1 in the column for attempt, pass, or correct. A third teacher explained, "The screen was way too small for these old eyes." This teacher indicated that having a randomly generated list for questioning was desirable, but she would have preferred the students' names on a 4 x 6 card to be put in the order suggested by the generator each day before class. Then the teacher would keep track of students' responses on the cards. All teachers participating in the project were provided with a paper copy of each day's spreadsheet in case of technical difficulties. This same teacher (the third teacher) chose to use the paper versions rather than the hand-held computer and entered the data at the end of each day.

All participating teachers indicated that their students liked the RQS, that their students were more attentive, and that they would like to use such a system for collecting participation data for student grades. As part of her feedback to me, one teacher took the student survey and answered it herself, adjusting it so that it reflected her evaluation and experience with the RQS. She indicated that students liked the RQS; she also indicated that the students liked the classroom procedure better before using the RQS (students were not required to participate in class prior to the RQS; classroom participation was voluntary) and preferred that the teacher not continue using the hand-held device for questioning in class. Following are several related comments:

> Teacher Q: The students seemed to enjoy the anticipation of being called on individually in random order. . . . Students who would normally try to sleep were awake and participatory. As they became comfortable with the system, they were less inclined to pass.

> Teacher R: Students knew that they had to pay attention even after they were called on because they could be called on again. (This was a positive voiced by several of my students.)

> Teacher G: The students seemed more quiet/attentive. Many were off task, but when called on and I repeated the question for them, they seemed to focus better. When I told them that answers to routine calculations would be included in the questions asked, they all got out their calculators and were prepared to use them when normally they can't be bothered to even get them out of their back pack. . . . They really seem more focused . . . and were often inquiring whether or not the information gathered on the hand-held would count toward their grade.

Two of the teachers indicated that using the hand-held device prevented them from relying on unison response during the question asking process and felt that this was a positive outcome. While unison response is often used by teachers, it is discouraged in most teacher training courses and in much of the questioning literature. Additionally, these teachers indicated that it changed the way they asked questions. It assured both them and their students of fairness in the classroom. The following quotes illustrate these ideas:

> Teacher G: I find that when I use the hand-held computer . . . that I ask better questions, am more patient waiting for a person to answer, give more leading information to lead a student to discover the answer or figure it out. . . . I want them to get it right if they can. I notice that this device has me call on students I never call on and that to some degree it makes them pay more attention because they might be called on. . . . The other thing is that it totally prevents me from doing random response which is my normal way of teaching and interacting. By avoiding this I think class is better behaved, less noisy and more focused.

> Teacher R: The random generation of names helps me not to encourage or accept unison response. . . . [It] assures me and the students of not being biased. We all know how easy it is to let the student who knows the answer just shout out.

Overall, the teachers' response to the RQS was positive. Teachers indicated that students seemed to like the RQS and were more attentive, focused, and better behaved. Teachers reported that the RQS encouraged a more fair and unbiased atmosphere in the classroom in the question asking and answering process. The one teacher who indicated

that her students both liked the RQS and would rather have things “the way they used to be” presents an interesting situation. From the focus group interviews, many students indicated that this teacher was very easy-going. and that as long as students didn’t disrupt the classroom, they could pay attention if they wanted; and if they didn’t want to, that was ok too. With the RQS, both the students and the teacher indicated that students paid more attention and did better in class. Additionally, student motivation scores for this teacher significantly increased from pre- to post-evaluation. Given that this intervention requires students to focus on class because they may be called on, their performance and attentiveness would improve. Prior to the RQS, it is then understandable that students reported not liking the RQS because it forced them to pay attention. Not having to pay attention in class if one didn’t want to would be preferable to most students. Thus, simply arranging classes so that students are required to pay more attention to avoid being called on and not knowing the answer in the RQS does seem to have a positive effect.

Students’ perceptions, attitudes, and feedback—surveys and comments RQS

Students in the experimental groups were given an additional ten questions about their experiences with the RQS. They were also given space for free response comments about their experience. Each of the follow-up questions was presented on a five-point Likert-type scale like the rest of the post-survey questions, with 1 being strongly agree and 5 being strongly disagree.

Follow Up RQS Questions

I like it when the teacher uses the hand-held computer in class.

I pay attention more in class since the teacher began using the hand-held computer.

I take more notes in class since the teacher began using the hand-held computer.

I understand better since the teacher began using the hand-held computer.

I do more homework since the teacher began using the hand-held computer.

I am more prepared for class since the teacher began using the hand-held computer.

I felt that I had a fair chance of being called on in class since the teacher began using the hand-held computer.

I am more willing to answer questions in class since the teacher began using the hand-held computer.

I prefer the way my teacher asked questions in class BEFORE she/he began using the hand-held computer.

I prefer that my teacher continue to use the hand-held computer.

There was no significant difference in response based on gender or ethnicity for nine of the ten questions. The exception was the question that dealt with students' perceived fairness of the RQS, which significantly differed by gender. The median score was 3, no opinion, for nine of the ten questions, indicating that as a group, the students had no strong negative or positive opinions regarding the RQS. However, when asked if they paid more attention in class since the teacher began using the hand-held computer, the modal response was "agree" for all groups, indicating that the students as a whole felt that the RQS helped them pay closer attention in class. When asked if they felt that they had a fair chance of being called on in class since the teacher began using the hand-held computer, while the modal response was 3 for all students, the boys' response was significantly higher than girls', indicating that boys felt more negatively than girls about the fairness of their chances of being called on in class than girls. Given the research indicating that boys are consistently called on more than girls in class, the RQS, while giving all students the same chance, may have lessened the boys' perceived chance of being called on.

As part of the student evaluation of the RQS, respondents were given a space to share their comments regarding the use of the RQS in class. Similar to the survey items, the responses were evenly balanced with positive and negative responses toward the RQS. There were several comments about how the RQS encouraged students to pay attention to their work since they could be called upon at any time. Students also commented that it encouraged more students to participate. These positive responses were balanced by students who indicated that they didn't like the RQS, felt it was a waste of time, and found it confusing or stressful, as indicated in the excerpts below:

Positive responses:

I liked my teacher using this method, because the whole class got a fair chance on answering a question, even ones that were quiet and never wanted to. It also made me listen more because I never knew if I was next.

I think that the hand-held computer was a good thing because it got people to participate in class.

I think that the teacher should continue to use the hand-held computer because it gives everyone a chance to participate in the lesson. It helps students understand the lesson more.

It didn't change much except it got the students more involved in your teaching.

Negative responses:

I think the hand-held computer was not very affected. For one, it took more time out of the lesson. It also got me confused because some students would say the wrong answer. I think it is better when students just raise their hand. Also, students tend to goof and play around more with this system of teaching math.

I strongly dislike the hand-held computer because not many people enjoy or are confident enough to answer or speak in front of the class. It puts people on the spot and can put them in an awkward situation. It can put someone in a stressful situation filled with anxiety. Thank you.

I don't like the hand-held computer. It seems that I never get called on. Everyone doesn't have a fair chance to answer the questions. I think it should go back to the old way. It doesn't make me pay attention any more or any less.

> I feel it is useless. . . . If you know the answer in class but it doesn't pick you, you can't answer even if others selected don't know the answer.

> It pisses me off because it sucks and always calls on me.

It seems clear from the free response and survey questions that the RQS encourages students to pay more attention in class, whether they think this is a positive attribute or not. Some welcome the opportunity to participate more and to have the whole class participating, while others seem to resent this invasion of the status quo. Given that the RQS encourages students to pay closer attention in class, and given that as a group the modal response is fairly ambivalent toward the RQS, further investigation over a longer period of time may be justified to more accurately gauge students' responses and academic outcomes to the intervention.

What Administrators Do: The School Environment

The third major theme apparent in the focus group data is what administrators do. It is the job of the school administration to maintain the school center and the school environment and to insure that learning takes place. Many policy decisions made by administrators determine who gets to "get" the content. Administrators determine teacher and student assignments to classes, class size within the state and local guidelines, expenditures and allocation of funds and school resources, discipline policy, and the enforcement of that policy. The actions of school administrators in many instances often determine who does and who does not learn and the degree of learning that takes place.

Under the heading of school environment are the sub-themes of good and bad classes and class size.

Class size

In six out of seven of the general curriculum focus groups, large class size was mentioned 85 percent of the times that class size was discussed; yet these students constitute only 57 percent of those interviewed. Students identified as high performers in the best practices groups' mentions of class size accounted for only 5 percent of the total, while the white male groups mentions were 10 percent of the total. The following comments indicate students' experiences and perceptions in terms of class size and the effect class size has on classroom behavior and instruction:

> BM: I bet my class is full, I don't know how much it is, but I think it's full. . . . Yeah, it's only one teacher for the whole class.
> WM: I just can't focus on what I'm doing because there's too many people. . . . I do my homework in class. They're always talking and I just can't focus anymore and I just, I just give up and don't do the homework. . . . If there's more people, there's more bad behavior.
> L: You don't have behavior problems in your class and you've had honors classes your whole life.
> WM (Honors): Emhm sometimes the classes have been a little large which is kind of hard on the teacher that he can't really get to everyone with their questions though.
> L: Are you still able to learn OK in a larger class? Do you still do OK?
> WM (Honors): I still do ok. I mean it's just a little harder.

The effect of a large class size on instruction is similar for both the regular and honors classes; however, the effect of class size on behavior seems to be less of a problem in a large honors class than in a large general curriculum class. Following are excerpts from the focus groups indicating the benefits to both students and teachers of a smaller, more intimate class size:

> BF: Like I had two math classes and one of the math classes was really small. [I]t was easier for [the teacher] to explain things to people [and not] get aggravated cause there's not a lot of people in the class talking and disrupting. And then I have another math class. I have . . . and we have a lot of students in that class and . . . acts totally different. To what a teacher with a small class would. You know getting really aggravated with always having to calm the class down. So if a class is smaller the teacher can do their job more because . . . doesn't have to worry about trying to get the class to be quiet and do all the other things instead of teaching.

WF: I remember back in like the 6th grade, it was a smaller class, it was like, it was to help you more on math, cause you needed like an extra push, and like my grades went up. Like I was getting A's in math. And then they put me in another class cause I was doing good enough, and it was smaller, and the teacher was like one on one. And you know, after like I watched it on the board, I was like, "Can you explain this to me, just one more time?" It has to go through my mind like twice, not once, so I can get it.

BM: I remember like, we had, in 5th grade, back then we had so many. . . . But like, I know once I got confident or something, I would get straight A's . . . when they put me in a smaller class I would you know, just [do better].

WM: At the very beginning of class there was so much chaos because we had like a whole bunch of people in the class. We couldn't get started, though. And that's how come she never really had any time to talk. And then, she just got so, like hardened to the middle of the year that she just didn't talk at all because they didn't want to do the work. And then if you got it wrong, oh well. And when it came to quiz and test time, I didn't get good, I didn't get anything good because I didn't know the work. [The teacher] just wasn't capable of um, keeping them down.
PL: Your teacher couldn't make the class behave, and because she couldn't make them behave then she didn't get to teach, and then you didn't get to learn?
WM: Right.
WF: I think that if the classes were smaller, then maybe the teacher could teach us.

WF: Our class is always small.
L: How small is really small?
WF: There's, like, 14 people. And there's only like 16 in the [Advanced Placement] Stat class.

From these comments, it is evident that these students feel that they are better served in smaller classes with a more intimate learning environment, which is contrary to much of the research on class size that indicates that in a secondary environment it doesn’t matter much. The comments of these students indicate that indeed class size does matter and has a direct effect on their learning opportunities. These data also indicate that larger class size is more detrimental in the general education curriculum than in the more advanced and honors courses.

Good and bad classes

In 9 of the 13 focus groups, the theme of good and bad classes was present. Of all the comments regarding classes 73 percent referred to good classes, described as high

level, honors, and college preparatory classes. The remaining 27 percent of the comments referred to bad or slow classes which are described as “on level” or “low level” classes and classes with behavior problems. Of the comments referring to bad classes, less than 8 percent were from the best practices groups; 15 percent were from the white male informants. The remaining 77 percent of the comments about bad classes came from the general groups, which is nearly 20 percent higher than their group proportional representation (Table 26).

Table 26. Focus Groups: Bad Classes

BP (25%)	**G (59%)**	**WM (15%)**
8%	77%	15%

Conversely, 34 percent of the comments regarding good classes being synonymous with honors and advanced classes were from the white male group, which was more than double their group proportional representation. These figures indicate that white males may perceive that only honors and advanced classes are good at a much higher level than their female and minority counterparts. Similarly, the general group’s increased proportion of the mentions of bad classes than their group proportional representation may indicate that these students are experiencing classes that they perceive to be bad or at least are under the impression that the general education curriculum is bad or at least not as good as the honors and advanced curriculum. Since most of these students are in the general education curriculum, it stands to reason that if they perceive these classes to be bad, they are also experiencing what they perceive to be bad classes at a rate higher than their white male and honors school mates.

Very recently I was discussing end of the year course recommendations with a colleague. During the course of the conversation, she indicated to me that she had

several students in her Honors Geometry classes the previous year who had been recommended for regular Algebra 2 because they didn't have the grades to be recommended for Honors Algebra 2. She indicated that for many of the students this was really devastating—not because they were being recommended for regular Algebra 2, but because these white students were worried about being in classes with black students in the regular curriculum; they were clearly under the impression that these were bad classes and that the minority students in them were bad as well. The comments of these students serve to verify the pervasive idea that good honors classes are white classes.

Views From the Field

Outside Participant Observations

The following text is from the field report of the colleague who assisted with the implementation of this project and conducted several of the focus group interviews. Her observations support both my field observations and many of the comments of students in the focus groups.

> - In all of the focus groups, students indicated that they enjoyed math and learning math. They did however indicate that their fellow students were often the very ones who hindered the process, by not paying attention in class, disrupting class, or simply demanding that the teacher(s) focus their attention on disciplinary problems rather than math. This speaks to the pedagogical and economic problems of teaching in a public school, rather than to the subject content.
>
> - I personally noticed how crowded the classrooms were, how many students were sharing books (I assume that they were all issued individual books at the beginning of the school year, but I am not sure) [yes they were – many of them would simply not bring them to class] and how distracted and distracting some of the students could be. This validates the focus group comments about the instructors spending valuable classroom time on other issues.
>
> - Out of all of the focus groups I conducted [4] only one woman said that she didn't like math. When I asked her why, she said it had to do with the personality of the instructor, not the content or anything else. She even said "If Mrs. XX were teaching history I probably won't like it because it was her."

- This comment is significant, in that out of all of all the students I interviewed with the exception of this one student, all of the women and minorities indicated that they like math and thought that it was important for them to master.

- Female students repeatedly commented that the examples given (context) were not always relevant or interesting to them. This speaks to mathematics textbooks continuing to use male and culturally biased examples to illustrate the problems. I noticed that even in Mrs. XX's classroom (a teacher who is also a feminist scholar) the examples on her bulletin boards were stock educational examples, not ones that spoke directly to the cultural, economic, or gender makeup of her students.

- One final impression from the focus groups and observations were that gender roles for women and minorities are changing, but very, very slowly. When I asked what people thought they would do after high school, those who answered go to college then proceeded to answer that that they wouldn't need math to major in the kinds of things they were interested in. As I remember it, only a couple of individuals indicated going into the medical, science, and or engineering fields. This speaks to Sue Rosser's continuing research on the career paths that women and minorities select.

A Lifetime in the Field

In qualitative research, the reflections, thoughts, reactions, and perspective of the researcher are recognized as part of that approach. It is common practice in qualitative research to give intellectual space to the resultant views and insights of the researcher, as the researcher is the instrument of measurement. This exploration along with self-reflection of biases, insights, and perspective of the researcher serves as a sort of calibration of the researcher as instrument of measurement revealing the underlying assumptions and position from which the researcher views the subject at hand. In this section I bring the self-reflective portion of the qualitative approach to the dissertation.

As an observing participant in this study and as a long-term mathematics educator in this school, I was in a unique position to observe the culture of the mathematics classroom from many different perspectives. I have my personal experience as a female student of mathematics and as a professional mathematics educator, my perspective as an observing anthropologist, and my perspective as both a member of the school system and

power structure as well as a member of the community and a parent of children attending the public schools in this area.

I recall that as a successful female student in mathematics, I often felt like I didn't know enough, like I always needed to learn more background as if I had missed something earlier in my math career. I remember feeling this all through high school and college. Even though I was relatively successful in my mathematical endeavors, what I wasn't sure of, what I didn't understand was what I focused on, not those things I did understand. This feeling of inadequacy often contributed to my ambivalence about math. I was good at it, I could do it, but I never felt smart enough, not like I could really be a mathematician. I always described myself (and still do) as a good mathematical mechanic but not a mathematician. When I began this topic of research I came to understand that these feelings of inadequacy are quite normal for women in the STEM fields (Pattatucci 1998; Rosser 1997). Women with better grades and a good grasp of the subject matter are much more likely to drop out of a STEM course than a man in the same course with lower grades. When women feel like they don't understand, they believe they aren't being successful and don't belong; whereas a man who is academically much less successful will often stick it out and successfully finish the course despite poor grades.

Over the years as a mathematics educator, I have watched students give up. Somehow they get the idea that they just cannot succeed. I've watched many females who do not seem to have any interest, and when they do try they have no idea what they are doing because they have been lost for so long or they have the idea that they just cannot do math. This idea tends to come either from the students themselves as a result

of repeated attempts and failures and a general lack of stick-to-it-iveness or from parental ideas such as, "I could never do math, so I don't really expect my kids to do well there either." The other issue I see in this area is students choosing to fail. Rather than try and then fail and be judged as unsuccessful by the system, often students will refuse to try. This way, their failure is by their own volition rather than assessed by the school system or their teacher.

My personal experience as educator and observing participant: In this section I will relate a couple of personal stories that serve to illustrate the idea of students' good behavior not serving them well and the necessity of having experienced teachers teaching those that need it the most in an environment where teachers can teach and students can learn. As an educator, researcher, and participant observer, I have been a practicing mathematics teacher in the public schools of north central Florida for the past 20 years. Over the last seven or eight years of this time, my observations have been focused on the gathering of ethnographic and observational data related to those students traditionally disenfranchised in the mathematics classroom. My research and observations have been particularly attuned to the practices of students and teachers that may affect the participation and attitudes of minority and female mathematics students. It has been my observation that the students who need the best teachers and the smallest class sizes are most likely to get the least experienced and the least qualified teachers in addition to oversized classes. Conversely, those students who could function very well in a large auditorium lecture setting with a reasonably competent instructor usually have the smallest class sizes and the greatest amount of individual attention and some of the most competent teachers. This inequitable distribution of space, time, and resources often

contributes to the relegation of African American and other working class minority students to a less than adequate mathematics education.

When the least qualified and most inexperienced teachers are assigned to low level and remedial math courses, students basically don't learn. If teachers are qualified in terms of education to teach mathematics, it is often the case that they have such a small amount of teaching experience that behaviorally they cannot control the class such that they can manage a reasonable learning environment. The other aspect of this situation is that those teachers that are not qualified to teach mathematics or who are qualified to teach it only at the lowest levels are assigned remedial classes. This is like the blind leading the blind. While some of these teachers are very adept at what they do, many are not. Each year students is assigned to such a class, they fall further and further behind and at the same time they learn that they can't do math, that they are in low classes, and that they must be "dumb." Even when they try, they don't get very far, often due to no fault of their own but simply because their teacher cannot or will not teach or that their teacher lacks the classroom management skills to provide an environment conducive to learning the mathematics that they need.

As an illustration of this point, not too long ago I ran into one of my former students who was in a special remedial class. Due to a scheduling error, I was assigned to teach about eight students SAT math and eight students Algebra 1A Remediation. These Algebra 1A students had failed the first semester and needed to be helped along and re-taught what they had missed so they could proceed to Algebra 1B. Algebra 1A was the lowest course taught in the math department at that time. I ran into one student in a bagel shop who was having breakfast with her boyfriend. We spoke and said hello.

After a while when I was leaving, she stopped me and said to me, “Your math class was the best class I ever had, and it was because you yelled at us so much and made us do our work.” At first, I wasn’t sure how to take that comment, but as I think about that class, I remember that the students would complain to me about how hard the tests were and their bad grades, and I would in return basically question each one as to whether or not they had their book in class and how much time they spent doing their homework. Literally 90 percent of them would regularly have no book and not bother to do any homework or even use the time I gave them in class to work. So I basically chewed them out about how unreasonable their expectations were. They wanted to be able to pass math, but they weren’t doing their job, and to expect that they could pass by just sitting there not taking notes or paying attention to my lecture was ludicrous. My daily practice in that class was to hold the students accountable by insisting that they bring their book and calling their parents if they didn’t emphasizing the need for passing grades, and asking each student how much time had been spent doing homework and having them tell others. I will admit that I was hard on them. I demanded that they be quiet in class and that they come prepared, and if they were going to fail, they had to do it silently. I would not allow those who chose not to work to disrupt the class. In the end, those girls did well (there was one boy and he dropped out of school). Most of them were successful in the course.

One particularly difficult but bright black girl went on to the next class and was graduating the following year. She came to me regularly when there were problems she didn’t understand in her math class, and I would explain them to her. She came to me when she was studying for her senior final and asked if she could borrow a book from me to study. That made me smile; quite a change from the girl I had met a year and a half

earlier in that remedial Algebra 1A course. Later I learned that this young woman was working nights as a custodian until 2:00 a.m., caring for her father with advanced AIDS, going to school, and basically supporting her family. She used to bring baked goods and sell them to raise money for her brother's football expenses. At the time, I had no idea of her situation. One doesn't always know why students don't study, but somehow in this case I did seem to get across the importance of studying and finishing high school. For this student, having her high school diploma will definitely make a difference in her life and afford her opportunities she might not have had if she had dropped out. Currently she is taking classes at the local community college where she is employed as a custodian.

I use this class as an example of what happens to the students who get teachers who either cannot or will not teach, or the new inexperienced teacher who cannot manage classroom discipline such that there is an appropriate learning environment. This small class of eight girls was very frustrating. They just did nothing they were supposed to do to be successful in class. They were convinced that they couldn't do math. I figuratively had to whip them into shape and force them to try long enough for some of them to begin to see that they could have positive results in a math class. These students "learned" long ago that they couldn't do math. In the end, I showed them that they could; however, it was a difficult lesson for them to unlearn. This is a poignant example of what happens when the most inexperienced or ineffectual teachers are assigned to teach the students who need the most effective and most experienced teachers.

Another illustration of how "good behavior" often works against students comes from my own experience as a teacher of 20 years. When I first began teaching I would usually know all the students' names by October. As the years went by, it became

December, and eventually it would be the end of the year and there would be students whose names I simply couldn't recall. To be fair to myself, I should make it clear that I always remember their faces and many details of their life, their clothes, shoes, and other details; it is just the names that escape me. After reading about the problem of teachers calling on boys more than girls, I began not only paying attention to my questioning behavior but also noticing whose names I remembered and whose I didn't. It turns out that the nice, quiet students who never give me trouble are the ones whose names I am least likely to remember. I may know that they are good students, but when it is time for me to use their names, my brain goes blank. This is the reverse of how it should be. Students who are well behaved and doing their jobs are the ones whose names I should know; however, as it turns out, the names I more easily remember are those of the students who are most badly behaved and acting out and to whom I have to give my attention to keep order in the class. I recall very early in the school year that there was a young lady who had a penchant for making smart remarks or some retort to most everything I said. It was only the third day of school and I looked at her and said "Rikki, it is not a good thing that I know your name already; you need to stop calling my attention to you with your remarks." Immediately, several students who had been in my class previously chimed in agreement, "You don't want her to know your name; if she knows your name this early in the year, that's bad!" The observations of my former students confirmed my own observations. The students whose actions should have been rewarded by receiving my attention were not getting it, while those who were behaving badly got my attention and instant name recall as well. This is a personal example of how teachers respond to pressure. Unfortunately, when one is trying to teach and keep

control of an unruly class of 30 students, the pressure students exert definitely has its affect.

Leadership for Social Justice

The patterns of injustice and bias inherent in the system as a whole have become quite clear to me as an observing anthropologist. The poorer minority students are consistently tracked to lower level courses with the least expectations and the least prepared and least effective teachers, while the middle- and upper-class white students tend to comprise the majority of the higher level academic courses, with the best teachers in the school, broader course offerings, and smaller class size. Similarly, it is the children of parents who have the know-how and the ability to advocate for their children who regularly have their needs met. Most children aren't really very good at advocating for themselves in a very hierarchical school environment where they are at the bottom of the power chain. The children whose parents advocate for them or have modeled this type of behavior are more likely to escape the detrimental effects of tracking and are kept on track academically by their parents. Parents who did not have a positive experience in school are not likely to have any better ability to advocate for their children than they did for themselves. Consequently, this phenomenon basically perpetuates the pattern of the haves having the best and the have-nots continuing to get what is left at the bottom of the school chain. While it appears that there is equal opportunity for all, some are consistently "more equal than others."

When new programs are added to the school, they are consistently directed toward the advanced end of the curriculum to "draw the best students to our school and prevent brain drain." When I have expressed my concern as a faculty member that we are not doing what we need to do for the less privileged of our student body, I am reminded that

these new prestigious programs bring money into the school which will trickle down to the programs for other students. As both an observing anthropologist and a member of the educational system, some of the mechanisms of bias and injustice in the system are clearly visible to me. These injustices and their apparent invisibility to those with the power to change things are very frustrating. An internal sense of personal outrage tends to flare up in me. If I can see this, why can't the rest of the people around here see it? And why aren't they doing something about it? I choose to view humankind as basically good, so it is difficult for me to just assume that these people are bureaucrats who do not care about children, because after all, they have dedicated their lives to the education of the same children that I have.

The outcome of this systematic injustice was clearly in evidence when OGHS received a school grade of D from the state because less than 50 percent of the lowest quartile of our students made a year's gain in their reading scores on the FCAT. In all fairness to the school, these low scores were compounded by a rather drastic zoning change such that the students tested had not been in attendance the year before; also, the school year had been disrupted by hurricanes that caused students' homes to be out of sorts for extended periods. However, as a result, these students are now getting more and better reading instruction than in previous years. The regrettable part of all this is that it took the school receiving a grade of D before real changes were made.

Operating under the assumption that the powers that be care about children, want the students of OGHS to do well, and are "dedicated to the success of every student," as the motto for OGHS claims, has caused me to really examine and give serious thought to how these inequities that are so obvious to me occur. The first place that this led me to

look was in the assignment process of teachers to classes and in course offerings. This examination is from the perspective of an activist educator, anthropologist, and critical ethnographer. I have used a recent series of curricular updates and changes at OGHS to illustrate one possibility of how this situation might occur.

Teaching assignments

Just as teachers are effected by pressure in the classroom from students raising their hands and behaving in ways to draw attention to themselves, so too, are school administrators effected by pressure. I find that school administrators are very susceptible to parental pressure. This is not a negative thing; school administrators should be listening to the desires of parents when it comes to the education of their children. However, in my experience, it is usually the parents of white middle-class students or the parents of higher SES minority students who are expressing their concerns to school administrators. In my 20+ years experience, I don't recall the parents of a Hispanic child ever going to school administrators on their behalf. Typically, if a student is having difficulty with scheduling or getting something done, I encourage the student to have the parents contact the appropriate administrator, as this usually takes care of the situation. I make this recommendation based solely upon my experience of what works.

Some of the most unpleasant experiences of my teaching career have been with parents. In advocating for their children, I have been exposed to some of the most unprofessional, abusive situations in my adult life. Parents are often very abusive to teachers and administrators when they are trying to take care of their children. It is not unique for parents to blame everyone but themselves and their children for their children's problems. Not all parents are this way, but many appear at school meetings and conferences as if the teachers were the enemy (Gibbs 2005). It takes only a few meetings

like this for a teacher or administrator to be perceptive to the potential for such attacks. One quickly becomes fairly adroit at avoiding them as simply a matter of survival. Again, I speak from my own observations and experience. However, over the years the patterns have become more clear, and when I began to sit down and think about how these inequities happen, a consistent pattern began to emerge.

Just as teachers avoid dealing with potential abusive parents, I believe that administrators, while they have to encounter these parents, become very adroit at minimizing, avoiding, and diffusing similar abusive and explosive situations. For example, if an inexperienced or ineffectual teacher is placed in a trigonometry or a similar high level advanced class and the students aren't doing well, the class is out of control, and things are generally not going well, there will be an onslaught of parental complaints about the teacher. Administrators will talk to the teacher and observe the class, and if things are bad enough they will replace the teacher. I have observed this many times in my career. However, if an inexperienced or ineffectual teacher is teaching Pre-Algebra or Algebra 1A or Liberal Arts Math or a similar lower level class, no one really complains. The parents of students in these lower level classes are not the ones who call the principal or the superintendent. The students in these classes tend to be of lower SES and have a high minority enrollment. The parents of these students tend not to be involved in their child's education. This is not to say that they don't care, but these are often the people who themselves were not comfortable in school and thus are not comfortable advocating for their children. There is a common phrase among many African American households: "Don't make me have to come down to that school." Given this impetus from parents of not wanting to have to become involved with the

school, having to take off work for a meeting, and so forth, students and parents of students in these classes tend not to make waves for administrators. A good illustration of this is parental attendance on open house night. When I teach honors-level classes, there is standing room only on open house night; when I teach lower level classes, there are usually only four or five parents per class visiting.

"The squeaky wheel gets the grease" is a well-known adage. Indeed, in public schools the squeaky wheels tend to be the higher SES parents and students. I believe that a good portion of the inequity that goes on in public schooling is due to the fact that the parents of lower SES and many minority students simply do not have the time, experience, or ability to effectively advocate for their children. If they were the squeaky wheels, then the pre-algebra classes with poor teachers would not be overlooked. Given that we all are susceptible to pressure, then it stands to reason that it makes life easier for administrators to assign the best teachers to the high level classes so they don't get so many complaints. If they assign a poor teacher to a high level class, they are sure to make problems for themselves; however, if an inadequate teacher is assigned to the lower end of the curriculum, administrators are less likely to have complaints from parents. This observation in no way is intended to imply that administrators don't care about all students but is simply noted here as a human mechanism for day-to-day survival.

High school administrators work hard. They are at school early, stay late, and attend untold numbers of athletic and extracurricular functions. They deal with the press, the public, students, teachers, discipline, parents, and the school board. They serve as a barrier between abusive parents and teachers and as mediators between students, faculty, parents, the public, and school board officials. As far as I have observed, their job is

thankless. Therefore, it would make perfect sense that in mediating the many opposing forces and stakeholders in a school, that school administrators would have their own mechanisms for survival. If people spend their days putting out fires, they learn early on how to avoid potential fire hazards. It is my contention that by placing the best teachers in the highest level classes and the beginning and more ineffectual teachers in the lower level classes that school administrators are avoiding potential fire hazards. I do *not* believe that it is an intentional assignation of the least effective teachers to students they deem not worthy of the best teachers. On the whole, school administrators care about students; otherwise they would not have dedicated their lives to working with them.

As an anthropologist, observing participant, and social advocate, I have come to see things in a different light than do most people in the school system and general public. I have expressed frustration and outrage at the seemingly obvious systemic injustices that I observe daily, and even more frustration that others are not seeing them as well. As I sit with this frustration, I am reminded that school is a culture and that in the vein of structural functionalism, each part of the culture serves to perpetuate the whole. As each individual in a school culture struggles for its own survival, the culture of school struggles to perpetuate itself. As teachers struggle to survive and avoid obstacles, so do students and administrators. Parents who themselves were successful in school have the skills to effectively advocate for their children, and they will; parents who weren't so successful in school themselves are not likely to effectively advocate for their children. With all persons doing the best they can in a difficult situation, it seems that the squeaky wheel gets the grease and potential fire hazards are avoided in a very understandable attempt to make it through the days.

It is my hope that by illuminating these mechanisms of survival and avoidance, the detrimental affects on those without the knowledge and the resources to advocate for themselves and their children will become clear. It is only by standing back and observing the forces that move us as individuals in a larger system that we are able to see them and hopefully remedy the inequities that result from them.

As an illustration if this theory, I will recount a recent mathematics curriculum meeting where the math department was asked to meet with the administrator in charge of curriculum to address what he and an experienced teacher new to our faculty perceived as some problems and concerns. In the school year before, this particular administrator (who was new to the school) had come to the math department and asked them to cut the curriculum offerings as we had recently gone from a seven- to a six-period day with fewer teachers, and we simply didn't have the resources to offer all the courses in our current math curriculum. The courses that were cut were Consumer Math, SAT Math, and Integrated Math. Consumer Math was a course usually for juniors and seniors who needed a final math credit but were not headed for college. SAT Math is just that: a review of the math on the SAT; it was a semester course offered with SAT English. Integrated Math is best described as Algebra 2½ for those college-bound students where not aiming for a STEM major but needed to keep their math skills up as they would be required to take some college math courses. The basic effect of this change in course offering was that all the students who normally would have been taking one of these three courses had no place to go. The students for all of these courses were mostly juniors and seniors with little flexibility for credits in terms of college admission and high school

graduation. Additionally, these courses all served the lower SES and minority population more so than the higher SES and advanced curriculum students.

Curriculum

The effect of this curriculum shrinkage was that there was no appropriate place to schedule these students in the math curriculum. Those that would have normally been enrolled in Integrated Math had no choice but to take Trigonometry & Analytic Geometry, in which they were not likely to be very successful. The student who would have normally taken Consumer Math as a final math credit had no choice but to take Algebra II or Geometry. Students needing to prepare for the SAT in mathematics had no support whatsoever. Consequently, as teachers we were faced with students in our classes that were misplaced due to no fault of their own. Some teachers just let them fail; other teachers compensated for this in ways that the new teacher called grade inflation. As the only Liberal Arts Math teacher (Algebra 1½ and Geometry ½ combined) I had an inordinate number of students who came to me as dropouts from Trigonometry. These students had already successfully completed both Geometry and Algebra 2, which put them and me in an awkward situation for these classes. These students already knew all the material I was covering and they either became behavior problems by talking or they slept through class; yet they were missing the skills and background to be successful in Trigonometry. The students who would have taken Consumer Math were forced into Geometry or Algebra 2. The teachers of these classes were faced with the choice of failing students who were misplaced or passing them along for doing the best they could, which again led to the accusation of grade inflation by the new teacher who had transferred from Buckhead High, which was the most elite upper-class high school in the district. The new teacher was incensed that we were passing students who could have

never met the Buckhead requirements. This teacher was not privy to the curricular collapse of the previous year; nor, do I believe, did she fully appreciated the different student population and needs of the OGHS student body and the Buckhead students.

In the meantime, the very same administrator who had been responsible for asking the math department to shrink the math curriculum was the one handling all the resulting problems. Seniors weren't able to earn their necessary credits and were having to be placed in classes that were below them. Parents were calling very upset because their child had always passed math successfully, maybe not with all As and Bs, but the child had successfully completed Algebra I, Algebra II, and Geometry and now all of a sudden the child wasfailing math class, Trigonometry and Analytic Geometry, miserably. The problem was not the teacher or the course; it was that the student had been misplaced. These students should have been in Integrated Math. The non-college-bound seniors were failing Algebra II and Geometry because they were misplaced and should have been in Consumer Math. Typically we don't hear much from the parents of non-college-bound students, but when the possibility of their child not graduating looms, they get very vocal and begin calling administrators as well. Again, the absence of feedback from these parents is not a function of not caring; it is a function of them not having time to take off work and not having successful experiences in school themselves. However, these parents, like most parents, want the best for their children and are vested in their children's graduation and having the opportunity for a successful adult life. Again, the squeaky wheel gets the grease.

A meeting to discuss the mathematics curriculum was called, accusations of grade inflation were made, and a lot of discussion took place. Issues of poorly prepared

students, passing grades, inappropriate placement, teacher assignments, and so forth were discussed. The administrator seemed to be concerned about what could be done to make the parents happy; he did not want to have to deal with all these irate parents. As I listened and observed this meeting, it became obvious that we were dealing not with a problem of grade inflation, but with a problem of not having the appropriate placements to meet the needs of all of our students. The students on the lower end of the curriculum were not getting adequate instruction, attention, or teaching.

By this time, the administrator was so frustrated with the situation of having to put out all the fires and dealing with the parents that he was very willing to listen. He kept asking for help in identifying pieces of the puzzle. After all was said and done, I quietly raised my hand and asked if he were interested in my perspective. He said "yes," and I explained about the effects of the previous year's curriculum collapse and how it gave us no alternative but to misplace students, which then put teachers in a very difficult situation of having to decide to fail students who were misplaced due to no fault of their own or to "inflate grades." I also explained about the difficulty that occurs when beginning teachers are regularly assigned the lowest level, wildest, and most overcrowded classes in the school, a situation that sets up both the students and the teachers for failure. They have no chance of being successful as teachers or students when a brand new teacher with no classroom experience is handed the toughest, most resistant classes in the school. Such teachers have not developed the appropriate classroom discipline and management skills to manage a group of 30 students who hate math, think they can't do it, and don't want to learn. If these teachers do not have the classroom management skills to deal with this group of students, there is no way that they

can effectively teach mathematics, even if they are well-educated mathematicians. If teachers cannot maintain an appropriate learning environment, then they have no chance of successfully teaching their students a full year of math. As I was saying this, the two first year teachers who were teaching these types of classes were vigorously nodding their heads in affirmation. I then used a couple of teachers from recent years as examples of teachers choosing not to teach after one year of being put into this lose–lose situation.

The administrator looked at me as if this were something he did not realize. For me this was quite difficult: It is so obvious to me; how could he not see it? Then he asked me what I suggested as a solution. I pointed around the room to all the experienced math teachers. I said that everyone deserves a good teacher, even the low level students. I personally choose to teach some low level courses because I believe that everyone deserves a chance. As I began saying this, the more advanced teachers got looks on their face indicating, "No way!" I said while no one should be saddled with all the low level classes, I believe that everyone should be teaching them. If everyone teaches some of the low level classes and some of the higher level classes, then the new teachers get to learn how to manage their classes with students that want to learn and have experienced some success in math. If the more experienced teachers all teach some low level classes, the students who need a positive learning environment and good teachers will get them, giving them the chance to learn what they need to be successful in mathematics and also that they too can do math.

Later I asked the calculus teacher if he would be willing to teach some of the lower level kids; he emphatically said, "No," that if the administration assigned them to him he would teach them, that he would not be happy, and that he would not volunteer for such.

This leads to the other set of stakeholders in this situation: the teachers. It is much easier to teach a group of students who want to learn; are vested in school; are school and math identified; and have personal, parental, and intrinsic motivation for performing well in school and mathematics. For this reason, most teachers strive to teach the highest level classes they can get. If a teacher teaches the high level classes well, the parents don't call the administrators, there are no squeaky wheels, and things go easy for everyone except the students whose parents don't or won't call the school. These students consistently get the least experienced and most ineffectual teachers, learn the least, and come to believe that they cannot do math.

Teaching and school administration are not easy jobs. Conservation of motion is a natural human instinct: it is standard to look for the easiest path to complete a task. As a teacher it is much easier to teach high level students. As an administrator it is much easier to insure that the high level classes have good teachers because then the parents do not complain and the AP, SAT, and FCAT scores are higher. However, the direct fallout of taking the easiest path is that those who need the best teachers and the smallest class sizes and who have the lowest chances of success are put in situations that worsen their chances rather than boosting them up and giving them a chance.

At this juncture it is appropriate to leave the discussion of the math department meeting and discuss the effects of the FCAT and school grading on this topic. Most educators that I know do not feel that the current school grading system based mostly on FCAT scores is effectual. It financially rewards the schools with the best grades and does very little to help schools with low grades. It seems to many to be a "Reverse Robin Hood" system: Rob from the poor and give to the rich. The schools with the worst scores

are the ones who need the extra resources to remedy the situation. The financial rewards to good schools and bonuses to teachers in these schools is a good incentive, but if the goal is to improve education for all, this makes little sense. However, there is one part of this school grading system that I must applaud. A school's grade is largely based on how much the scores of the lowest 25 percent of its population improve from year to year. This does not allow the lower level kids to be ignored anymore nor; does it allow for the scores of the higher level students to mask those of the lower by raising the schools average scores. Scores are disaggregated by gender, race, ethnicity, and lower quartile. This forced examination of the lower 25 percent of a school's population has the potential to help remedy this situation to some degree, as evidenced by the increased number of small intensive reading courses offered at OGHS after receiving a D grade for poor reading scores.

Returning our attention to the math department meeting: As a result of this meeting, the math department was given carte blanche to rework the curriculum however we saw fit such that there would be appropriate placement for all students. The result of this new and improved curricular map was the addition of Integrated Math and Informal Geometry, and Trigonometry was replaced with Pre-Calculus. At the meetings about the new curricular progression and in the memos and e-mails regarding this, what became apparent to me was the clear tracking of students. While a teacher can always recommend a student out of one track and into another, if one follows the map, the low level students go from Algebra 1A and Algebra 1B to Informal Geometry and Liberal Arts Math, totally preventing them from any chance of meeting the state requirements for Bright Futures scholarships or the requirements for NCAA athletic scholarships which

fund many lower SES and minority college educations. As a teacher of these lower level students, during registration, I had to make clear the consequences of the students taking the less rigorous Informal Geometry (to which the flow chart directed them). This curricular path would disallow them from many scholarship opportunities. When this was made clear to them, many students come to me to request regular Geometry even though it might be more difficult for them. When this curricular map was being discussed, however, it was this same administrator who brought up these problems with that flow and cautioned the department about depriving students of opportunities by placing them in lower tracks. This then ensued in the continued discussion of grade inflation and how a B in Geometry at OGHS should be the same as a B in Geometry at Buckhead High. This leaves us with a dilemma: How do we fix this problem? It seems no matter how one looks at it, we continue to fail at fairness.

Suggested improvements

In all focus groups, students were given the opportunity to suggest additions, changes and improvements to their math classes that they felt would help them learn better. There were a total of 38 suggested improvements, with 16 percent coming from the best practices group, 11 percent from the white male group, and 74 percent from the general group. The percentages for the best practices and white male group are both under their group proportional representation, and the general group's percentage of suggestions is significantly higher than their group proportional representation.

Of all the suggested improvements, making the mathematics classroom a more interactive and fun place was top on the list. Students indicated that they wanted to be able to work together, have study groups, play math games, and be able to more freely interact both student–to–student and student–to–teacher. While students indicated that

they wanted this, they also indicated that they wouldn't likely stay focused during these activities without someone constantly keeping them on task. (This is why these kinds of activities are rarely done in high school math classes; class gets out of hand and quickly becomes chaotic such that teachers are rarely willing to arrange these sorts of things as students are hard to control and little learning actually takes place.)

Students felt it was important for teachers to go over at least some of their homework the next day before going on to a new topic. Students also said that the teacher should go over what would be on a test the day before the test. There were also several indications that maintaining order in the classroom in terms of student behavior and a positive learning environment were very important. Included in this part of the discussion was the suggestion of allowing those who don't want to participate to sit in the back of the room silently in a non-disruptive manner and have those that want to learn sit up in the front rows. Students felt that giving them the choice of whether to participate was a good thing as long as the non-participating students were not allowed to disrupt the class. Reducing class size, having time in class to begin their homework, and going at a slower pace were also suggested. Students indicated that when part of a class was studying for the FCAT, those who had passed the FCAT should be given SAT or ACT material instead of being required to do the FCAT material. Finally, students felt that if a student offered a mathematically correct solution to a problem, it should count, even if it was not exactly the way their teacher had taught them. Perhaps they had learned it from a tutor or another student, but if it was mathematically correct and answered the question correctly, such solutions should be given credit.

There were many suggestions and indications that teachers should always do what is best for their students. All these suggestions have their merits; however, given the actual reality of the public high school classroom, the conflicting needs of students, and limitations of an already overtaxed system, they are not always reasonable or feasible. For each course, a teacher is required to cover a certain amount of material in an academic year. Slowing down the pace and spending too much time reviewing and going over previous lessons prevents appropriate progression through the material. While some review and the opportunity to answer student questions are important, too much of this prevents adequate academic progress, so a balance between the two must be maintained. Similarly, interactive cooperative learning activities are often the preferred and most effective way to teach many mathematical topics; however, again, given the difficulty of keeping students on task during such activities, these are not likely to be regularly implemented unless students can become more responsible for their own behavior and learning. Additionally, the material often covered in classes that is on the FCAT is also part of the curriculum standards for that particular course. While those that have passed the FCAT would like to have an SAT/ACT review and practice, it is hardly reasonable to expect the teacher to be carrying on double classes while trying to cover the required curriculum and review for the FCAT. However, a good solution for this perceived need of students is to implement an SAT/ACT review class in the standard mathematics curriculum or provide students with SAT/ACT material to study on their own. Such a class was previously offered at OGHS, but during a teacher and budget shortage it was eliminated from the curriculum.

Given the perceived needs of the students the limits of time and energy, and monetary limits in education, the needs of students must be balanced with the limited staff and physical resources of the school system. This must be done while making whatever efforts we possibly can to continue to be aware of and eliminate institutional and cultural bias and implement practices and programs that continue to engage students in school and the activities that foster success in this setting. At the same time it is important to remember that the world is a constant state of change and that simply doing things the way we always have is not necessarily the best way to approach students and their learning in the 21st century. We must be open to innovation in a way that is fair and equitable and meets the needs of all of our students rather than a select few.

Practicing leadership for social justice

The only remedy to this situation is to grease all the wheels, not just the squeaky ones. To use an analogy, on a car, a warning noise appears early on to tell you that you need new brakes. If you ignore that sound long enough it will go away. This does not mean you don't need new brakes; it means that now you need a whole new brake job instead of just pads. After you do this once and realize that if you had paid attention earlier, a $120 repair bill would have been preferable to the $400 bill that resulted.

The current situation with the lower 25 percent of the school population being underserved could have been remedied had we paid attention to the warning signs which have been apparent in the state mandated skills tests and aptitude tests for years. It was not until we needed the equivalent of a complete new brake job that we have been forced to do something about it. To remedy this situation, administrators will have to be the tough ones here. They will have to endure the complaints of parents whose advanced students might have a beginning teacher who is learning the ropes and the complaints of

veteran teachers who do not believe that they should have to teach “those kids.” Teacher assignments are a leadership issue, and everybody deserves a fair shot in school. That means we spread the less effective teachers around fairly, not just to the bottom of the curriculum. Everyone teaches the more difficult classes—the low level classes—so that everyone has a chance to succeed. Additionally, administrators can work to make things less difficult by limiting enrollment in the lower level courses, making them easier to manage and allowing for teachers to give more individual attention to those students who need it the most.

The following school year, after having written the above passages, I was so pleased to see that when assigning classes every teacher in the math department, including those who were usually exempt from such assignments, had at least one low level course. I made it a point to tell the administrators in charge of teaching assignments how much I supported their decisions and how proud I was of them for making what I felt was a difficult but correct decision for students at OGHS. A similar policy had been in effect at OGHS when I first began working there; everyone taught some low level and some more advanced students. However, over the years, this policy had eroded to the situation described above. It is my hope that administrators will hold the line and not succumb to pressure from teachers and parents, taking us back to the previous method of assigning teachers to classes. I truly believe that the lower level math students at OGHS are better served by an “everyone teaches some lower level classes” policy.

Discussion of Qualitative Results

The qualitative portion of this study addressed several research objectives. The first was to elicit and document students of mathematics’ perceptions and experiences in order to gain a clearer understanding of their participatory behavior in the mathematics

classroom. The second was to document the effect that the use of the random questioning strategy intervention had on teachers' and students' classroom activities and behaviors. The third was to document best practices data from high-achieving female and minority students.

The research questions addressed by the first objectives are as follows:

> What are differences in the attitudes and practices of highly successful women and minority students than those of their group that do not succeed at the same level?
>
> Do the experiences and perceptions of students in the research population vary along gender, ethnic, and socioeconomic lines?

Both of these questions were addressed in the focus group data. The attitudes and practices of highly successful minority and female students were very different than those of their group that did not succeed at the same academic level. Highly successful students engaged in the common practices of successful schooling and were comfortable in the school setting as well as being highly school identified. The experiences and perceptions of students varied according to their groups of best practices, general population, and white male as well as along lines of gender and ethnicity.

The research questions related to the second objective are:

- Will teachers' questioning behavior change? Will the types of questions asked and encouraging behaviors within their questioning interactions change as a result of the random questioning strategy?
- Will students be more attentive in class?

The focus group data and comments from both students and teachers in the RQS feedback process speak to these questions. Both students and teachers reported that the way they asked and interacted during classroom questions was different and for the most part improved, and that students were both more attentive and better behaved in classes when the RQS was used.

The research questions related to the third objective were:

- Will attitudes of high-achieving students be more positive toward mathematics than those of the general study population?
- Will classroom practices and behaviors of high-achieving students be different than those of the general study population?
- Will the attitudes and practices of highly successful women and minority students be closer to those expressed by white males in the research population?

The first two questions are clearly supported by the focus group data; however, the third question is only partially supported. While highly successful minority and female students do engage in more of the same behaviors of schooling as successful white males, many white males in the focus groups were not highly successful and did not engage in the practices of schooling that tend to lead to success, as the highly successful minority and female students did. It would be fair to say that highly successful students tend to engage in the same activities that lead to success in schooling, but my perception from my conversations with these students was that the female and minority students who were highly successful in mathematics were more engaged in the actions of study and schooling than their highly successful white male counterparts. The white males engaged in the activities of schooling; however, they seemed to do so in a more relaxed manner than the highly successful female students. Additionally, the focus group data point to the possibility of a high level of stress and anxiety for white males with respect to math which is supported by the math anxiety and attitudinal scales in the quantitative portion of this study.

The focus group data, reflections of outside observers, and my own reflections point to the importance of examining the current system of mathematics education and schooling to find ways of serving and engaging students that overcome the gender,

ethnic, racial, and SES bias in our society that find their ways into schools that deprive many students of an equitable educational experience. The observations and excerpts in this chapter illustrate that while all students are attending the same good school, OGHS, their experiences are vastly different and result in very different outcomes in terms of their learning experiences and the quality of their education. This translates to major differences in their opportunities for success as they go into the world as high school graduates seeking higher education and career tracks. When the students in the lower level of the curriculum are systematically under-served, these students are deprived of the opportunities given those at the higher levels. By overlooking and allowing systematic disenfranchisement of low-status students that occurs through the inequitable distribution of effective teachers, appropriate learning environments, and allocation of school resources, the distribution of who gets to "get" the curriculum is skewed. If the resources of schooling were applied in an equitable fashion, the proportions of students in high, middle and low level classes would much more closely mirror that of the school population as a whole. While it is clear that all students cannot function at the top, these data do indicate that the students at the bottom could be much better served and prepared for lives as productive, self-supporting, contributing citizens with the opportunity to better themselves and improve their place in the societal hierarchy. In the following chapter I will bring together the qualitative and quantitative data and examine how the two inform each other, where they support each other, and where the data differ. By situating the quantitative data within the qualitative experiences and reflections of informants and observers, a richer tapestry of students, schooling, and the culture of the mathematics classroom will emerge.

Key Findings

Focus Groups and Participant Observation

Teachers

- A positive student–teacher relationship is important for student success.
- Working multiple examples, good explanation, and extra help from the teacher contributes to student academic success.
- It is important that students feel that teachers treat students fairly and equitably.
- Preconceived notions based on gender and ethnicity can contribute to unfair treatment of students.
- Negative feedback, attitudes, and behaviors can be devastating for many students, resulting in them shutting down and withdrawing from the learning process in response to such treatment.

Students

- Actively engaging in the activities of schooling—paying attention, preparing for class, taking notes, asking questions, requesting extra help when needed, regular homework and study—and a positive attitude are the behaviors that successful students indicate contribute to their success.
- Understanding the benefits of education and the role education plays in the students' future success is an important element in the process of students forging a meaningful connection with school and learning.
- White male students reported stress related to math at a much higher level than all other groups (general or best practices).
- Best practices students reported feelings of stress and frustration with math at lower levels than the other groups (general and white male).
- Student behavior was reported as problematic for many students; most instances were reported in the general and white male groups. Students indicated that badly behaved students and teachers' inability to control their classes was often detrimental to their learning.
- Bad behavior was not routinely associated with higher level and honors classes.
- General curriculum classes were often considered "bad classes."
- Female and minority students indicated that they felt they had to work harder to prove themselves.

- Male students tended to attribute their lack of success in math to not trying, indicating that they believed they had the ability to do well but did not apply themselves.

- Advanced male students indicated that advanced female students ”couldn’t take” a bad grade such as a C as well as male students could.

Administrators

- Students indicate that they learn better, students behave better, and their teachers are more able to teach in smaller classes.

- Students indicate that the general education classes are thought of as “bad classes” due to class size, unruly students, teachers who either cannot or do not teach, and teachers’ inability to maintain a positive learning atmosphere.

- Many students in the general curriculum want to learn but are often hindered by fellow classmates or poor instruction.

- Students in the general education curriculum appear to be less satisfied with their educational experiences than those in the best practices and white male groups.

- A broader curriculum that serves the needs of students at all levels of the curriculum is needed: honors, non-honors college bound, vocational–technical, and remedial. The current curriculum effectively addresses the needs of the advanced students; however, the non-honors college bound, vocational–technical, and remedial students’ needs are all lumped together into the “regular curriculum.” A more broadly focused curriculum that addresses the needs of these four disparate tracks within the larger curriculum would more effectively address the needs of a majority of the school population. This calls for an equitable distribution of school assets, resources, facilities, and educators.

RQS Feedback

- Students indicated that they rarely answer questions in class or participate in the question ask and answer process unless they are sure of the answer.

- Students and teachers indicate that students are more attentive, better prepared for class, and better behaved in class with the RQS.

- Students who tend to answer most of the questions in class were forced to wait their turn and give others a chance.

- The RQS prevents teachers from relying on unison response.

- Teachers asked better questions and were more patient and encouraging in allowing students to answer questions using the RQS.

- Both students and teachers reported feeling assured of a sense of fairness in the questioning process with the RQS.

- Survey responses indicate that male students felt more negatively than female students about the fairness of their chances of being called on with the RQS; however, all students had the same chance of being called on and they were informed of this.

Focus Group Data Table

Data in Table 27 are organized in descending order according to major theme and sub-themes in the focus group data. All analysis has been conducted with respect to the proportional makeup of each of the best practices (BP), general (G), and white male (WM) groups. The proportional makeup of each group is listed in parenthesis at the top of each column.

Table 27. Focus Group Data: Major Themes and Sub-Themes

Theme	Sub-Theme	Total #	% of Total	BP % (25%)	G % (59%)	WM% (15%)	# of Focus Groups
Teaching/ Instruction		517	100				13
	Student–Teacher Relatonship	101	19				12
	Positive	58	57	21	69	9	10
	Negative	17	17	29	70	0	5
	General	26	58	15	81	4	8
	Teaching Methods	387	78				
	Positive	259	50	17	70	13	13
	Specific + Practices	184	71				
	Explains Well	89	37	15	72	12	11
	Extra Help from Tchr	33	18	18	67	15	12
	Repitition/Work Prblms	26	14	35	65	4	7
	Negative	114	22				
	Specific Neg Practices	100	88	22	58	20	13
Student Effort		274	100				13
	In School						
	Classroom Participation	88	32	16	73	11	
	Off Task (In Class)	70	25	31	61	7	
	Out of School						
	Homework/Study	94	34				
	Engaged in HW & Study	68	72	22	53	25	
	Avoids HW & Study	26	28	18	54	25	6
	Value of Education	12	4	67	25	8	

Table 27. Continued.

Theme	Sub-Theme	Total #	% of Total	BP % (25%)	G % (59%)	WM% (15%)	# of Focus Groups
Student Behavior		215	100				
	Student Behavior Problems	215	100	15	61	23	13
Curriculum	Math Rating	106	100				
	Positive	63	59	27	52	21	13
	Negative	43	41	21	65	14	
Classes							
	Class Size	54	100				9
	Large	40	74	5	85	10	
	Small	14	26	14	78	7	
	Classes	48	100				9
	Good	35	73	6	54	34	
	Bad	13	27	8	77	15	
Unfair Treatment		94	100	14	75	12	13
Ethnicity & Gender		79	100				
	Ethnicity	36	46	19	45	36	8
	Gender	29	37	10	55*1fg	34	4
	Bias	6	8	0	67*1fg	33	3
	Gate Keeping	7	9	43	57	0	2
Questions		72	100				
Classroom							11
	Ask	53	74				
	Ask Questions	25	47	36	44	20	11
	Not Ask Questions	28	53				
	Answer	19					
	Answer Questions Voluntrily	8	11	0	75	25	4
	Called On (+)	2	3	50	50	0	2
	Called On (-)	9	12	0	100	0	3
Student Feelings		68	100				12
	Stress/Frustration	59	87	7	59	34	12
	Positive/Confidant/Adequate	9	13	56	44	0	3
RQS		53	100				
	RQS Positive(+)	15	28	80	7	13	4
	RQS Negative(-)	33	62	36	64	0	2
	RQS General Comments	5	10				

CHAPTER 6
CONCLUSIONS AND CONTRIBUTION

Data Summary and Conclusions

Quantitative Data Summary—The Random Questioning Strategy Experiment

Three kinds of data were gathered in the RQS experiment: academic performance measures, attitudinal and beliefs measures, and participation measures. Key predictor variables for academic performance, beliefs, and attitude measures were gender, ethnicity, and treatment/control. There was no significant difference in T1 and T2 implementations for academic performance for any of the predictor variables. On the seven attitudinal and beliefs scales, neither ethnicity, treatment, nor gender significantly accounted for change in the anxiety, enjoyment, or attitudes toward mathematics scales. However, ethnicity significantly accounted for change on the math value, self-concept, and beliefs scales. In all cases, white students had positive change, black students had very little change, and Hispanic students had negative or near zero change.

Treatment/control accounted for change on the motivation scale only, with students in control classes having an increase in motivation to do mathematics outside of classroom requirements. This appears to indicate that the RQS negatively motivates students; however, this could be an artifact of teacher or timing as well. Analysis of student participation data during the RQS indicated that none of the key predictor variables—gender, ethnicity, class, grade, or treatment/control—was a significant predictor of participation.

T1 and T2 scores were examined on the basis of gender and ethnicity for relative rank comparison from pre- to post-implementation. Some interesting patterns appeared in these data that are contrary to common cultural assumptions. On the academic performance, anxiety, and beliefs scales, Hispanic males tended to increase their relative ranking from T1 to T2; Hispanic females' rankings decreased strongly on academic performance and anxiety. Academically, white students scored the highest, with both white and black females outranking their male counterparts. While black women are academically outperforming their male counterparts, they are doing so with consistently high levels of anxiety. Similarly, while white males are performing at the highest academic levels, they too are doing so with some of the highest levels of anxiety. White students' high academic performance is coupled with math value scores that are among the lowest. Hispanic students' math value rankings are among the highest, with a significant decrease in black females' math value ranking. White females have the highest math self-concept rankings of all groups, which is an interesting contrast to white males' self-concept rankings being among the lowest. The highest rankings for enjoyment were among black females and Hispanic males, with white students' enjoyment rankings among the lowest. Motivational scores for black students were among the highest, with black females outranking their male counterparts, and white students' rankings among the lowest. Hispanic females have the lowest rankings on beliefs about mathematics, while black and white females are among the most positive. Hispanic males' and black females' attitudes toward mathematics are among the highest, compared to white students' attitudes which rank among the lowest. These patterns are contrary to common cultural assumptions about gender, ethnicity, and mathematics. The

students who are performing at the highest levels have some of the lowest scores on attitudes and beliefs toward mathematics coupled with high levels of anxiety. While students who do not necessarily perform at the highest levels have some of the highest perceptions of the value of mathematics and the highest levels of enjoyment and motivation, these inconsistencies indicate a need for further examination.

The purpose of the RQS was to determine whether providing students with the same chance of being called upon in the classroom would improve their academic performance, participation, attitudes, and beliefs about mathematics. In no case did the implementation of the RQS indicate statistically significant, positive changes from T1 to T2. However, examination of the pre- and post- ranking data revealed some interesting relationships between performance and attitudes and beliefs that seem contrary to popular beliefs. The absence of evidence of change on the predictor variables chosen for this study does not necessarily mean that the RQS itself was ineffectual; rather, it means that the predictor variables addressed were not significant. Perhaps a set of different predictor variables such as timidity, self-confidence and self-esteem would be affected by the RQS. This strategy may well help overcome obstacles to student learning that are variables not addressed in the present study, but that remains for further study.

Qualitative Data Summary—Focus Groups, Surveys, and Observations

The three major themes apparent in the focus group data are (1) what teachers do, (2) what students do, and (3) what administrators do. Major sub-themes are student–teacher relationship, teaching methods, student effort, student behavior, class size and quality, gender, and ethnic bias. Students indicated that the quality of the student–teacher relationship was important to their success in class. If the relationship suffered, so too did the students' performance, more so in the general curriculum classes than in the

advanced classes. Students indicated that a teacher's teaching methods and the way the teacher interacted with students was also critical to classroom success. Teachers that explain well, offer extra help to students, and work more than enough problems in class were considered good teachers. Teachers that ridiculed students, made negative remarks if they didn't understand something, got an answer wrong, or picked on students were not thought of in a positive light. Students indicated that they were aware of the importance of their effort both in and out of school and those who put forth little effort admitted that they knew that they should be doing more for their academic success. Student behavior problems and classroom disruptions were among the biggest impediments to student learning. These problems appear to decrease in number the more advanced one progresses in the mathematics curriculum. The incidence of student behavior problems in honors and advanced classes was experienced much less than in the general curriculum. Class size and quality were also issues that contributed or detracted from students' experiences in the mathematics classroom. Students consistently indicated that smaller classes allowed the teacher to teach better and also allowed for a more positive classroom environment in which to learn. There was the common assumption among students that honors and advanced classes were good and general education classes were bad or not as good, both in terms of the quality of education received and in terms of student behavior. Students expressed concern over instances of what they perceived to be unfair treatment both by the teacher and the school system. Interestingly, more observations of gender and ethnic bias were reported by the white male groups than were reported by all other groups. Both women and minority students discussed difficulties and obstacles related to gender and ethnic stereotypes and cultural presuppositions.

There were several indications of student frustration and stress, with very few indications of positive and confident attitudes and feelings about mathematics.

All focus groups were asked about the RQS, and students who were in treatment groups shared their opinions about the intervention in the focus groups as well as on post-project questionnaires where they answered survey questions and were given free space to voice their opinions. Students indicated that they paid more attention with the RQS and that when they would not attempt to answer questions before, they would attempt with the RQS. Several students indicate that they did not like the RQS but that they did focus in class more when it was in use. There was some frustration at not being able to answer when students knew the answer but were not called on. There were a few who indicated that they really objected to being called on in class that way and found the RQS objectionable. The feedback from teachers was mostly positive in terms of the effectiveness of the RQS in the classroom. Teachers indicated that students paid more attention and were better behaved, and the RQS discouraged teachers from allowing free response, promoted better questions, and encouraged patient reactions when students were trying to answer. All of the teachers indicated that they would like to implement such a practice in their classrooms as long as it could be fairly transparent to the teaching process. Students also indicated that if they paid attention while others were answering questions in the RQS, someone would get the answer and they would understand what was going on if they were patient.

One of the goals of this study was to elicit and document the best practices of highly successful female and minority math students. Identifying and outlining the behaviors that contribute to the successful academic performance of students in

traditionally less successful groups illustrates positive strategies for success for both teachers and students. Students in the best practices groups indicated that note taking and studying their notes was one of the most important activities. Nightly homework, being prepared for class, asking questions, and paying attention were also standard practices for this group of students. Self-confidence and believing in themselves was also an important element in their success.

During the course of the qualitative portion of this study, students made many suggestions for improvement of their math experiences. Seventy-four percent of the suggested improvements came from the general education group, suggesting that as a group they are less satisfied with their educational experiences than those in the best practices or white male groups. Student suggestions included making mathematics teaching and learning more interactive, cooperative, and fun, which is consistent with the tendency of women and minority students to be connected learners (AAUW 1992; Bleneky et al. 1997, 1986). Students felt that it was very important for teachers to go over their homework the day it was assigned and to address it at least some the next day before proceeding to a new topic. Maintaining classroom order and a positive learning environment were very important needs as well. Students also expressed a need for more review and opportunity to ask questions in class.

Conclusions and Interpretations

In a multi-method research project such as this, many different kinds of data are generated, both quantitative and qualitative. While each data set is informative and valid individually, examining the two data sets in concert and melding the findings gives us more clarity and a more in-depth look into the culture of the mathematics classroom.

Random Questioning Strategy Experiment

Given the results of the RQS showing no difference in treatment or control for the aggregate, one might conclude that it did not work. However, when these quantitative data are informed by the qualitative data from the teachers, students, and focus groups, there is sufficient evidence to suggest that the RQS did have positive effects on teaching and learning in the classroom. Both students and teachers indicated that students paid more attention and teachers were more aware of the way they interacted with students, giving them clearer questions and being more patient with them as they answered. In addition to more attentive students and better questioning techniques from teachers, everyone was assured that they were having an equal opportunity to participate in class. At any time, the next question could go to any student in the class. Not only did this motivate the students to pay more attention in class; teachers indicated that the students in class were quieter and exhibited better classroom behavior. Despite the lack of statistically significant results for the predictor variables chosen in this experiment, teachers and students indicated positive changes in the classroom environment as a result of the RQS. The qualitative data indicate that further research of this sort is in order with the same and possibly an expanded range of predictor variables including characteristics such as timidity, self-confidence, self-esteem, and similar measures of self worth.

Between-Group Comparisons

The between-group comparisons yielded some very interesting results that were surprisingly contrary to generally held beliefs about gender, ethnicity, and mathematics. Groups that typically perform well in a subject area are assumed to be comfortable in that subject area. However, in the between-groups data, it was clear that for this group of students, white males and females who perform academically at the highest levels are

doing so with some of the highest levels of anxiety toward mathematics and lowest levels on attitudes toward mathematics scales. While white women have some of the highest self-concept toward mathematics scores and the most positive beliefs about mathematics, their male counterparts' scores are among the lowest. Black and white women are outperforming their male counterparts academically but again with high levels of anxiety. Conversely, Hispanic males are outperforming their female counterparts academically, with very low levels of anxiety and high self-concepts with respect to mathematics. The relationship between mathematics success among Hispanic students is somewhat reversed from that of white and black students in the same courses. Hispanic males are performing well while their female counterparts have very low self-concepts, academic scores and the most negative beliefs about mathematics, while at the same time both Hispanic males and females have the highest scores for the value they place upon mathematics.

Black females, while performing at higher levels academically than their male counterparts, are also doing so with the highest math enjoyment and motivational scores. These high scores are accompanied by high levels of anxiety, low value of mathematics scores, and low self-concepts with respect to mathematics.

Examining these trends from the perspective of U.S. cultural norms, these scales and scores would indicate that while white males are still performing well and at the highest levels, both white and black females perceive the value and benefits of being successful in mathematic such that they are persistent in performing at the highest levels academically among their ethnic groupings despite feelings of discomfort and anxiety toward mathematics. Conversely, within the Hispanic population, mathematics seems to

be a male domain, with males feeling positive and confident about mathematics and increasing their performance over time. Interestingly, both Hispanic females and males have high scores on the value of mathematics. Perhaps, unlike the white and black population in this study which is mostly students who have lived in the U.S. for the entirety of their lives, since many of the Hispanic population at OGHS are recent immigrants, their ideas, attitudes, and beliefs toward mathematics fall into more traditional gender roles than for the more Americanized student. Given that Americanized black and white students have existed in the current U.S. culture where a large proportion of the work force is comprised of women working outside the home, perhaps the value and benefits of some mathematical proficiency are more apparent to black and white females than to Hispanic females. Recall that the value of mathematics scales for all Hispanic students was high. This may indicate that Hispanic females realize the benefits of mathematical proficiency but do not see themselves in such roles that they may perceive reserved for males.

The seeming inconsistencies and trends apparent in the between-group comparisons are interesting and indicate the need for further investigation through more thorough and specifically designed methods to examine these differences more clearly than the data here allow.

Contributions

Personal Contributions—Understanding the Research Process

This research project has expanded my understanding and respect for the research process in many ways. First, as a veteran of the public school system where I implemented this project and have implemented other innovative projects associated with educational research, I did not anticipate this project to be as large a task as it turned out

to be. My original research proposal was for a much larger and more extensive research plan; however, available funding required a scaled-down version of the original project. I am often grateful for the necessity of scaling down this project. It was a daily challenge to stay on top of my job and implement this study at the same time. When one writes a research proposal, the plan seems so clear in one's mind; however, the minor daily obstacles of the smallest sort seem to regularly turn up and if not addressed calmly and in a positive way can become major difficulties.

Practical Contributions—Problems with Educational Research

The most practical expectation one can have when embarking on a school-centered research project is that things will not likely go as smoothly as planned or exactly as anticipated. The daily interactions of researcher, teachers, school activities, time of the school year, student and teacher apathy, researcher exhaustion, and little mishaps combine to make research in schools a difficult and often frustrating process. One has to be satisfied with the data one is able to collect. One must simply accept that no one is going to take the research project as seriously as the researcher. Administering teachers and research informants don't realize that doing things just a little differently complicates data collection and often results in the desired data not being collected or renders that data unusable in the final analysis.

While research in the actual school setting can be done, it is often a difficult, laborious, frustrating, and thankless task and is not nearly as easy, systematic, or convenient as on a university campus from which much of the educational research data come. However, if we are to accurately assess the state of secondary education, then it is paramount that we negotiate the obstacles and make the necessary compromises to work

within the school systems to get the most appropriate and accurate information to answer the questions at hand.

Teachers and principals may often be reluctant to participate in research projects. If the researcher can structure the research such that something can be given back to the teachers, the students, and the school, it is much more likely that the project will be accepted for implementation. Offering to pay teachers for their time, leaving equipment such as computers in the schools for classroom use after completion of the project, or offering free in-service education to the faculty as a way of returning something to the school are always appreciated by faculty and administration alike. Offering the students some small token of thanks, be it a blow pop for a returned consent form or pizza and soda during interviews, serves not only to attract willing informants but to set a cordial and comfortable atmosphere in which to conduct the interviews.

When one embarks on a research project, it is important to remember that an exchange of energies is appropriate and should take place. The information that your informants and research subjects are providing for your research should be met with some sort of positive exchange, with those giving also receiving something in return in appreciation for their time, effort, and consideration. Be it a stipend for the teacher, free in-service classes for the faculty, or treats for the students, the exchange process is most important; otherwise, the research is strictly extractive, taking from the schools and their inhabitants without giving anything in return. If the point of educational research is to improve the state of education, not only should the information gathered help to illuminate the answer to a particular question; the information gleaned should be useful

(Burns 1993, Emihovich 1999), the research process in and of itself should be a positive one for the school and all informants.

One practical point that became clear to me during the focus group process is that if you feed them, they will come. Given enough pizza and soda or doughnuts and coffee (Bernard and Kilworth 1997), or ice cream and hamburgers, informants are very willing to sit down, talk to you, and answer your questions. People who agree to participate in this sort of a process have a desire to help and answer the questions at hand. Providing a comfortable, supportive environment facilitates the interview process immensely.

While this sort of research can be difficult, the information gained is invaluable and is worth the inconvenience of the many small obstacles one must negotiate in order to carry out such a project. Educational research done within the actual school setting gives the most realistic picture of what is happening; therefore, whenever possible, this sort of data should be collected in the most authentic and realistic settings available.

Methodological Contributions—Blending Qualitative and Quantitative Research

One of the highlights of this project is the blending of qualitative and quantitative research methods. This approach helps to answer a broader range of questions and allows us to examine these questions from different perspectives. For this project, the blending of qualitative long-term participant observation with quantitative methods for measuring behaviors and attitudes allowed for a much more in-depth understanding of the culture of the mathematics classroom. The questions addressed were the direct result of qualitative observation further examined by both quantitative and qualitative methods to address these questions as precisely as possible. Similarly, while I was an observing participant in this research process, as an adult, teacher, and outsider, I could never truly understand the culture of the mathematics classroom from the perspective of a student.

The focus groups allowed me to talk to students in an intimate and safe atmosphere where the students felt free to express their feelings, experiences, and perceptions of mathematics and math education. By simply relying on a series of surveys on mathematics-related beliefs and attitudes, the picture of the conflicting forces that meet daily in the classroom and in the lives of children which extend further than the instructional day would have not been revealed.

It is by the careful blending of qualitative and quantitative research methods that we can ground our research in the actual reality of the educational setting and at the same time measure the effects of interventions and assess the current state of that particular research population. As complimentary methods, each informs the other, broadening and deepening our view of the situation. Both methodological approaches are used in concert to enrich the other and provide a clearer, more expansive analysis of the situation at hand. The qualitative research informs the quantitative, and the quantitative analysis illuminates patterns and relationships to be further explored. The blending of qualitative and quantitative methods in this study illustrates the benefits of combining rigorous experimental methods with equally rigorous qualitative research methods in the process of knowledge discovery. Educational anthropology has a long history in the U.S., and the majority of this work is strictly qualitative. My contribution to the field is in bringing the integration of these approaches to the anthropological study of education.

Research design: For purposes of this research project, there are design flaws that should be addressed in future research projects. In terms of quantitative data collection, the assignment of treatment and control will have to be re-evaluated such that there is less of an analysis confound caused by teacher effect when treatment classes have one teacher

and control classes have another. Also, a better process for instrument implementation will be necessary in order to eliminate the effects of several scales being administered together rather than separately. Additionally, a more effective and less cumbersome method of collecting RQS data for the control teachers must be devised so that both treatment and control RQS data is collected in a more uniform manner. Furthermore, refinements in the RQS hand-held computer software should be developed such that it is less cumbersome and flows more easily for the implementing teacher. Research assistants should be employed in future implementations of this study such that all subject area and survey instruments are implemented in a more uniform, consistent, and timely manner. Adequate funding must be obtained in order to pay teachers a sufficient amount such that they will have enough incentive to implement the study but also have some incentive to follow through with the study according to protocol and such that the technology used in the project can be left in the schools for teacher and student use after completion of the project.

Theoretical Contributions

Ethnicity and gender: While there has been some concern in the gender equity literature regarding inequities for boys in school and educational settings, claiming that the feminist research agenda is doing a disservice to male students, most of that concern has been about the over-treatment of young males for attention deficit disorder and deficits in language and reading skills, the areas in which females tend to excel. Regardless of these claims, women and minorities are still performing less well than white men on the mathematics portions standardized tests, are continuing to under enroll in STEM-related majors, and are underrepresented in STEM-related careers (AAUW 1998; Fordham 1993; Croom 1997; Fennema 1996; Gray 1996; Rosser 1997). Women

tend to drop out of STEM-related majors with entry and exit grades that are consistently higher than those of their male counterparts (Boland 1995; Pattatucci 1998; Rosser 1997). These findings are consistent with those found in this study. Both white and black females are consistently outranking their male counterparts academically. The reverse, however, is true for the Hispanic students in this population, with males consistently outranking their female counterparts.

Similarly, findings in this study indicating that white students are consistently performing at the highest academic levels, with blacks and Hispanics students following, in that order, are consistent with those of the National Assessment of Educational Progress (NAEP) indicating that less than half of African American and Hispanic students demonstrate basic knowledge of mathematics and science (NSF 1999).

While the data gathered in this research project are specific to the setting of OGHS and cannot be generalized to a larger population, the differences in beliefs and attitudes for whites, blacks, and Hispanics are also generally supported in the current literature. Many black and Hispanic minority students are situated in an oppositional stance toward education and the dominant white status quo it represents (Stanton-Salazar 2001). The psychosocial sacrifice required for school success under the dominant white paradigm is deemed by many as simply too costly; thus, many minority students simply self-select out of the benefit stream of a good education (Fordham 2000; Stanton-Salazar 2001). Many African American students do not include academic success as part of their self assessment, and while Hispanic students and their parents often indicate that school success is important and education valuable, cultural discontinuities often contribute to parents and students lacking the knowledge and skills to successfully negotiate the

educational system. These same trends are apparent in the RQS attitudinal and beliefs measures as well as in the focus group data. Hispanic and black males exhibit some of the highest self-concepts toward mathematics coupled with the lowest academic scores. In many instances, minority students, particularly black males, indicated that they failed simply because they chose not to try rather than because they lacked ability. Often these same students indicated that when they decided to apply themselves, they were successful in their math classes.

On the other hand, the findings of high levels of anxiety and stress associated with mathematics for white males is contrary to generally held cultural beliefs regarding mathematics being a white male domain. White males indicated fairly high levels of anxiety toward mathematics on their attitudinal and beliefs scales from the RQS as well as in the focus group interviews. The low academic performance and belief and attitude toward mathematics scores for Hispanic females is consistent with that of other research on Hispanic students (Stanton-Salazar 2001). However, the significant differences within ethnicity, by gender, points to further questions to be addressed in the future.

As economic and social conditions in the United States change, so do the cultural messages received by school children. As cultural messages change, the outcomes of schooling change as well. Most consistently, these outcomes are in alignment with the material and cultural ideals and assumptions upon which school and society are situated (Margolis 2000). Continued examination of the culture of mathematics education in the secondary setting will help to answer existing questions as well as those raised by the results of this research project and hopefully generate appropriate solutions and strategies

to continue to allow the practice of mathematics education to evolve toward a more equitable and socially just experience for all students.

Implications for Educational Policy

Data collected in this study point toward several key issues. Among these are the following:

- Ethnicity is a much stronger factor than gender in predicting mathematical success and in predicting student attitudes and behaviors known to be conducive to a successful and positive experience in mathematics education.
- Avoidance of parental pressure is a strong factor in the policy-making process among teachers and school administrators.
- Students in RQS treatment groups were encouraged to stay more focused in class.
- Teachers were discouraged from using unison response in the classroom lecture setting allowing more students to have a chance to participate in the classroom questioning process.
- Many students want to learn, but often the reality of the educational setting of overcrowded classes and overtaxed or ineffectual teachers prevents students from getting the attention they want and need for school success.
- Students who are high achievers as well as those who are not high achievers but who are successful students are doing the same basic "best" practices. They attend school, pay attention in class, take notes, ask questions, do their homework, study for tests, and ask for extra help when needed. They engage in the fundamental activities of schooling.
- The process of calling on students in both RQS and control classes was not significantly different, indicating that for these classes there was no evidence of bias in the question-asking process. However both students and teachers indicated that the RQS improved classroom preparedness, question quality, student behavior, and the perception of fairness in the classroom.

Implications for Administrators

The data generated in this study illustrate that it is important for those who are influential in the policy-making process to realize that they are susceptible to parental pressure and that the students who are most likely to be disenfranchised in the

educational setting are those same students who's parents are least likely to advocate and produce parental pressure on teachers and administrators on behalf of their children. In order to provide a socially just and equitable education to all students, administrators must be willing to make the tough decisions and take the heat from parents who may not like the outcomes of those decisions that insure that those students who traditionally do not have an advocate are justly served by the educational system.

All students, not just the highest performing students, deserve to have the best teachers on a faculty. All levels of classes should share the break-in period of a new or beginning teacher, not just the low level classes. All classes should have appropriate textbooks and supplies, not just the classes where there are additional funds for technology and supplementary materials such as AP and advanced courses. Administrators must realize that every child deserves an appropriate and positive learning atmosphere and that it is their responsibility to insure that space, resources, and teachers are allocated in a manner that is fair and equitable to all.

Implications for Teachers

Similarly, teachers could greatly enhance the fairness of the classroom environment by using some method of randomly calling on students such that all students are insured of getting a chance to participate. Data gathered in this research indicate that teachers feel that they asked better questions, called on students rarely called on, and gave more students a chance to participate than when they called on students without a random strategy in place. Additionally, teachers and students report that students pay more attention and that they are more prepared for class when questioning takes place in this random manner. While it may feel awkward or less free-flowing to implement such a process, if something as simple as a random questioning strategy serves to help students

feel they are being treated more fairly and encourages students to pay more attention in class and prepare for class more, then I suggest that this simple strategy encourages the best practices behavior in students who do not normally practice such behaviors. If by implementing a random questioning strategy students are more likely to engage in those behaviors that help them succeed in school, then the awkwardness or slight inconvenience of getting used to the process is a small price to pay for decreasing the unintentional bias that creeps into the classroom questioning routine as well as increasing the perceived sense of fairness and expectation that all students can participate successfully in the mathematics classroom.

Future Research

In her article "Ethical Discourse in Educational Research," Emihovich (1999, p. 42) calls for a rethinking of research agendas "that connect the hopes, fears, dreams and aspirations of communities engaged in securing a better life for its citizens." Citing Pritchard, Emihovich highlights three ethical principles that should permeate educational research agendas: autonomy, justice, and beneficence. Using these principles as a foundation, the next stage of research in this program will include examining the affect of the RQS itself over a larger range of classroom factors (such as student focus on task, spontaneous questions from students, student preparedness, etc.) which will be examined for their effect on the question asking and answering process in addition to extensive classroom observations using a variety of stratified observational sampling protocols (Fragaszy, Boinski et.al. 1992). A deeper investigation of the relationship between gender and ethnicity, stress, anxiety, and academic performance will be among focus group and interview topics.

Future research in this area calls for a follow-up study similar to the RQS and focus groups with an expanded list of predictor and outcome variables as well as the examination of additional attitudinal, personality, self-worth, and behavioral variables over an extended period in multiple localities. An expanded examination on the affect of the RQS in terms of both teacher questioning and interaction behaviors in addition to student behaviors such as classroom preparedness, focus, and on-task behavior would be included. The qualitative portion of the study would focus on finding the mechanisms behind the gender differences within ethnicities as well as the mechanisms behind the differences among ethnic groups. A closer examination of the relationship between gender and ethnicity, stress, anxiety, and academic performance in this setting is also in order.

Additional future research may include an examination of students' social networks based on gender, ethnicity, and SES with the testing of interventions designed to teach students the necessary skills and attitudes necessary to build and expand the academic portions of their social networks and increase the behaviors and resources available to them that contribute to their school success.

APPENDIX
SAMPLE FOCUS GROUP QUESTIONS

Focus Group Questions

Following are sample interview questions from the focus groups. These are samples of questions compiled from multiple groups to give an idea of the questions asked during the focus group process. Given the dynamic nature of focus groups, each group was slightly different, while discussion topics remained focused around the general topic of the culture of the mathematics classroom.

Introduction, General Business and Grand Tour

> We are having a focus group today on women and minorities in math. I am a teacher here at Gainesville High School. I'm Paige Lado and I've been working on my Ph.D. at the University of Florida and I study Women in Math and—Minorities in math. I don't know if you've heard things where people say, "Oh, girls can't do math," or "People of color can't do math," or "They don't do as well," and I'm working on my degree in the Anthropology of Education and we study Education. I'm looking at what's going on with people in terms of this. So your teachers recommended you to me as students who would be willing to share with me and talk to me about how you feel about math some of your experiences in math—whether you like it, whether you don't like it—what's worked for you what hasn't worked for you—maybe how you'd like it to be different. Rather than a one-on-one interview, we call this a focus group because we've got several people in it. So we're talking about our experiences in math. There is a microphone here in the middle of the table. It's a kind of special mike. It works really well. It's called a conference mike and so it picks up everybody pretty well. There are a few formal things that I have to take care of. First of all, is there anybody who objects to me getting this interview on audiotape? OK, the tape will be private; nobody will ever listen to it except for me. The information from it will just be used for my research and you'll always remain anonymous. Nobody will ever hear this. If I ever use it I would say, "A student said thus and so"; I would never give identifying information. And all of you that are here either gave me a signed permission slip or you had one signed in your regular math teacher's class?

School Enviromnent

Who is your math teacher?

Do you like it here at this school? What do you or don't you like about this school?

How long have you been going here? (How long did you go there?)

What math classes are you currently enrolled in?

Do/did you like it?

What do you like about it most?

What do you dislike about it most?

So how do you feel about math? If you think about math or think of yourself as a student of math, do you feel that you're good at it, that you're not good at it, you could be better or I would be better if or I do a pretty good job and if I keep doing what I'm doing I'm gonna do fine. What do you think about yourself as a math student?

Suggestions

If you could design the mathematics class of your dreams, what would you include and exclude? How would it be different or the same as the math classes you have been in?

So do you have any suggestions about how that could be different?

Gender and Ethnicity

What about, like, according to gender or race? Have you seen any bias that way?

What I am trying to find out is your experiences and perceptions as a female/minority student in a mathematics class. What are your experiences, realities and perceptions? Is there anything else you would like to tell me to help me understand this better?

Are you familiar with this phenomenon that we see, this trend that when people are out of high school and working in jobs, we don't see very many women or minorities in careers that typically have math involved in them? And when they have math involved in them, they earn a lot more money. Why do you think that is?

Ethnicity:

Have you ever been the only person of color in an all white class?

Was it hard when you were the only black kid in an all white class?

How would you fill out on your forms? What do you call yourself—how do you self-identify?

Do you feel as a minority you have to prove yourself?

Gender

Have you been in a classroom that's been mostly guys? How did it feel?

Is it different for boys or girls?

Do you think you're discriminated against because you're women, do you think you have to prove how smart you are?

Do you feel like you have to compete against the boys?

Questioning

How do students get called on to answer a question in the class?

Do you volunteer to answer questions?

How do you decide to do that?

What happens if you are called on and you know the answer?

What happens if you don't know the answer?

Do you answer if you aren't sure of the answer? Do you guess?

How do you feel when you answer a question and get it right?

How do you feel when you answer a question and get it wrong?

Do you ask questions in class? Why or why not?

How do you feel when you ask questions in class?

How do you decide to ask a question in class?

What happens when you ask questions in class?

How does the teacher respond to you?

How do other students respond to you?

Is there anything else you would like to tell me to help me understand about questions in your math class that will help me understand this process better?

Getting Help/Student Effort

What do you do when you don't understand something in class?

Do you ask the teacher?

Do you ask a friend?

Do you ask "the smartest person"?

Are some people more willing to work with you in class than others?

So where do you go for help? Do you go for help to your parents? If the teachers will help you extra will you ask them? Where else do you get help?

You think you failed because you didn't try very hard, or because you couldn't do it?

How do you feel about this idea that, if you don't do well, is it because you don't try enough? Is it because you can't do it, is it about your teacher, is it about your environment?

Class Atmosphere

Do people make fun of others in class when they get a wrong answer or they ask a "dumb" question?

How would you describe the atmosphere in your class?

Is it very competitive between students in class? How?

Is it cooperative between students in class? How?

Is it math that's boring, or is it the way it's presented?

Is there a lot of cheating?

How do students cheat?

You were suffering from somebody else's actions?

Are there different standards for different students?

What was good about the teacher who was good, and what was bad about the ones who weren't?

What works for you to understand it?

Let's talk a minute about behavior in your classes. And your class size and things like that. Things, you know, about the structure and the way school is and we function within.

What about stuff that teachers do that really helped? Think back, you can think back all the way to elementary school and kindergarten if you want. What is stuff that you have experienced that has been very helpful? For example, this teacher helped you learn your multiplication tables by playing bingo or something. Can you think of things that have been helpful?

Future Plans

Do you think you are learning enough to go on to college?

Are you all going to go on to college?

What are you interested in studying?

Best Practices

We are talking about what I am calling Best Practices. If you are here it means your teacher has identified you as highly successful student in math. I am trying to get your experiences. No part of your experience is unimportant. So what do you think makes you folks successful math students?

Is there anything else that any of you folks can tell me that you would call a best practice? Anything else you think that has really helped you to be successful?

Do you do homework?

Do you study for tests?

Do you take notes in class?

Do you bring a book to class?

Do you think those things help you be successful?

Do you do anything else that helps you be successful? Besides coming in and having a positive attitude like you just described?

Testing/Stress

What happens if you don't pass the FCAT?

So how much time out of the regular math classes is taken for the FCATs?

Are there ever students in your class who don't have to take the FCAT?

How do you feel about standardized tests like the SAT, ACT, and FCAT?

RQS

Have you been experiencing the hand-held computer for questions in class? How do you feel about it?

When you are called on do you answer? Do you pass?

Has it changed the way you or your teacher does things in your classes?

Closure

Thanks so much for your participation in my study. If you think of anything else after you leave that may help me understand your experiences with math, please feel free to stop by and tell me or jot it down on a piece of paper and drop it by. Your participation in this focus group has really helped me to understand things much better. Thank you again for coming.

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