Teachers' Beliefs on Gender Differences in Mathematics Education

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TEACHERS’ BELIEFS ON GENDER DIFFERENCES
IN MATHEMATICS EDUCATION

By

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ABSTRACT

The purpose in this study was to understand the specific beliefs that are held by two high school teachers about gender differences in mathematics education, and the extent of consistency between these teachers’ stated beliefs about gender and instructional practices and classroom interactions. This study was built upon three previous studies of teacher’s gender-related beliefs, conducted by Tiedemann (2000a), She (2000), and Garrahy (2001). Five high school mathematics teachers from a southeastern United State’s school were participants in this study as a result of a convenience selection. Two of these five participants were selected for case studies based on their availability and cooperativeness. Data were generated from four sources: (1) questionnaires completed by five classroom teachers on each of the six students selected within his/her class; (2) teacher interviews; (3) classroom observations; and (4) videotapes of instruction documenting teacher and students. Although the participants claimed that they took student’s ability instead of students’ gender into account as a mathematics teacher, they held some gender-related beliefs toward the male and female students in their classes. Some of these beliefs were: (1) lower ability female students put on more effort in their mathematics classes compared to the boys; (2) girls are more emotional than boys; (3) girls are less competitive than boys; and (4) female students in the higher ability courses are less confident than male students. The result of this study also indicated that the participant’s stated beliefs on gender-related differences were not always consistent with their instructional practices and classroom interactions.
CHAPTER 1

INTRODUCTION

Motivation

Since Maccoby and Jacklin’s research in 1974 showed that male’s achievement in mathematics was higher than females, a large number of research studies have been conducted to determine whether and why gender differences exist in mathematics education. Many of these research studies have documented gender differences in mathematics test performance (e.g., Hyde, Fennema, & Lamon, 1990; Kimball, 1989; Wilder, 1996; Wilder & Powell, 1989; Willingham & Cole, 1997). At the early stage of research, when psychologists were looking for an explanation for women’s lower achievement, they actually began to look for proof that the female brain was smaller than male brain. As they were unable to find such proof, they began to look for more subtle intellectual deficits. When research did not confirm that women were less intelligent than men, they began to look for answers in societal expectations of women and the relationships between different societal institutions (Crenshaw, 2001). Thus, some researchers shifted their attention to research on gender-related differences in relations to school cultures, more specifically, to the teacher’s role in students’ gender socialization.

The most common conclusion stated by researchers is that female students keep pace and even outperform male students throughout elementary school grades in all areas related to language. By the end of middle school or Junior high, males narrow the gap in reading and surpass females in mathematics. Drawing from other studies, Eccles and Jacobs (1986) made three observations. First, adolescent boys have been found to score higher than girls on standardized mathematics achievement tests. Second, males more likely than females tend to engage in a variety of optional activities related to mathematics, from technical hobbies to careers in which mathematics skills play an important role. Third, adolescent males typically perform better than their female counterparts on spatial visualization tests. The result of the Third International
Mathematics and Science Study [TIMSS] showed that as students move toward higher grade levels, the gender difference in mathematics also becomes larger favoring the male students (TIMSS, 1995). Educators recognized this gender gap in mathematics, which influenced the National Council of Teachers of Mathematics (NCTM, 2000) to list “educational equity” as the first principle.

Research suggests that female students are systematically discouraged from courses of study in higher-level mathematics (Gober, 1998). Gober also states that retaining women in mathematics courses and careers becomes a problem between early elementary school and high school. During this period, many girls lose interest in mathematics and also lose confidence in their ability to succeed in this subject.

According to the National Center for Educational Statistics [NCES] (1997), fourth grade boys and girls show similar interest and ability in mathematics. However, by grade 12, girls may find themselves behind (Sadker & Sadker, 1994). Tartre and Fennema (1995) identified confidence as the affective variable most consistently related to mathematics achievement. Studies conducted by Fennema and Sherman (1977, 1978) reported that female students often show less confidence than male students in their ability to do mathematics even when there is no gender difference in mathematics achievement. Lack of confidence in mathematics achievement may contribute to a lack of persistence on difficult tasks (Koehler, 1990; Peterson and Fennema, 1985). Gober (1998) suggested that in order to attract more women to mathematics courses and careers, changes should be made in the way it is taught.

Classroom interactions, both with the teacher and other students, are critical components of education. Whether one looks at preschool classrooms or university lecture halls, at female teachers or male teachers, research spanning the past twenty years consistently reveals that males receive more teacher attention than do females (American Association of University Women [AAUW], 1992). In preschool classrooms, boys receive more instructional time, more hugs, and more teacher attention (Serbin et al., 1973; Ebbeck, 1984; AAUW, 1992). This pattern continues through elementary and high school years. After longitudinal studies on this behavioral and instructional pattern, researchers David and Myra Sadker (1986) reported that boys in elementary and middle school called out answers significantly more often than girls did. They also reported that
whenever boys called out the answers, the typical teacher reaction was to listen to the comment. When girls called out answers, they were usually corrected with comments such as, “Please raise your hand if you want to speak”. According to the AAUW report (1992), “the issue is broader than the inequitable distribution of teacher contacts with male and female students; it also includes the inequitable content of teacher comments” (p. 119). It was also included in the report that males receive more teacher comments (praise, acceptance, and remediation) from the teachers compared to the female students.

Seligman and Maier (1967) reported in their study that the differences in teacher evaluations of male and female students have caused “learned helplessness,” or lack of academic perseverance, in female students. Psychologists have used this concept to explain why girls sometimes abandon while boys persistently pursue academic challenges for which both groups are equally qualified. Psychologists have also made a link between learned helplessness and attribution theory. Research has indicated that casual attributions of mathematical achievement differ between genders. Females tend to attribute success to effort, while males attribute success to ability. These different attributions can affect future expectations for success, and consequently achievement motivation in the area of mathematics (Crenshaw, 2001).

The most reasonable conjecture behind the gender differences found by Fennema, Carpenter, Jacobs, Franke, and Levi (1998) is that teachers treated and encouraged the boys more than they did the girls (Sowder, 1998). Social psychologists’ research shows that people often swiftly and unconsciously categorized an individual, frequently on the basis of gender (Fiske & Neuberg, 1990). Once the individual is categorized, the beliefs and expectation about the category are activated (Hamilton & Sherman, 1994; Hamilton & Trolier, 1986). The teacher’s interaction with the individual student may therefore be frequently influenced by stereotypes, and teachers-perhaps quite unconsciously- may show differential treatment toward the male students and female students.

Teachers are influential role models for many aspects of children’s educational experiences, including gender socialization (Garrahy, 2001). Needless to say that teachers’ instructional practices affect student learning. Numerous research studies have concluded that the beliefs teachers hold influence their perceptions and judgments, which, in turn, affect their behavior in the classroom (Ashton, 1990; Ashton & Webb,
1986; Brookhart & Freeman, 1992; Buchmann, 1984; Clark, 1988; Dinham & Stritter, 1986; Munby, 1982, 1984; Nespor, 1987; Pajares, 1992; Tabachnick, Popkewitz & Zeichner, 1979; Weinstein, 1988, 1989; Wilson, 1990). However, other studies found discrepancies between teachers’ professed beliefs about teaching mathematics and their practice (Brown, 1985; Cooney, 1985; Garrahy, 2001). Thompson (1992) stated that these inconsistencies reported by different studies indicate that teachers’ beliefs of teaching and learning mathematics are not related in a simple cause-and-effect way to their instructional practices. Instead, they suggest a complex relationship that might result from the social context in which mathematics teaching takes place.

According to Elmesky (1997), within educational research, it has become a priority to develop studies oriented toward understanding the nature of the actions and interactions between teacher and students (Reyes-Herrera, 1996), as well as, toward understanding the influence of teacher beliefs on those actions (Heshweh, 1996). Along with other educational disciplines, teacher belief has been a subject of investigation in mathematics education as well. Research suggests that teachers’ beliefs about the teaching and learning of mathematics influence the way in which their students are likely to view the learning of mathematics (Carter & Norwood, 1997). A significant positive relationship has also been found among teachers’ beliefs, teachers’ knowledge and students’ problem solving achievement (Peterson, Fennema, Carpenter, & Loef, 1989).

Because of the positive relationship between teachers’ beliefs and students’ learning outcomes, in order to improve the quality of mathematics teaching and learning, a researcher should begin with an understanding of the conceptions held by the teachers and how these are related to their instructional practices. According to Thompson (1984), failure to recognize the role that the teachers’ conceptions might play in shaping their behavior is likely to result in misguided efforts to improve the quality of mathematics instruction in the schools. It is often the case that teachers are not fully aware of their beliefs (Garrahy, 2003). By helping them to define their own implicit theories, it is possible they may become more reflective (Herring, 2000). If teachers have a chance to reflect upon their own beliefs and behaviors, they will be able to evaluate their role as teachers. Those who do reflect have greater control over their thinking and consequently can make more informative decisions as to their instructional practices and
behaviors and how these affect their students (Jost, 1992; Wheatley, 1992). Thus, examining teachers’ gender-related beliefs and the relationship between these beliefs and instructional practices can play a significant role in improving the quality of mathematics instruction and promote educational equity for all the students.

Since beliefs are complex mental processes, it is not easy to examine teachers’ beliefs. According to Thompson (1992), at the very least, investigators of teachers’ beliefs should examine teachers’ verbal data along with observational data of their instructional practice or behavior; it will not suffice to rely solely on verbal data. If the researcher observes any discrepancies between teachers’ stated beliefs and instructional practices, Thompson has suggested that one must question the extent to which teachers are aware of such discrepancies and, if so, how they explain them. It is often the case that teachers are not always aware of the ways in which they interact with the students (AAUW, 1992). In a gender-related study, Sadker and Sadker (1994) reported that the same teachers, who believed that they did not have any gender-stereotypical views and always treated their male and female students fairly, were shocked when they saw themselves in the videotapes of their actual classroom interactions with the students.

Although it is crucial to understand the nature of teacher’s gender related beliefs and its impacts on the students in mathematics education, no comprehensive review of the literature has been found that explicitly deals with gender issues in relation to teachers’ beliefs (Li, 1999). According to Li, there appears to be consensus that teachers’ beliefs are an important variable in the study of gender issues. Fennema (1990) suggested that insights into teachers’ beliefs and behaviors related to gender may lead to deeper understanding of gender differences in mathematics as we learn more about the mental life of teachers and students, and how this influences daily decisions about learning mathematics.

**Rationale**

The investigation of teachers’ gender-related beliefs was started by Fennema (1990) in the United States. After a gap of almost a decade, the topic was further investigated by a limited number of researchers in different countries (e. g., Garrahy, 2001, 2003; Tiedemann, 2000a, 2000b, 2002; Mujis and Reynolds, 2002). The majority of these studies concentrated on elementary school teachers. No single research has been
conducted on high school teachers’ gender-related beliefs. Results from the TIMSS study in 1995 indicated that the gender difference in students’ mathematics achievement is more significant in the 8th and 10th grade levels than in the 4th grade level (TIMSS, 1995). This suggests that there is a need for investigation of teachers’ beliefs on gender differences in higher-grade levels. Moreover, there is a lack of qualitative studies in this area. The current research attempted to fill in that gap in this particular field of education and to add new information to the existing literature by an exploration of high school teachers’ beliefs on gender differences in mathematics education using multiple data sources. The results can be used to design teacher-development workshops to prompt teachers to reflect upon and examine their own beliefs and practices.

**Research Questions**

Two research questions were addressed in this study:

i) What specific beliefs do high school teachers hold about the relationship of gender to the teaching and learning of mathematics?

ii) What is the extent of consistency between teachers’ stated beliefs about gender and instructional practices and classroom interactions?

**Significance**

A review of the literature reveals that although many researchers indicated that there is a strong relationship between teachers’ beliefs and instructional practices, many also indicated that teachers’ stated beliefs and their instructional practice are not always consistent. It has also been indicated that teachers’ instructional practices affect student performance. Ensuring educational equity is a national challenge for the United States. To understand how teachers’ gender-related beliefs might influence mathematics teaching and learning, one has to first take into account what specific gender-related beliefs are held by teachers and how consistent these beliefs are with their instructional practices. For this reason, the researcher began this investigation in the fall semester of 2003. Her goal was to understand the specific beliefs that are held by two high school
teachers about gender differences in mathematics education, and the extent of consistency between these stated beliefs and their instructional practices and classroom interactions.

The researcher chose to examine high school teacher’s beliefs for two reasons. First, the result from the Third International Mathematics and Science Study in 1995 indicated that the gender difference in mathematics achievement was more significant at the high school level than it was at the elementary level (TIMSS, 1995). Secondly, no single research has been documented on high school teachers’ gender-related beliefs. Besides choosing participants from the high school level, the beliefs of the participants were examined in two different levels of classes to see if teachers’ gender-related beliefs about a higher-level class differed from their beliefs about the lower-level class. Previous research has indicated that female students’ achievement and confidence in mathematics decrease as they move toward higher-level courses (Gober, 1998).

It is often the case that teachers are not fully aware of their beliefs. Because of the very close relationship of beliefs and knowledge, one might treat his/her knowledge as beliefs or vice versa (Thompson, 1992). Under Title IX of the Educational Amendments of 1972, discrimination on the basis of sex is illegal in any educational program receiving federal funding. Although this could be knowledge for a teacher, he or she might treat this knowledge as a belief. More specifically, the teacher might think that he/she believes in Title IX, but in reality he/she might hold stereotypical beliefs toward his/her male and female students. Sadker and Sadker (1994) reported that teachers sometimes are unaware of their own discriminatory instructional practices until they see themselves in a videotape of their classroom instruction.

The researcher wanted to make the two teachers (under case study) conscious of their own beliefs. Furthermore, the teachers’ beliefs and practices were examined in two different classrooms, one in the upper performance level and the other in the lower performance level. This was to find whether or not the level of consistencies in the two different classes were the same. If the level of consistency in one class was found to be higher than it was in the other class, the researcher intended to find the reasons for that. The researcher intended to share her knowledge from the classroom observations with the teachers, so they can develop and modify their own strategies for fostering gender-equitable classrooms.
CHAPTER 2

REVIEW OF LITERATURE

Beliefs

Around the beginning of this century and into the 1920s, a considerable interest grew among social psychologists in the study of the nature of beliefs and their influence on people’s actions (Thompson, 1992). In the 1970s, an interest in the study of teachers’ beliefs and conceptions was fueled among educators. Since 1980, many studies in mathematics education have focused on teachers’ beliefs about mathematics and mathematics teaching and learning. Despite the current popularity of teachers’ beliefs as a topic of study, the concept of belief has not been dealt with in a substantial way in the educational research literature. For the most part, researchers have assumed that readers know what beliefs are (Thompson, 1992). Researchers have yet to come to a consensus on the meaning of what is a belief. Thus, the concept has acquired a rather fuzzy usage (Borg, 2001).

Pajares (1992) acknowledged the messy construct of the concept of beliefs in educational research and provided us with the available definitions of beliefs given by different researchers. Sigel (1985) defined beliefs as “mental constructions of experience—often condensed and integrated into schemata or concepts” (p. 351) that are held to be true and that guide behavior. Nisbett and Ross (1980) wrote of beliefs as “reasonably explicit ‘propositions’ about the characteristics of objects and object classes” (p. 28). Artzt and Armour-Thomas (2002) defined beliefs as an integrated system of personalized assumptions about the nature of the subject. Dewey (1933) described belief as the third meaning of thought, “something beyond itself by which its value is tested; it makes an assertion about some matter of fact or some principle or law” (p. 6).

Rokeach (1968) defined beliefs as, “any simple proposition, conscious or unconscious, inferred from what a person says or does, capable of being preceded by the phrase, ‘I believe that…’” (p. 113). He argued that all beliefs have a cognitive
component representing knowledge, an affective component capable of arousing emotion, and a behavioral component activated when action is required. Rokeach cautioned that understanding beliefs requires making inferences about individuals’ underlying states, inferences fraught with difficulty because individuals are often unable or unwilling, for many reasons, to accurately represent their beliefs. For this reason, beliefs cannot be directly observed or measured but must be inferred from what people say, intend, and do.

In order to understand the concept of beliefs more deeply, we need to look at some common features of beliefs along with the presented definitions.

**The Truth Element**

According to Borg (2001), drawing on research in the philosophy of knowledge, a belief is a mental state, which has as its content a proposition that is accepted as true by the individual holding it, although the individual may recognize that others might hold alternative beliefs. This feature of belief is also supported by Harvey (1986) since he defined belief as an individual’s representation of reality that has enough validity, truth, or credibility to guide thought and behavior. Green (1971) stated that when a person believes something, he believes it to be true or to be a reasonable approximation to the truth. “Besides, arriving at some decision about its truth or reasonableness, a person need not decide, in addition, he shall go about believing it” (p. 43).

**Beliefs through Cultural Process**

Individuals develop a belief system that houses all the beliefs acquired through the process of cultural transmission (Abelson, 1979; Brown & Cooney, 1982; Nisbett & Ross, 1980; Rokeach, 1968; Pajares, 1992). Researchers agree that beliefs evolve as individuals are exposed to the ideas and more of their parents, peers, teachers, neighbors and various significant others. They are acquired and fostered through schooling, through the informal observation of others, and through the folklore of a culture, and they usually persist, unmodified, unless intentionally or explicitly challenged (Al-Sharafi, 1998; Lasley, 1980). That is, beliefs evolve and develop over time through an individual’s socialization process in the daily interaction with other members of the society (Al-Sharafi, 1998; Lortie, 1975).
The Relationship between Beliefs and Behavior

Individuals’ beliefs strongly affect their behavior (Abelson, 1979; Bandura, 1986; Brown & Cooney, 1982; Clark & Peterson, 1986; Eisenhart, Shrum, Harding, & Cuthbert, 1988; Ernest, 1989; Goodman, 1988; Harvey, 1986; Kitchener, 1986; Lewis, 1990; Nespor, 1987; Nisbett & Ross, 1980; Pajares, 1992; Rokeach, 1968; Tabachnick & Zeichner, 1984). Brown and Cooney (1982) explained that beliefs are dispositions to action and major determinants of behavior, although the dispositions are time and context specific-qualities that have important implications for research and measurement. Few would argue that the beliefs teachers hold influence their perceptions and judgments, which, in turn, affect their behavior in the classroom (Ashton, 1990; Ashton & Webb, 1986; Brookhart & Freeman, 1992; Buchmann, 1984; Clark, 1988; Dinham & Stritter, 1986; Munby, 1982, 1984; Nespor, 1987; Pajares, 1992; Tabachnick, Popkewitz & Zeichner, 1979; Weinstein, 1988, 1989; Wilson, 1990). However, a few researchers have documented the conflict between beliefs and actions (Cooney, 1985; Brown, 1985; Garrahy, 2001). In an investigation of the beliefs held by teachers with varying years of experience, Brickhouse (1990) found that the beliefs of experienced teachers are consistent with their actions, while a beginning teacher found it difficult to implement his beliefs.

Conscious versus Unconscious Beliefs

Another feature of belief is, belief can be conscious or unconscious. We are not always aware of the beliefs we hold. In the investigation of teachers’ gender-related beliefs in mathematics, Garrahy (2001, 2003) found that teachers could be unaware that they hold certain beliefs until someone points out their contradictory behavior. Rokeach (1968) supported this view of beliefs in his definition by stating that “beliefs can be conscious or unconscious” (p. 113).

Various Degrees of Conviction

Beliefs can be held with various degrees of psychological convictions (Green, 1971; Shaw, 1989; Thompson, 1992). According to Green (1971), beliefs that are held with “passionate conviction” (p.53) are called core beliefs and reside at the very center of a person’s belief system. These beliefs are not easily subject to investigation or dispassionate discussion. Thus, core beliefs are not likely to change and are generally
fundamental to one’s personality. Beliefs that are held with less psychological strength are called peripheral beliefs. The peripheral beliefs are beliefs that people are more apt to examine and modify when provided because they are held with less conviction.

**Evidential versus Non-E evidential Beliefs**

Green (1971) distinguished between beliefs that are held on the basis of evidence and those that are held non-evidentially. Beliefs that are held on the basis of evidence or reasons are open to criticism and modification because the reason for the beliefs can be questioned through the presentation of additional evidence. Beliefs that are held without regard to evidence, or contrary to evidence, or apart from good reasoning, Green labeled as non-evidential beliefs. Non-evidential beliefs are resistant to change because they are not based on reason or evidence. Therefore, it is difficult to change them through rational argument.

**Relationship between Beliefs and Knowledge**

Distinguishing knowledge from belief is a daunting undertaking (Pajares, 1992). Because of the close connection that exists between beliefs and knowledge, the distinction between them is fuzzy (Scheffler, 1965; Thompson, 1992). Although these two concepts are very closely related, there are some differences between them. According to Nespor (1987), knowledge system information is semantically stored, whereas beliefs reside in episodic memory with material drawn from experience or cultural sources of knowledge transmission. Nespor argued that beliefs drew their power from previous episodes or events that colored the comprehension of subsequent events. Nespor (1987) made another distinction between beliefs and knowledge. He suggested that beliefs have stronger affective and evaluative components than knowledge and that affect typically operates independently of the cognition associated with knowledge. Knowledge of a domain differs from feelings about a domain, a distinction similar to that between self-concept and self-esteem, between knowledge of self and feelings of self-worth (Pajares, 1992).

Another distinctive feature of beliefs is that they are not consensual. “Semantically, ‘belief’ as distinct from knowledge carries the connection of disputability-the believer is aware that others may think differently” (Abelson, 1979, p. 356). A common stance among philosophers is that disputability is associated with beliefs; truth
or certainty is associated with knowledge. Scheffler (1965) argued that a claim to knowledge must satisfy a truth condition, whereas beliefs are independent of their validity. From a traditional epistemological perspective, a characteristic of knowledge is general agreement about procedures for evaluating and judging its validity; knowledge must meet criteria involving canons of evidence. Beliefs on the other hand, are often held or justified for reasons that do not meet those criteria, and, thus, are characterized by a lack of agreement over how they are to be evaluated or judged (Thompson, 1992). Ernest (1989) suggested that knowledge is the cognitive outcome of thought and belief the affective outcome, but he acknowledged that beliefs also possess a slender but significant cognitive component.

**Teacher Beliefs**

According to Elmesky (1997, p. 3), within educational research, it has become a priority to develop studies oriented toward understanding the nature of the actions and interactions between teacher and students (Reyes-Herrera, 1996), as well as, toward understanding the influence of teacher beliefs on those actions (Heshweh, 1996). Along with other educational disciplines, teacher belief has been a subject of investigation in mathematics education as well. Research suggests that teachers’ beliefs about the teaching and learning of mathematics influence the way in which their students are likely to view the learning of mathematics (Carter & Norwood, 1997). A significant positive relationship has also been found among teachers’ beliefs, teachers’ knowledge and students’ problem solving achievement (Peterson, Fennema, Carpenter, & Loef, 1989).

Because of the positive relationship between teachers’ beliefs and students’ learning outcomes, in order to improve the quality of mathematics teaching and learning, we should begin with an understanding of the conceptions held by the teachers and how these are related to their instructional practices. According to Thompson (1984), failure to recognize the role that the teachers’ conceptions might play in shaping their behavior is likely to result in misguided efforts to improve the quality of mathematics instruction in the schools. It is often the case that teachers are not fully aware of their beliefs (Garrahay, 2003). By helping them to define their own implicit theories, it is possible they may become more reflective (Herring, 2000). If teachers have a chance to reflect upon their own beliefs and behaviors, they will be able to evaluate their role as teachers. Those who
do reflect have greater control over their thinking and consequently can make more informative decisions as to their instructional practices and behaviors and how these affect their students (Jost, 1992; Wheatley, 1992).

**Gender Differences in Educational Setting**

In the past few decades, educational researchers have given special interest to gender differences. Maccoby and Jacklin’s (1974) work, *The Psychology of Sex Differences* was a significant event in the course of research in this field (Cole, 1997). Their analysis was based on 1600 studies in eight areas of achievement, personality, and social relationships. From their analysis, Maccoby and Jacklin (1974) reached four main conclusions regarding “sex differences that are fairly well established”. They concluded that:

- Girls have greater verbal ability.
- Boys excel in visual-spatial ability.
- Boys excel in mathematics.
- Males are more aggressive.

These conclusions have since been qualified in various ways by succeeding research (Cole, 1997). Coley (2001) studied the interaction of gender and racial/ethnic differences. In this study, data were gathered from various sources, including the K-12 test results from the National Assessment of Educational Program [NAEP] from year 1992 to 1998, admission tests, and advanced placement tests. Across all racial/ethnic groups, the following gender differences were found:

- Females scored higher than males in NAEP reading.
- Females scored higher than males in NAEP writing.
- Males scored higher than females in NAEP science.
- White fourth grade males scored higher than females in NAEP mathematics.
- On the SAT I Mathematics Test, males scored higher than females.
- Males scored higher than female on the GRE Verbal, Quantitative, and Analytic Tests.
- Males had higher GMAT scores than females.
- Males were more likely than females to score high in AP Biology.
• Males were more likely than females to score high in AP Calculus AB.

In 2000, the National Center for Education Statistics published *Trends in Educational Equity of Girls and Women* (Bae, 2000). This report assembles a series of indicators that examine the extent to which males and females have access to the same educational opportunities. These 44 indicators look at how males and females avail themselves equally of these opportunities, perform at the same level, succeed at the same rate, and obtain the same benefits. Coley (2001) provided a summary of the conclusions drawn from the report:

• In the early school years, girls are less likely than boys to repeat grades and have problems in school.
• Girls outperform boys in reading and writing.
• Girls lag behind boys in mathematics and science.
• Girls are more likely to major in subjects leading to lower paying fields and less likely to major in engineering, physics, and computer science.

From these findings, it is apparent that gender differences still exist within America’s education system. These differences are noticeable in our boys’ and girls’ performance in reading, writing, mathematics, science, and technology. According to Pajares (2001), there are gender differences in student motivation as well as achievement. It is also clear from the above data that the gender differences in earlier grades contribute to students’ academic achievement, choices of major and career choices at the college level.

Some research studies, however, appear to show that the level of gender difference has decreased significantly over the years (Pallas & Alexander, 1983. This claim is mostly concerning the elementary classrooms. The result from the Third International Mathematics and Science Study [TIMSS] shows that the gender difference in mathematics and science is much larger in 8th grade and 12th grade levels than in 4th grade (TIMSS, 1995). We cannot ignore the differences in our boys’ and girls’ achievement in mathematics, science, reading, and writing if want to ensure an equitable educational environment.
Gender Differences in Mathematics Education

Gender differences in mathematics achievement are by now a well-known fact and research in this area has a long history dating back to the seventies (Cheng & Seng, 2001). Since Maccoby and Jacklin’s (1974) study showed that male’s achievement in mathematics is higher than females, a large number of research studies has been conducted to determine whether and why gender differences exist in mathematics education. Many of these research studies have documented gender differences in mathematics test performance (e.g., Hyde, Fennema, & Lamon, 1990; Kimball, 1989; Wilder, 1996; Wilder & Powell, 1989; Willingham & Cole, 1997). Benbow and Stanley (1980) reported on the mathematical aptitude scores of approximately 10,000 seventh and eighth graders, all of whom were self-selected applicants responding to a talent search. They found a great disparity between males and females in the upper range of mathematical reasoning ability with males exceeding females, although both groups had essentially identical formal educational experiences.

Some of the studies done to date purport to establish that by age 13 there is a significant difference in mathematical ability between the sexes and that it is especially pronounced among high-scoring exceptionally gifted students, with boys outnumbering girls 13 to 1 (Benbow & Stanley, 1983; Hanna, 1984). Drawing from other studies, Eccles and Jacobs (1986) made three observations. First, adolescent boys have been found to score higher than girls on standardized mathematics achievement tests. Second, males are more likely than females to engage in a variety of optional activities related to mathematics, from technical hobbies to careers in which mathematics skills play an important role. Third, adolescent males typically perform better than their female counterparts on spatial visualization tests. A Meta analysis based on 100 studies (Hyde, Fennema, & Lamon, 1990) showed that there was a slight female superiority in the elementary and middle school years, a moderate male superiority in high school, and larger male advantages in college and latter adulthood.

Research suggests that female students are systematically discouraged from courses of study in higher-level mathematics (Gober, 1998). Gober also states that retaining women in mathematics courses and careers becomes a problem between early elementary school and high school. During this period, many girls lose interest in
mathematics and also lose confidence in their ability to succeed in this subject. According to the National Center for Educational Statistics [NCES] (1997), fourth grade boys and girls show similar interest and ability in mathematics. However, by grade 12, girls may find themselves behind (Sadker & Sadker, 1994). Tartre and Fennema (1995) identified confidence as the affective variable most consistently related to mathematics achievement. Studies conducted by Fennema and Sherman (1977, 1978) reported that female students often show less confidence than male students in their ability to do mathematics even when there is no gender difference in mathematics achievement. Lack of confidence in mathematics achievement may contribute to a lack of persistence on difficult tasks (Koehler, 1990; Peterson and Fennema, 1985). Gober (1998) suggested that in order to attract more women to mathematics courses and careers, changes should be made in the way it is taught.

In 1999, the Third International Mathematics and Science Study [TIMSS] had a gender gap favoring males in mathematics and science achievement in more countries among eighth graders than fourth graders, and the differences were more pronounced in eighth grade (Mullis, Martin, Gonzalez, Gregory, Garden, O’Connor, Chrostowski, & Smith, 2000). According to the result of the TIMSS (1995) study, United States’ mathematics achievement test shows that at the fourth grade level, males’ mean score was 545 and the females’ mean score was 544. The gender difference in the international average score in this category was 2 points. At eighth grade level, males’ mean score was 502 and females’ mean score was 497 for United States. The gender difference in the international average score in this category was 8 points favoring males. Finally, the male students’ mean score at the twelfth grade level was 466 and females’ mean score was 456 in the United States. The gender difference in the international average score in this category was 33 points favoring males.

Looking at the above data, we can clearly see that there is a gender difference in male and female students’ mathematics achievement scores. Along with achievement, female students’ self-confidence in their performance is also different than their male counterparts. As the students go to higher levels, the differences in achievement and confidence level between these two groups becomes larger. It is also clear from the TIMSS (1995) study results that this is not an issue for the United States only. This is an
issue for other countries as well since a similar pattern is present in the international average score.

**Teachers Beliefs on Gender Differences in Mathematics**

Teachers’ beliefs have been an attractive research topic to mathematics educators for the last two decades. There have been few studies conducted on teacher’s beliefs in relation to gender and mathematics. Many of these studies have focused on elementary or middle grades teachers (e.g., Fennema, Peterson, & Carpenter, 1990; Tiedemann, 1995; Tiedemann & Faber, 1995, Tiedemann & Steinmetz, 1998; Tiedemann, 2000a, 2000b; Jussim & Eccles, 1992; Mujis & Reynolds, 2002; Garrahy, 2001, 2003).

**Elementary Level.** Although test scores show that gender differences in mathematics are more prominent in the secondary school level than earlier grades, research reveals the existence of gender differences in teachers’ and parents’ beliefs as early as at the elementary grade level.

Fennema, Peterson, & Carpenter (1990) investigated teacher beliefs in relation to gender and mathematics. The subjects for the study were 38 first grade female teachers in 24 schools in the USA. The subjects were asked to identify two of their most and least successful male and female students and to describe their characteristics. The results indicated that teacher beliefs about male and female students in mathematics were different. Teachers perceived male students as being their best students and were most inaccurate in selecting their most successful students. The teachers tended to explain males’ success in mathematics in terms of ability more often than they did for females, whose successes were described more often in terms of effort.

Similar findings have been reported by Tiedemann (2000a) from his investigation of elementary mathematics teachers’ gender-related beliefs. Fifty-two third and fourth-grade German teachers were each asked to choose 6 students from his/her class—three boys and three girls. In both gender groups, one student had to be from upper performance level, one from medial performance level, and one from low performance level. Then, the teachers were given a survey for each of their selected students regarding the students’ abilities and effort, casual attributions of multiple achievement outcomes, and expectations of future achievements. The survey results showed that teachers thought that average achieving girls are less logical than equally achieving boys.
and that girls profit less from additional effort, and find mathematics harder than boys. The result gave us some proof of stereotypical teacher beliefs on gender differences in math achievement. In a later study, Tiedemann (2002) examined the effects of teachers’ gender-role-stereotypes on their perceptions of their children’s mathematics ability. Forty-eight German elementary school teachers of two hundred eighty eight students were surveyed in this study. The result supported the hypotheses that teachers’ gender stereotypes have a well-defined effect on the specific beliefs about their students’ ability and effort resources. Muijs and Reynolds (2002) studied the relationship between teacher behaviors and beliefs with students' math achievement in England. The result suggested that student achievement has a strong direct effect with teacher beliefs.

In recent years, Garrahy (2001, 2003) conducted 2 studies on mathematics teachers’ instructional practices in relation with the teachers’ gender-related beliefs in the United States. Fennema et al. (1990), Tiedemann (2000a, 2000b, 2002) and Muijs & Reynolds (2002) conducted their studies using purely quantitative methods (survey, questionnaires, students’ achievement score). Unlike them, Garrahy (2001, 2003) conducted her study using multiple data sources (teacher interviews, classroom observations, classroom material analysis). Garrahy’s studies were case studies, having three participants in 2001, and two participants in 2003. Both of these studies concluded that although the teachers believed that they did not take students’ gender into account when teaching, their classroom practices did not match with their stated beliefs. Teachers’ classroom practice demonstrated some stereotypical attitudes toward male and female students.

Middle School Level. Middle school is a complex transition period for students. This is a time for self-discovery; learning what is expected of them as they play different social roles. Gender is a crucial reason at this stage to change our perceptions about our social status, performance and abilities. At this transitional period, teacher’s beliefs and expectations about the students’ abilities and skills can influence students’ attitudes toward certain subjects, such as mathematics.

In a quantitative study on teacher expectations, constructions and reflection on student achievement by Jussim and Eccles (1992), a correlation between middle school teachers’ (n=98) expectations and the change in student achievement was found. The
result of the study suggested that teacher perceptions were generally consistent with stereotypes of gender differences: Boys have more talent and girls compensate by working harder. It was stated in the study that, “Adolescents hold similar beliefs regarding their own talents and abilities.” If there is a relationship between these beliefs held by the teachers and the students, still remains a question to be answered.

She (2000) conducted a cross-relationship study on a Taiwanese seventh-grade biology teacher’s beliefs, practices, and classroom interaction with either male or female students. The study was analyzed both quantitatively and qualitatively. The teacher’s classroom practice reflected her teaching philosophy. Gender-based characteristics played an important role in establishing and maintaining differences in interactions between male or female students and their teacher. The teacher’s beliefs concerning boy/girl differences in learning style and classroom participation were reinforced or sustained by her behavior, which included unequal distribution of direct questions, unbalanced feedback and encouragement, and a lack of restrictive controls on calling out answers.

**High School Level.** In the early stage of research on sex-related differences in mathematics achievement, it was concluded that these differences are more visible in adolescents than younger children. Fennema and Sherman (1978) found that in the high school years, girls expressed less confidence than boys in their ability to do mathematics along with other negative attitudinal influences, such as girls’ perception of mathematics as being less useful to them and girls’ perception of less favorable attitudes on their part of their teachers and parents. The differential results in mathematics achievement test suggest that important negative influences may exist within the schools themselves. Fennema and Sherman (1978) imply that further research is needed to be done to find and explain these negative influences embedded in the school systems that are contributing to the negative attitudes held by female students toward mathematics. Since teachers are an important part of schools, and their attitudes are guided by their beliefs, this supports a need to study teachers’ beliefs about gender differences and their influences on the formation of students’ beliefs related to gender differences at the high school level.

Stipek and Gralinski’s (1991) quantitative study on gender differences in children’s achievement-related beliefs was conducted on 194 third graders and 279 high
school students. Data were measured by a student survey that was given before and after a regularly scheduled mathematics exam. The results showed that girls expect less on their ability to succeed than boys do. These achievement-related beliefs were found to be gender related. It was also suggested that the third graders’ beliefs might not affect their behavior as much as the older girls’ behavior in future course and occupational choices. Thus, we see the pattern in gender related differences in mathematics is emerging as the students are moving toward high school level. But, why is that? Fennema, Carpenter, Jacobs, Franke, and Levi’s (1998) conjuncture behind the gender differences was that teachers treated and encouraged the boys more than they did the girls. Since teachers’ behaviors are directed by teachers’ beliefs, we come up to the question, how gender differences in mathematics at the high school level may be related to the teachers’ beliefs on gender related differences.

Ensuring educational equity is a challenge for today’s educators and gender difference is one of the main obstacles in this path. Gender differences still remain in our nation’s schools and influence the learning experiences of girls and boys. Since students spend a large portion of their day in school, it is important to examine the beliefs teachers hold with regard to gender socialization (Garrahy, 2003). Numerous research in the field of gender difference in mathematics have indicated that gender difference becomes larger in higher grades compared to the lower grades. Research has also indicated that teachers’ beliefs could be a possible reason for gender differences in mathematics education. Yet, research on teachers’ beliefs on gender differences in mathematics at the high school level is lacking. In addition, most of the studies done on this topic at the elementary and middle school level have used only a quantitative method to measure teachers’ gender-related beliefs.
CHAPTER 3

METHODOLOGY

Research Focus

This current study on high school teachers’ beliefs on gender differences in mathematics was built upon three previous studies conducted by Tiedemann (2000a), She (2000), and Garrah (2001). Tiedemann (2000a) investigated elementary mathematics teachers’ gender-related beliefs. Fifty-two third- and fourth-grade German teachers were each asked to choose six students from his/her class—three boys and three girls. In both gender groups, one student had to be from upper achievement level, one from medial achievement level, and one from low achievement level. Then, the teachers were given a survey for each of their selected students regarding the students’ abilities and effort, casual attributions of multiple achievement outcomes, and expectations of future achievements. Tiedemann’s teacher survey was adopted as a data source in this current study. The result of this survey was used in data triangulation to allow the researcher to define teachers’ beliefs and find the extent of consistency of these beliefs with their instructional practices and classroom interactions. Tiedemann found five gender-biased beliefs of elementary mathematics teachers in his study:

1) Teachers thought that average achieving girls were less logical than equally achieving boys.
2) Teachers thought that girls profited less than boys from additional effort.
3) Teachers thought that girls exerted relatively more effort to achieve the level of actual performance in mathematics.
4) Teachers thought that mathematics was more difficult for average achieving girls than equally achieving boys.
5) With regard to girls, teachers attributed unexpected failure more to low ability and less to lack of effort than boys.

In this study, the survey results were compared with Tiedemann’s (2000a) five conclusions to compare if the high school teachers in this study held identical gender-biased beliefs about their students as it was found in Tiedemann’s study at the elementary level. Along with Tiedemann’s teacher survey, Garrahy’s (2001) research method was also followed to design this study. Garrahy also measured elementary teachers’ beliefs on gender-related differences in mathematics education using multiple data sources (teacher interviews, classroom observations, classroom material analysis). In this study, data were gathered through multiple data sources as well (teacher survey, teacher interviews, classroom observations, and document analysis). The classroom observation technique was adopted from She’s (2000) observation method used in an investigation of a middle school science teacher’s gender-related beliefs. She’s observation method included categorizing the data as teacher-initiated teacher-student interactions, student-initiated teacher-student interactions, teacher-feedback, and student responses. Thus, built upon Tiedemann, Garrahy, and She’s investigation of teachers gender-related beliefs in mathematics and science, this study investigated high school teachers’ gender-related beliefs in the field of mathematics education and extend the knowledge on this important topic.

**Definition of Key Terms**

It was important to define some of the key terms in the research questions to have a clear understanding of what this study really wanted to find out. Definitions of these key terms are as follows:

I) Teacher beliefs: Beliefs are integrated systems of mental processes that develops in our mind independent of consensus and validity throughout a cultural transmission, held with various degrees of conviction, prioritized according to their connections to other beliefs, and acts as a major determinant of our behavior. Beliefs can be conscious or unconscious. Such beliefs held by teachers about students, teaching and learning, education, schooling, and school culture are teacher beliefs.
II) Gender differences: Gender differences are distinguishing characteristics between male and female students such as ability, achievement, motivation, skill, attention, curiosity, memory, determination, competitiveness, imagination, creativity, career choices, etc.

III) Consistency: Consistency is maintaining a particular relationship between a person’s belief and his/her action on any issue.

Participants

The participants for this study were five mathematics teachers from a high school in north Florida. Pseudonyms have been used to refer to the school district, school, and the teachers throughout the study. This was a convenience sampling of participants based on their availability and cooperativeness. All the participants taught high school mathematics courses during the 2003-2004 school year. Four of these five participants were females. Two of these teachers were National Board Certified. Two teachers from these five participants were chosen for case studies. None of these two teachers were National Board Certified.

Data Sources

In this study, multiple approaches were followed to gather data. Multiple sources of information were sought and used because ‘no single source of information can be trusted to provide a comprehensive perspective’ (Merriam, 1998). A teacher’s gender-related beliefs are most often inferred and difficult to capture with one instrument or means of data collection (Garrahy, 2001). Thompson (1992) stated that “at the very least, investigators of teachers’ mathematical beliefs should examine teachers’ verbal data along with observational data of their instructional practice or mathematical behavior; it will not suffice to rely solely on verbal data” (p. 135). By using a combination of teacher surveys, formal and informal interviews with the teachers, classroom observations, and videotapes of teacher-student interactions, the researcher employed different data sources to validate and crosscheck the findings and establish a
data triangulation. What was the researcher’s interpretation of such data sources? Drawing from educational research textbooks, the followings were concluded.

**Case Study**

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly defined (Yin, 1994). A case might be selected to achieve as full an understanding of the phenomenon as possible (Merriam, 1998). Becker (1968) defined the purpose of a case study as, “to arrive at a comprehensive understanding of the groups under study and to develop general theoretical statements about regularities in social structure and process” (p. 233).

**Interview**

In all forms of qualitative research, data are primarily collected through interviews. The main purpose of an interview is to obtain a special kind of information (Merriam, 1998). The researcher wants to find out what is “in and on someone else’s mind” (Patton, 1990, p. 278).

**Observations**

Just like interviews, observations can be a primary source of data in educational research. Observations take place in the natural field with the phenomenon of interest and its data represent a firsthand encounter with the phenomenon. When combined with interviewing and document analysis, observation data allows for a holistic interpretation of the phenomenon being investigated (Merriam, 1998).

**Documents**

Documents are, in fact, a ready-made source of data easily accessible to the imaginative and resourceful investigator. Public records, personal documents, and physical materials are three major types of documents available to the researcher for analysis. A researcher can also create documents for the purpose of the investigation (Merriam, 1998).
Procedure

In this study, data from different sources were collected in the following five phases:

**Phase I**

In Phase I, the researcher contacted the five high school mathematics teachers and the school officials at Rainbow High School to enquire about their availability and cooperativeness with this study. During the first meeting, which was held in December of 2003, all of the five high school teachers agreed to participate in the study. The school officials also agreed to provide the necessary school documents. Those documents included students’ math grades from previous semester and their FCAT grades from the last three years. It was decided that the researcher would begin data collection in January of 2004. According to the plan, the teachers were contacted back in January. At this point, two of the five teachers, Mr. Brown and Ms. Green showed as much cooperativeness and enthusiasm as they did in the first meeting. As the other three teachers, Mrs. White, Mrs. Black, and Ms. Grey showed lack of interest in being observed in their classrooms, the researcher chose Mr. Brown and Ms. Green to be the final participants for the case studies.

Each of the other three teachers agreed to answer a questionnaire concerning six of their students from a certain class taught by them. Mr. Brown and Ms. Green were also asked to answer such questionnaires in two of their classes. One of these classes was an upper level, and the other one was a lower level mathematics class. For Mr. Brown, the upper level class was AP Calculus, and the lower level class was Liberal Arts Mathematics. For Ms. Green, the upper level class was Algebra, and the lower level class was Algebra1A. These two teachers were asked to answer two sets of questionnaires instead of one for a specific reason. Two sets of questionnaires on the students from two different courses were to help determine if the teachers’ beliefs toward students from upper level and lower level courses were consistent. Research indicates that female students’ achievement and confidence level in mathematics goes lower as they move toward higher-level courses. The reason for choosing two different levels of courses in this study was to see if there was any difference between the teacher’s
behaviors in those two classes. For the other three teachers one course was randomly selected. Thus, the course Algebra II Honors was chosen for Mrs. White, Geometry was chosen for Mrs. Black, and Algebra IB was chosen for Ms. Grey.

**Phase II**

Once the courses were chosen, the researcher selected six students from each of these courses. The goal was to choose a pair of male and a female student from upper, medial and lower level. That way, there would be three male students and three female students from each of the three achievement levels. Since the previous studies have suggested that teachers might hold gender biased beliefs to different degrees for different achievement levels (Tiedemann, 2002; She, 2000), the researcher chose to categorize students according their achievement levels also. Several criteria were followed in the selection of these students. First, students’ mathematics grades from the previous semester (in the same class) were collected. Students were placed from each of these courses in the rank of upper, medial, and lower level according to their grades. A student was placed in the upper level if his/her math score was 85% or higher. Students with scores between 70% and 85% were considered medial, and below 70% were considered low achievement level students.

Once the students were categorized in three different achievement levels, their FCAT (Florida Comprehensive Achievement Test) scores of the last three years were also examined. The state of Florida administers the FCAT to assess student achievement of the high-order cognitive skills represented in the state standards in Reading, Writing, Mathematics, and Science. All students in Grades three to ten take the FCAT Reading and Mathematics in the spring of every year. For this study, only students’ Mathematics scores from the FCAT were considered. The FCAT result places students in five achievement levels, with level 1 being the lowest and level 5 being the highest. Students’ FCAT achievement levels from the past 3 years were averaged for this study. An average level of 4 or more was considered high, above 2.5 and below 4 was considered medial, and below 2.5 was considered low achievement level. There were some students who were in grade 11 and 12. Since these students did not take part in FCAT after 10th grade, the last 2 years’ of FCAT scores were considered for the 11th graders and only 1 year’s FCAT score was considered for the 12th graders. The consistency of the student’s
achievement level was determined by matching their level from their previous semester’s mathematics grade and the average of their FCAT performance level. After establishing the consistency of students’ achievement level through this process, a pair of male and female students from the high, medial, and low level was finalized for each of the selected courses.

Phase III

In this phase, each of the math teachers completed the questionnaire (see Appendix A) on each of the selected students in order to elicit teachers’ stated beliefs about gender differences in mathematics. The survey items were based on Tiedemann’s (2000a) study on elementary teachers’ gender-related beliefs and included six categories of questions: (a) estimation of the child’s competence; (b) attribution of current performance in mathematics; (c) attribution of improvement; (d) attribution of deterioration; (e) prognosis of performance; (f) presumed self-concept of the child. The survey had six sets of questionnaires concerning each of the six students from the selected courses, each set containing 15 true/false and multiple-choice questions in them. The purpose of this survey was to inquire if the five participants in this study held similar beliefs about their male and female students’ achievement, abilities, and attitude toward mathematics as it was found by Tiedemann (2000a). The result was also used to prepare future interview questions for the case studies.

Phase IV

After choosing Mr. Brown and Ms. Green as the case study participants, the researcher started to observe each of them in both the upper and lower level classrooms. She observed these two teachers in both of their classrooms three times a week for up to six weeks. These observations provided her an opportunity to gather information about the relationship between teachers’ stated beliefs and their practice of these beliefs in real classrooms. To determine if the teachers’ stated beliefs were consistent with their classroom practices, each of these observations were videotaped. Besides videotaping the observations, a chart consisting teacher-initiated teacher-student interactions, student-initiated teacher-student interactions, teacher-feedback, and student responses (She, 2000) was completed to see if any patterns exist in the classroom (see Appendix B).
Phase V

Although this part of the research is categorized as phase V, it began right after phase III was finished. To elaborate data on the two teachers’ stated beliefs and to address the degree of consistencies and inconsistencies in their stated beliefs with their instructional practices and behavioral interactions, interviews were conducted throughout this phase of the study. The initial interview (See Appendix C) with each of the final participants began in early February. Throughout the six weeks of observations, short conversations between the teacher and the researcher took place during the planning period for clarification and elaboration on lessons observed. These conversations lasted for five to ten minutes. The final interviews took place after all the observations were completed. In the final interview (see Appendix D & Appendix E), teachers were challenged with the inconsistencies in their stated beliefs with their instructional practices and behavioral interactions and asked for explanations on them. They were also presented with hypothetical situations (Cooney, 1985) related to gender differences in mathematics education and asked to reflect upon them. Each of the interviews was video taped. Facial expressions, body language, and emotions about the topic of conversation were important in this study since according to Pajares (1992), we can distinguish between beliefs and knowledge by observing our feelings about the domain. Individuals’ feelings and emotions are related to what they believe and how they believe it, but feelings or emotions are not related to knowledge. To sufficiently capture the expressions and the body language, observation data (Appendix B) from the classroom observation was just not enough. Since distinguishing between beliefs and knowledge has been documented as a difficult task by researchers, the researcher in this study decided to videotape the interviews, which in result was extremely helpful to capture the participants’ emotions. Both of these teachers were very natural in their classroom setting since other researchers had videotaped them before in numerous occasions.

Data Collection

In this study, data were generated from four sources: (1) questionnaire completed by classroom teachers on each of the six students selected within their classes; (2) teacher
interviews; (3) classroom observations; and (4) videotapes of instruction documenting
teacher and student behavior. By using multiple data sources, the researcher was able to
use a questionnaire that had been used twice in other research (Tiedemann, 2000a), and
furthermore gathered rich, thick, descriptive data from teacher interviews and classroom
observations. With the multiple sources, data were triangulated so that assertions from
the study that emerged could be confirmed or disconfirmed.

![Data Triangulation Diagram]

**Figure 3.1**
Data Triangulation

**Analyzing the Data**

Data were analyzed to determine teachers’ specific gender related-beliefs and if
teachers’ stated beliefs about gender differences in mathematics are consistent with their
teaching practices. As the study unfolded and particular pieces of information came to
light, efforts were made to triangulate each data piece against at least one other source.
For example, a teacher’s belief from the questionnaire was compared to data from the
follow up interview and classroom observations. No single item of information was
given serious consideration unless it could be triangulated (Lincoln & Guba, 1985).
The researcher’s approach to data collection and analysis was iterative: questionnaire results, interview transcripts, videotapes, and observation data (Appendix B) were analyzed, as they were collected. The questionnaire results were analyzed to compare the findings from Tiedemann’s (2000a) study and were analyzed with the data from follow-up interviews to determine the individual teacher’s stated beliefs. The videotapes and observation data from classroom observations were simultaneously analyzed based on teacher/student interactions. The videotapes and observation data were then compared to stated beliefs from the questionnaire and follow up interviews. Consistencies and inconsistencies between stated and practiced beliefs about gender differences in mathematics were identified.

Data were coded as follows:

C: beliefs are consistent with teaching practices, and
NC: beliefs are not consistent with teaching practices.

Data that were coded as consistent beliefs (C) and not consistent beliefs (NC) with teaching practices were further analyzed to find the reason for this consistency and inconsistency. Throughout the classroom observations and teacher interviews, some beliefs and instruction-related questions emerge and were answered:

- How did the teachers develop their beliefs about gender differences in mathematics?
- Are they conscious of their beliefs?
- Which beliefs about gender differences come to play in their teaching practices?
- If these beliefs do not come into play in their teaching practices, how do they prevent them?
- What are the efforts made by the teachers to create an equitable class environment where boys and girls are given equitable opportunities to learn actively with the same expectation level from the teacher, accomplish their best, and reach their potential?
- Are there any differential treatments from the teacher toward the male and female students in the math class? If so, what are the differential treatments?
- Do the male and female students participate actively in the classroom?
• Does the teacher give the same amount of feedback to both boys and girls?
• Are the girls challenged as much as the boys in the class?
• What is the classroom setting (lecture based/ cooperative)?
• Are both the male and female students enthusiastic about classroom-participation?

The data were mainly mediated through the researcher rather than a computer. According to Guba and Lincoln (1981), certain characteristics differentiate the human researcher from other data collection instruments: the researcher is responsive to the context; he or she can adopt techniques to the circumstances; the total context can be considered; what is known about the situation can be expanded through sensitivity to nonverbal aspects; the researcher can process data immediately, can clarify and summarize as the study evolves, and can explore anomalous responses.

Thus, analyzing data gathered through multiple sources the researcher was able to answer the research questions.

**Data Gathering Map**

### Table 3.1

<table>
<thead>
<tr>
<th>Data Sources</th>
<th>Research Question 1</th>
<th>Research Question 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Set 1: <em>Teacher survey result</em></td>
<td>What specific beliefs do high school teachers hold about the relationship of gender to the teaching and learning of mathematics?</td>
<td>What is the consistency between stated beliefs about gender and instructional practices and classroom interactions?</td>
</tr>
<tr>
<td>Data Set 2: <em>Video tapes of instructions</em></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Data Set 3: <em>Classroom observation transcript</em></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Data Set 4: <em>Teacher interview transcript</em></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Validity and Reliability

Internal validity of a research ensures the consistency of the research findings with the reality. Reliability of a research ensures that if the study is repeated, it will yield the same result. To ensure the internal validity, Merriam (1998) has suggested six basic strategies to enhance the internal validity of a research. The researcher in this study followed Merriam’s suggestions to promote the internal validity.

1) Triangulation: This study used multiple methods of investigation previously followed by other researchers in the inquiry of teachers’ gender-related beliefs. As a result, multiple sources of data were used to confirm emerging findings. Data consisted of the teacher questionnaires, field notes from classroom observations, videotapes of instructions documenting teacher and student behavior, teacher interviews along with informal conversations with the teachers, and documents, including students’ mathematics grades from the previous semester and their FCAT result from the last three years. Triangulation of these data on a continual basis allowed the researcher to define the teachers’ stated beliefs and find the extent of consistency of these beliefs with the instructional practices and classroom interactions.

2. Member check: The researcher described to the participants about the patterns she observed in the classrooms and if any inconsistency was found between the teacher’s stated beliefs and the instructional practices and classroom interactions. Sometimes, video clips from the previous observations were presented to the participants to remind them of a specific incident. The participants were asked to explain whether they agreed with the researcher’s statements or not, and were also asked for explanations for that.

3. Long-term observation: Observations were conducted in the classrooms over six weeks. During every classroom observation, the researcher wrote a memo to herself about any incident or a pattern of behavior that seemed related or important for answering the research questions. In the next observation sessions, the researcher observed if those patterns were reoccurring. Patterns from one class were crosschecked with the patterns that existed in the other class taught by the teacher and looked for similarities or differences. The researcher also asked questions to the teachers to clarify issues in such
patterns during their next day’s informal conversations. Thus, the researcher kept gathering and analyzing data until she was able to conclude on a pattern of behavior in the classroom. Data collection was finished once the researcher found that the same pattern of behavior kept repeating itself.

4. Peer examination: The researcher took two of her fellow doctoral students’ opinions on some video clips from the class observations and comments made by the participants that reflected their beliefs about gender and mathematics. Their interpretations provided the researcher with valuable feedback on the findings from this study.

5. Researcher’s biases: It is important that the researcher’s assumptions, views and theoretical orientation be discussed at the outset of the study. The researchers’ views concerning the teaching and learning of mathematics are consistent with Robert Gagne’s (1985) conditions of learning. In her opinion, different people have different learning styles. So, what works for one learner might not work for a different learner. People develop intellectually at different rates because of their learning capabilities. Numerous factors work behind a person’s learning process. Learner’s previous knowledge, environmental and cultural background, interest, and learning capabilities are some of these factors. Therefore, no set of characteristics can be applied to all learning. The researcher believed that as groups, boys and girls do not differ in their mathematical abilities. Given equitable opportunities to learn, both boys and girls can do well in mathematics. Furthermore, the researcher also believed that teachers’ beliefs are developed through their personal experiences as social beings and some of the pre-existing beliefs are subject to change by encountering new experiences.
CHAPTER 4

RESULTS

This chapter presents the results from this study. The results are presented in the order of findings from teacher survey, findings from the case of Mr. Brown, and findings from the case of Ms. Green. The teacher survey was given to five math teachers at the Rainbow High School. Each of the two case study participants, Mr. Brown and Ms. Green answered two sets of survey questions concerning three male and three female students from two of their classes. The other three teachers, Mrs. White, Mrs. Black, and Ms. Grey answered just one set of the survey questions on the students from one of their classes. Thus, the participants in this survey were five teachers and the total numbers of survey-questionnaires were seven. The results from each of the cases are consisted of the observation result in both of the upper and lower level classes along with a description of each class, followed by the findings regarding stated beliefs, instructional practices and classroom interactions, survey result, and a discussion of the findings.

The Teacher Survey

In the beginning of February 2004, each of the 5 teachers was given the teacher survey. By that time, the researcher had already decided that Mr. Brown and Ms. Green would be the final participants for her case studies. So, she asked both of these teachers to answer two sets of questionnaires. The two sets were concerning six students from each of the classes the researcher had decided to observe three days a week for six weeks. Thus, Mr. Brown had to answer questionnaires concerning students from his AP Calculus class and Liberal Arts Mathematics class. Ms. Green had to answer questionnaires concerning students from her Algebra and Algebra 1A class. The other three teachers, Mrs. White, Mrs. Black, and Ms. Grey had to answer questionnaires concerning students from their Algebra II Honors, Geometry, and Algebra IB course respectively. The
surveys were sent to them through campus mail. Each survey was sent with a stamped envelop with the return address on. The teachers were given one week to answer the survey. On completion, they mailed it back to the researcher.

**Survey Result**

Table 4.1
Teacher Survey Results

<table>
<thead>
<tr>
<th>Item</th>
<th>Level</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Good computation skill</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>7</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Medial</td>
<td>6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Low</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Good logical thinking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>6</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Medial</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Low</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. Math difficult</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Medial</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Low</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>4. Too much expected</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>0</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Medial</td>
<td>0</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Low</td>
<td>1</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>5. Effort helps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Medial</td>
<td>5</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Low</td>
<td>7</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>6. Uses capabilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Medial</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Low</td>
<td>0</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>7. Encouragement is useful</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>6</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Medial</td>
<td>5</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Low</td>
<td>6</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>8. Little endurance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Medial</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Low</td>
<td>6</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td><strong>11. Will improve</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>4</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Medial</td>
<td>5</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Low</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. Will deteriorate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>2</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Medial</td>
<td>1</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Low</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>
** Item 9 and 10 had a different format than the other 13 items. Since there were four answer choices (see Table 4.2) instead of two, the result for items 9 and 10 are given in Table 4.3.

### Table 4.2

*Question Format for Items 9 & 10*

| If she/he does considerably better in the next math test than expected, the reason is: |
|------------------------------------------|------------------------------------------|
| a) Good ability. | c) The test was rather too easy. |
| b) Increased effort. | d) She/he was lucky. |

| 10. If she/he does considerably worse than expected, the reason for this is: |
|------------------------------------------|------------------------------------------|
| a) Lack of ability. | c) The test was rather too hard. |
| b) Lack of effort. | d) She/he had bad luck. |

### Table 4.3

*Results from Survey Items 9& 10*

<table>
<thead>
<tr>
<th>Item</th>
<th>Level</th>
<th>Ability</th>
<th>Effort</th>
<th>Easy Test</th>
<th>Luck</th>
<th>Ability</th>
<th>Effort</th>
<th>Easy Test</th>
<th>Luck</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>High</td>
<td>4</td>
<td>3</td>
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<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Medial</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 4.3 – continued

<table>
<thead>
<tr>
<th>Item</th>
<th>Level</th>
<th>Total students=7</th>
<th>Ability</th>
<th>Effort</th>
<th>Easy test</th>
<th>Luck</th>
<th>Ability</th>
<th>Effort</th>
<th>Easy test</th>
<th>Luck</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>High</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Medial</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

The purpose of these data was to see how the five participants in this study fit into Tiedemann’s (2000a) findings and use it for data triangulation. Tiedemann found five gender-biased beliefs of elementary mathematics teachers in his study:

1) Teachers thought that average achieving girls were less logical than equally achieving boys.
2) Teachers thought that girls profited less than boys from additional effort.
3) Teachers thought that girls exerted relatively more effort to achieve the level of actual performance in mathematics.
4) Teachers thought that mathematics was more difficult for average achieving girls than equally achieving boys.
5) With regard to girls, teachers attributed unexpected failure more to low ability and less to lack of effort than boys.

Tiedemann’s 1st conclusion was drawn from the answer to item 2 in the survey. Conclusions 2, 3, 4, and 5 were drawn from the answers to item 9, 5, 3, and 10 respectively. To compare the result of this survey with Tiedemann’s conclusions, the researcher looked at those items closely for each levels of students. The result from item 2 in this study showed similar findings as Tiedemann’s 1st conclusion (average achieving girls were less logical than equally achieving boys). While six out of seven medial level male students were believed to be good at logical thinking, only four out of seven female students of the same level were believed to be good at logical thinking. In addition to that, at the low achievement level, five out of seven male students were believed to be good at logical thinking while three out of seven students were believed to be good at logical thinking. There was not much difference at the high achievement level for this item.
The result of item 5 in this survey did not support Tiedemann’s 2\textsuperscript{nd} conclusion (girls profited less than boys from additional effort). The result from item 9 however supported Tiedemann’s 3\textsuperscript{rd} conclusion (girls exerted relatively more effort to achieve the level of actual performance in mathematics) at the medial and low level. Teachers in this study believed that at the medial level, four out of seven students would do considerably better in the next math test than expected for good ability, two would do better for increased effort, and one would do better if the test is too easy. For the medial level girls, teachers thought that only one out of seven students would do better for high ability and six students would better for increased effort. At the low achievement level, teachers thought that two out of seven male students would do better for high ability, four for increased effort, and one for the test being too easy. At the equally achieving level, teachers thought that all seven female students would do better only for increased effort.

The result from item 3 also had a very similar result to Tiedemann’s 4\textsuperscript{th} conclusion (mathematics was more difficult for average achieving girls than equally achieving boys). In item 3, teachers believed that for two out of seven medial level male students, mathematics was difficult, whereas for five out of seven equally achieving female student, mathematics was difficult. In addition to that, at the low achievement level, teachers believed that mathematics was difficult for three out of seven male students, whereas mathematics was difficult for six out of seven female students. Result from item 10 in this study did not show similarity with Tiedemann’s 5\textsuperscript{th} finding (with regard to girls, teachers attributed unexpected failure more to low ability and less to lack of effort than boys).

**The Case of Mr. Brown**

**Biography**

Mr. Brown is a male instructor in his mid fifties. He was born in Ohio, where he lived until finishing high school. After high school, he attended college in central Florida, majoring in mathematics. Upon graduation from college, he took a teaching job at a high school in the east coast of Florida with the idea that he was going to live at the beach for a year and relax. Although he had intended to get a different job after one year,
Mr. Brown had to change his mind after a very short time since he already started to love what he was doing—teaching mathematics at the secondary level. He has been a mathematics instructor for thirty-five years. Since his first teaching job, he worked at two different high schools in north Florida, with twenty years of service at his current institution.

In high school, Mr. Brown’s favorite subject was Physics. He liked it because he thought Physics explained the way everything works. Such as, motions, machines, etc. About his idol in life, he said,

Growing up, Chuck Eager was my idol. Chuck Eager was the first man to fly faster than the speed of sound. He was a test pilot. And I had, ideas in those days to be a fighter pilot. And of course that didn’t happen. It never worked out that way. (Interview, 2/17/2004)

Because of his interest in machines and motions, he started his college life as an engineering major. Soon, he realized that engineering was not exactly what he expected it to be. As a result, he changed his major to mathematics and grew a fondness of it.

When I got into college, taking math courses, I actually discovered that I really liked theoretical math, and I ended up liking math more. I thought it was kind of neat. You don’t need massive amount of money or equipment to do it. You just do it in your head, as they say. (Interview, 2/17/2004)

Over the years, Mr. Brown has taught various math course including mathematics for 6th grade, 7th grade, 8th grade, Pre-Algebra, Algebra 1A, Algebra 1 Advanced, Geometry, Advanced Geometry, Algebra 2, Advanced Algebra 2, Trigonometry, Analytical Geometry, Pre-Calculus, AP Calculus, Liberal Arts Math, Consumer Mathematics, and General Mathematics.

After 35 years of experience, Mr. Brown has developed strategies for teaching that helps him to run the classes in an organized way. His strategies differed according to the need of the specific class.

What you try to do is look at what you are doing, and look at what they are doing and tell if what you are doing is working for them. The object is to get them where they are comfortable, expressing what they are doing. If they say things like, “I have no clue what you just said”, then you have to say, “Ok, forget that, let’s take a look at this instead”. And, you pace your presentation based on the feedback that you are getting from the kids. Which is why classes like the Liberal Arts class is so hard. Because you are not getting much feedback. Either
they are not interested at all, or you can’t engage them at all. They either wanting to do something else, or they are not wanting to do anything. At the classes like my AP Calculus class, you get a lot of feedback. When they first walk into class, the first thing they say is “You have to go over the homework”. Then, you got, you have some place to go. When they don’t have any thing to say, it is really difficult to do. You try to make situations where they can relate to what you are doing. Sometimes it works, sometimes it doesn’t. (Interview, 2/17/2004)

Mr. Brown’s teaching strategies were related to his view about the role of a teacher in the classroom. He believed that a teacher’s role depends on the particular course he or she is teaching. For certain type of courses, such as survey or discussion courses, a teacher needs to be a facilitator, which would basically just provide direction and resources. For other kind of courses, he/she has to be the instructional leader according to Mr. Brown.

You have to guide the direction of the things are going, you have to make sure that everything is included. You also have to be the manager, which means you are in charge, and you have to maintain the control over the classroom so, everybody have an equal chance. (Interview, 2/17/2004)

Long-term teaching experience has made Mr. Brown a confident teacher. He believed that his personality was his greatest strength. He stated, “I get along with most of the kids and can convince them that they need to know what I am trying to show them. That’s motivation probably. I can do that pretty well” (Interview, 5/6/2004).

As far as his weakness as a teacher, Mr. Brown’s biggest concern was his lack of patience since he has been growing older. In his own words, “It’s harder to make yourself realize that, well you have done this fifty times, and this is their first time” (Interview, 5/6/2004). In these cases, he would try to back himself up and would tell himself that although the problem looks simple enough to solve it in his head, it might not be so easy for the students.

Mr. Brown’s Findings

The findings from Mr. Brown consist of the findings from class observation data in both of his Liberal Arts Mathematics and AP Calculus classes, Interview data, and teacher questionnaires. In this section, a description of each class is provided, followed
by the findings regarding stated beliefs, instructional practices and classroom interactions, Mr. Brown’s answers to the teacher survey, and a discussion of the findings.

**Observation Result**

As a case study participant, Mr. Brown was observed in two of his classes three days a week for six weeks. These two classes were his 4th period Liberal Arts Mathematics class and 6th period AP Calculus class. Each of these observations was videotaped. The researcher coded each one of the observations in a chart consisting of teacher-initiated teacher-student interactions, student-initiated teacher-student interactions, teacher-feedback, and student responses. An interaction was counted as “teacher-initiated teacher-student interaction” every time the teacher asked a question or made a comment related to the learning topic directly to a male or a female student. Similarly, every time a student asked a question or made a comment related to the learning topic to the teacher was counted as the “student-initiated teacher-student interaction”. “Teacher feedback” (praise, negative comments) toward the students were the feedback from the teacher to the student concerning the learning topic. An example of praise would be saying “good job” when a student can answer a question correctly. Similarly comments such as, “not good” when a student fails to answer a question would be an example of negative comments. Each time a male or a female student answered a question posed by the teacher toward the whole class concerning the leaning topic, it was counted as “student response”. If more than one student answered such a question, the additional response(s) were counted too. This chart was completed to see if any patterns existed in the classroom. Besides completing the chart, the researcher wrote some field notes to make the chart more comprehensible for future analysis.

**Liberal Arts Mathematics Class.** Mr. Brown’s 4th period Liberal Arts Mathematics class had twenty-three students. Thirteen of them were male and ten of them were female students. Twenty of these students were seniors and only three students were juniors. According to Mr. Brown, all of them had already taken Algebra II. This was a teacher directed classroom, where the teacher lectured and the students took notes and answered questions asked by the teacher. Students also asked a lot of questions to the teacher. The students always worked individually. The textbook used in this class included many
group activities. Mr. Brown however never incorporated any group activity in his lessons. The male and female students in the class were friendly to each other.

Mr. Brown always started his class with checking the attendance. As the students took a few minutes to get settled in their seats, Mr. Brown talked to the male students who sat in the first row, right in front of his table. Their conversation was always about outdoor activities, such as fishing, weekend plans, some recent baseball game, etc. After that, Mr. Brown spent approximately twenty minutes of going over the previous day’s assigned homework. He always asked students if they needed to see any of the homework problems worked. In the remaining twenty-five minutes, of class, he presented the new material. He would begin the new topic with some easy examples leading to the examples increasing in complexity. His examples often involved real-life situations and he liked the students to get involved during solving each of the example problems.

Keeping order in this classroom was a challenge for Mr. Brown since the majority of the students showed minimal level of interest in learning, or just staying inside the classroom. Students often talked, made noises, and walked around in the classroom. At times, Mr. Brown became very frustrated and got tired of asking them to be quiet. He often shared his frustration with the researcher during their informal conversations.

I don’t like teaching this class. This is probably the most difficult class that I have had in last ten/fifteen years. They are not interested at all no matter how hard you try to get them interested. The teaching material is too simple here. There is basically nothing challenging for me in this class. I can do these stuff in my head. There is no challenge. I teach this class because I have to, but I don’t like it. (Informal Conversation, 2/9/2004)

Fourteen observations took place in the classroom by the researcher from a specific place in the classroom. A video camera was placed above a bookshelf next to where the researcher observed the classroom from. The researcher was able to get the full view of the classroom from this point without disturbing the natural classroom environment. The specific categories under observation consisted 1) teacher-initiated teacher student interactions, 2) student-initiated teacher student interactions, 3) teacher feedback, and 4) student response. The fourteen days of observation in the Liberal Arts Mathematics classroom provided the following result:
Table 4.4

Interaction Pattern Observed in Liberal Arts Mathematics

<table>
<thead>
<tr>
<th>Date</th>
<th>TEACHER INITIATED</th>
<th>STUDENT INITIATED</th>
<th>TEACHER FEEDBACK</th>
<th>STUDENT RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TEACHER-STUDENT</td>
<td>TEACHER-STUDENT</td>
<td>PRAISE</td>
<td>BOY</td>
</tr>
<tr>
<td></td>
<td>INTERACTIONS</td>
<td>INTERACTIONS</td>
<td>BOY 1</td>
<td>GIRL 1</td>
</tr>
<tr>
<td>Feb2</td>
<td>2</td>
<td>0</td>
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<td>Feb3</td>
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<td>2</td>
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<td>Feb6</td>
<td>2</td>
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<td>3</td>
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</tr>
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<td>3</td>
</tr>
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<td>3</td>
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<tr>
<td>mean</td>
<td>0.93</td>
<td>0.43</td>
<td>3.43</td>
<td>1.57</td>
</tr>
</tbody>
</table>

The results from the observations in table 4.4 show that there is a gender difference in all the categories favoring males. The occurrence of teacher-initiated teacher-student interactions, praise, and negative comments were limited in number. It is important to note here that only a limited number of boys and girls took an active part of any type of mathematics-related discussions, and in giving responses. Four male students and two female students were consistent with taking parts in these discussions. The teacher-initiated interactions toward boys included other male students besides these four male students, whereas toward the female students, it always stayed limited to the two female students. The researcher made an interesting observation that, the students, who took an active part during learning discussions, were also the ones who distracted the class by talking in the regular basis regardless of their gender. Some of the students never seemed interested in the class. They either stared outside of the classroom, or tried hard not to fall asleep. The male students seldom took any notes. Most of the female students on the other hand took notes in a regular basis.
**AP Calculus Class.** Mr. Brown’s 6th period AP Calculus class had thirteen students. Seven of them were male and six of them were female students. All but one student was a senior in this class. The other student was in 11th grade. Students in this class were serious and they were active learners. They came to the classroom with a number of questions for the teacher everyday. Although this was a lecture-based classroom, continuous discussion between teacher and the students on problem solving was a regular part of this classroom.

Everyday, Mr. Brown started this class with checking the attendance. After that, he spent approximately thirty minutes of going over the previous day’s assigned homework. He always asked students if they needed to see any of the homework problems worked. Mr. Brown always asked the students for feedback during problem solving. Students, regardless of their sex, took part in this activity. In the remaining twenty minutes, of class, Mr. Brown presented the new material. He always picked example problems out of the book. Everyday, he assigned reading on the next chapter along with some exercise problems. The students always read and worked out the assigned problems. Mr. Brown was very satisfied with this group of students. In fact, he told the researcher that this was his most favorite class.

Thirteen observations took place in the classroom by the researcher from a specific place in the classroom. A video camera was placed above a bookshelf next to where the researcher observed the classroom from. The researcher was able to get the full view of the classroom from this point without disturbing the natural classroom environment. The thirteen days of observation in the AP Calculus classroom provided the following result:

<table>
<thead>
<tr>
<th>DATE</th>
<th>TEACHER INITIATED TEACHER-STUDENT INTERACTIONS</th>
<th>STUDENT INITIATED TEACHER-STUDENT INTERACTIONS</th>
<th>TEACHER FEEDBACK</th>
<th>STUDENT RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BOY</td>
<td>GIRL</td>
<td>BOY</td>
<td>GIRL</td>
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<tr>
<td></td>
<td></td>
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</tr>
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</table>

Table 4.5
Interaction Pattern Observed in AP Calculus
The result from the observations in Table 4.5 shows that there is a small gender difference in all the categories. The female students in this class had more student-initiated teacher-student interactions, student responses, and negative comments compared to the male students. The occurrence of teacher-initiated teacher-student interactions, praise, and negative comments were limited in number. The researcher included interactions that were related to the learning topic only. Besides the learning topics, students interacted with Mr. Brown on non-mathematics related topics as well. For the most part, the female students had more interactions with the teacher on non-mathematics related issues, whereas boys mostly took part in mathematics related conversations.

Mr. Brown’s Stated Beliefs

Mr. Brown’s stated beliefs were defined by the researcher in the discussions she had with him over the course of two interviews and numerous informal conversations between them. All these interviews and conversations occurred between February 2 and May 6 of 2004. The majority of this work was accomplished by consistently reviewing
interview transcriptions and questionnaire responses from the teacher survey, all the while taking notes on repetitions of words and ideas. These repetitions were then discussed with him in elaboration and finally were listed as Mr. Brown’s stated beliefs.

**On the Meaning of the Phrase “Gender Difference”**

*Gender difference is the difference in ways men and women look at things.* Mr. Brown interpreted the phrase gender differences as the separate ways men and women perceive the world. He thought that men are generally very linear thinker. They see things from one direction and tend to think in a straight way. On the other hand, women are more universal thinker and they see things from different angles. They tend to see things from more than one point of view. This belief of Mr. Brown was based on the 35 years of interactions with his students.

**On the Presence of Gender Differences in Mathematics**

*We have overcome gender differences in mathematics.* Mr. Brown believed that gender differences existed in our society in the past. It does not exist anymore since girls are as much capable in mathematics as the boys are and they have proven that by working at different math and science related fields. He shared his memory from high school years with the researcher and said,

> Personally, I never experienced any differentiated treatment because of my sex. But, I often wander now that the girls that I was in class with, if they were. I don’t think I ever noticed any, you know, I was kind of clueless. In high school, you don’t even know what that is. And it didn’t appear that I was being singled out for special treatment or lack of. (Pause) There were several girls in my class, and I don’t know about them. I don’t know how they felt. But, for me personally, I would say that I was never treated differently because of my sex.

(Interview, 2/17/2004)

**On Students’ Ability**

*Girls do better in the lower-ability courses.* According to Mr. Brown, the female students in his classes believed that they are every bit of capable as the boys are. He thought that in his lower ability classes, the girls have had a little bit of success compared to the boys and they tend to think that if they work a little bit harder, they can actually do better than the boys. When the researcher asked Mr. Brown for the reasons for the female students’ success in his lower ability classes, Mr. Brown replied:
I think in the lower ability classes, the girls have had a little bit of success compared to the boys. And they think that if they work a little bit harder, they can actually do better than the boys. It’s not because they are smart or any thing. It’s because they are willing to do more work. But, guys, if they don’t want to do it at all, they will just not do it. (Interview, 2/17/2004)

On Boys and Girls’ Learning Styles

**Boys and girls learn mathematics differently.** Mr. Brown believed that his male and female students learned mathematics in two different ways. He believed that women in general, think in terms of an entire situation, in a family of ideas. Men on the other hand, think about an individual concept. Thus, when men are given a task, they break it down to different parts and they perform them one at a time and proceed toward a specific direction. Women put all the little parts together and solve them as a whole. “Women take a very broad view of things whereas, men struggle with that sometimes” (Interview, 2/17/2004).

Mr. Brown stated to the researcher that his belief about men and women’s distinct learning style influenced his instructional strategies.

If I have classes with majority girls, I tend to approach the things differently, remembering that girls tend to think more globally than guys. Guys tend to focus on very narrow, straight-line thing, whereas, the girls tend to view things more globally. So, the more things you can relate it to, the more they think it is important. If you show a single thing, and you are showing that it’s only good for this one thing, they will say, “ok, I will learn it, but I am not going to do it.” But if you can show some other things, they think it is important, and say, ok, I will do that. (Interview, 5/6/2004)

On Students’ Academic Potential

**There is no dramatic differences in boys’ and girls’ academic potential.** Mr. Brown believed that there was no significant difference in the academic potentials of the boys and girls he taught. He added that although girls have as much potential and abilities as boys do, they tend to not go into the direction of mathematics and science when they go to college. He believed that if the female students from his higher-level courses chose to go into the direction of mathematics and science, they would do well. He said that he tried to encourage all his AP Calculus students to take the Advanced Placement test regardless of their sex because he wanted all of them to be sure of their
capabilities. Nevertheless, Mr. Brown found it as a trend for the girls not choosing mathematics and science as college majors.

I think the girls in my AP Calculus class are very pleased that they have come this far and they are thrilled that they can do it. But, when they go to college, they will go into other things. You know, they will go into things like Business, they will go into Language or something like that. (Interview, 5/6/2004)

On Behavioral Interactions with Boys and Girls

Girls take things more personally than boys do. On the issue of behavioral interactions with his male and female students, Mr. Brown said that he tried to relate to both groups equally well. Both boys and girls came to him for extra help. Sometimes they just wanted to sit and talk for a minute. He tried not to differentiate whom he talked to or how he responded to each of them. He believed that it has become a lot easier for him to respond neutrally to the boys and girls since he grew older.

When you are younger, you have to be a lot more careful about what you say to young women. Because a lot of times, they don’t completely understand what you are trying to say. They take everything personally. Whereas guys tend to be a lot less impersonal about how they react. (Interview, 5/6/2004)

When the researcher asked Mr. Brown why the female students react that way, Mr. Brown replied that a lot of young women have not been in a position where they deal with a male other than their father in an authority position. So, they want to do well, and they want the teacher to think well of them. If the teacher says something that is not positive, they take it very seriously. Mr. Brown said that he was gentler with the girls compared to the boys when he criticized them for an unexpected behavior in the classroom.

On the Competitive Interests of Boys and Girls

Boys are generally more competitive by nature. Mr. Brown believed that from childhood, boys are taught to be competitive and girls are taught not to be. That affects their competitiveness in academic areas as well. The difference is more visible in lower ability classes than the higher ability classes. Mr. Brown also added that if girls are given the opportunity to compete, they could be as competitive as the boys can. He said that he always encourages his AP Calculus girls to be more competitive. Mr. Brown had coached football, basketball, and tennis over the years. He shared his experience with the
dramatic differences he observed in women’s competitive attitude from a coach’s point of view with the researcher.

When I first started coaching, the girls were not competitive at all. Over the last couple of decades, I have seen them to become extremely competitive. I think we, the society has started to look at women with title IX, and some other things. It made a dramatic difference in how they view themselves. Because, they did not have the opportunity to compete before. When I was in high school, girls could either cheer lead, or play field hokey. That was it. Those were the only 2 things they did. Whereas the boys played football, basketball, baseball, track, tennis, golf, you know, all of these things. You look now, and the girls play soccer, volleyball, they play basketball, they play golf, they play tennis, they swim, cross-country, that kind of things. They have been given a lot more opportunities to compete. So, they have become more competitive. (Interview, 2/17/2004)

On Parents’ Expectations of the Boys and Girls

Parents’ expectations are not gender-differentiated. Mr. Brown believed that the parents of his students expected their children to do well regardless of their gender. In fact, sometimes Mr. Brown found the parents expecting more from girls compared to the boys. They made comments such as, “Boys will be boys. They will always have other interests, whereas the girls should focus on school”. Mr. Brown said that he never heard any parents to make gender-biased comments. He added that if he ever heard such comments, he would be quick to point out that they are wrong since his girls are as much capable as his boys are.

I haven’t run into any such situations. And if I did, I will be quick to point out that, that is not the case because I have not seen a girl who is not as capable as a boy. So, for every really good boy I can find a really good girl too. For every low ability boy, there is every low ability girl. So, as far as I am concerned, gender has nothing to do with their ability. (Interview, 2/17/2004)

Mr. Brown’s Instructional Practice and Classroom Interactions

On the Meaning of the Phrase “Gender Difference”

Gender difference is the difference in ways men and women look at things. During the six weeks of observation, the researcher noticed that the female students in the AP Calculus class always talked about different methods of solving a problem, and compared them on the accurateness or simplicity. For example, in early February, they
were learning definite integrals using the Trapezoidal rule, and the Simpson’s rule. The boys in the class always tried to figure out a general rule on when to use which method, and they always used a specific method to solve a certain problem. The girls on the other hand tried out a problem using different methods and came up with their own conclusion about when to use which method. They always did not see eye to eye on how to solve the problem with the boys. Moreover, the boys in the class tended to work by themselves, whereas, the girls often worked together, shared ideas, questions, solutions with other girls. So, they were interested in looking at the problems/approaches from other points of view as well. The girls also got frustrated easily in this class. They spoke out loud of their frustration if they had trouble understanding a problem. Thus, the female students’ approach to a problem and toward its solution was different than the male students’ way in the class. In that respect, Mr. Brown’s beliefs about the different ways men and women view things was consistent with the classroom interactions in his AP classroom.

In Mr. Brown’s Liberal Arts Mathematics classroom, no similar trend stood out to the researcher. The students were happy with one type of explanation of a problem regardless of their sex. The students always wanted a specific formula to solve certain problems, so it would be easy to memorize. The students never shared their ideas or points of view with other students in this class. Thus, no difference was observed in the male and female students’ approach in problem solving. It was concluded by the researcher that Mr. Brown’s stated beliefs about the different ways men and women view things was not consistent with the classroom interactions in his Liberal Arts Mathematics classroom.

**On the Presence of Gender Differences in Mathematics**

*We have overcome gender differences in mathematics education.* One day, Molly, a female student in Mr. Brown’s Liberal Arts Mathematics class was talking very loudly and disturbing the class while Mr. Brown was solving problem on the blackboard. Mr. Brown was annoyed by this disturbance and decided to have a discussion with the students about proper classroom manners. He talked for almost 25 minutes about proper manners and the need for that in the society. He used many examples on how to avoid social conflicts during this discussion. The researcher observed that all his examples
were directed toward the male students as if he found boys only to misbehave and correct their behavior. At one point, the discussion turned into the following:

Mr. Brown: If you come by your girlfriend’s house, you go to the door, pick her up, you open the car door, you put her in the car, you close the car door. Now, where did that come from?
Male student 1: Manners.
Mr. Brown: Manners. But why?
Male student 1: So you make a good impression.
Mr. Brown: What conflict can you avoid? Women can take a different role than the past. I am not saying the old is better than the new. Because, I have a very specific opinion about women given the opportunity to perform what they choose to perform. Ok, there is nothing wrong with a woman working in a job if she can do the job. There is nothing wrong. There is nothing wrong with a woman to stay at home, being a stay at home mom, there is nothing wrong with it.
Male student 2: What about a man choosing to be a stay home dad?
Female student 1: (Laughing). Yah, like any women will go out with him!
Mr. Brown: In my opinion, women should have an opportunity doing what they want to do.

The researcher found that Mr. Brown’s discussion was completely directed toward the male students. In this discussion, he never gave an example to the girls about how they can avoid potential conflict although the reason for him to have this discussion was a girl’s (Molly) disturbing behavior. Although his comments sounded like quotes from a book, Mr. Brown was in support of the female rights of taking decisions, and giving them the opportunities. Mr. Brown’s interaction with the students in the AP Calculus class was much friendlier compared to the Liberal Arts students. He always encouraged all his students and had confidence in their abilities. The students’ achievement also did not show any gender difference. Thus, Mr. Brown’s stated belief that there is no gender difference in math students’ achievement was found consistent with the classroom interaction by the researcher.

On Student’s Ability

Girls do better in the lower-ability courses. In Mr. Brown’s Liberal Art’s mathematics class, boys were much more active during the problem solving sessions. They asked more questions as well as answered more questions compared to the girls. Out of the ten female students, only two of them took part in any type of interaction during the problem solving sessions. The rest of the female students were quiet most of
the time. The researcher observed that the majority of these girls took notes, whereas the male students seldom took any notes. Sometimes, some of the quiet female students went up to Mr. Brown to show if the way they solved a problem was right. Thus, Mr. Brown’s stated belief that the girls in the lower–level courses work harder than boys was found consistent with the instructional practice. However, the female students’ grade in the Liberal Arts Mathematics course was not higher compared to the male student’s grade. According to the previous semester’s mathematics grades, there was almost no difference between the male and female students’ achievement. Thus, Mr. Brown’s stated belief about the female student’s success in this class was not consistent with the instructional practices.

**On Boys and Girls’ Learning Styles**

**Boys and girls learn mathematics differently.** The researcher found that Mr. Brown’s stated belief on boys and girls different learning styles was consistent with the instructional practice in the AP Calculus class. The boys in this class always tried to figure out a general rule on when to use which method, and they always used a specific method to solve a certain problem. The girls on the other hand tried out a problem using different methods and came up with their own conclusions about when to use which method. They always did not see eye to eye on how to solve the problem with the boys. Moreover, the boys in the class tended to work by themselves, whereas, the girls often worked together, shared ideas, questions, solutions with other girls. So, they were interested in looking at the problems/approaches from other points of view as well.

In the AP Calculus class, Mr. Brown sometimes showed two different ways to solve a problem since the girls asked for it. If there was limited time in the classroom to solve problems in multiple ways, sometimes he solved them at home, and shared his solutions with the students in the next class. The girls in this class were more demanding than the boys were. They went for help to Mr. Brown during his off periods. Mr. Brown was eager to help students whenever they went for extra help. Thus, Mr. Brown’s view of modifying the instructional strategies according to the need of the students was consistent with his classroom practice in his AP Calculus class. No such an effort was made by Mr. Brown in the Liberal Arts Mathematics class.
On Students’ Academic Potential

There is no dramatic differences in boys’ and girls’ academic potential. After comparing the mathematics grades from the previous semester and the FCAT scores of the students from both of the courses, the researcher did not find any dramatic difference between the achievement of male and female students. Thus, the researcher concluded that Mr. Brown’s stated beliefs about the male and female students’ academic potential was consistent with the instructional practice.

During a specific observation session in the AP Calculus class, a female student Susan shared her frustration on not being able to some homework problem with Mr. Brown and stated, “I am smart, but not smart enough to solve these problems!” The female students in this class always expressed more frustration than the male students if they did not understand the concept. In this specific instance, Susan almost sounded as if she had given up. From the following observations, the researcher found Susan to get rid of her frustration by putting more effort and starting to have a positive attitude. One day, the female students started to ask Mr. Brown about the content of Calculus II course. They asked Mr. Brown if they can call him up to get some help with the higher level Calculus courses when they go to college. The question was not if they go to college, but when they go to college. This specific inquiry by the girls in the AP Calculus class revealed that they were considering going in the direction of mathematics in college. This contradicted Mr. Brown’s stated beliefs that his female students from this class will not go to the direction of mathematics in college.

On Behavioral Interactions with Boys and Girls

Girls take things more personally than boys do. The researcher found out from her observation in the Liberal Arts Mathematics class that whenever Mr. Brown confronted the male students about their unexpected behavior, they apologized about it. If he did the same to the girls, they were not apologetic. They expressed anger by making more noises or not doing what they were asked to do. For example, one day, a female student Abby was disturbing the class by talking continuously during lecture. Mr. Brown had already asked her to stop talking a few times already. As Abby did not listen to him and kept on talking, Mr. Brown asked her to change her sit to the other side of the classroom. Abby looked very unhappy about it, but she picked up her backpack and went
to the other side of the room. On her way there, she intentionally pushed some chairs around and made loud noises. The girls in the AP Calculus class did not have behavioral problems. However Mr. Brown sometimes joked with the student in this class, and in one of those moments, if Mr. Brown even jokingly maid some harsh comments to the girls, they became quiet and upset. The researcher concluded that this type of behavior of girls was consistent with Mr. Brown’s stated beliefs that girls take criticism from him more personally.

Mr. Brown seldom criticized the female students. If he did, he was very gentle about it. For example, if a girl were loud in the classroom, generally, he would not point her out in front of everybody. Instead, he would ask the whole class in general to behave properly or talk to that female student at the end of the period, so she is not embarrassed in front of the whole class. Thus, Mr. Brown’s stated belief that he was gentler with the girls compared to the boys when he criticizes them for an unexpected behavior in the classroom was found consistent with his classroom interactions.

**On the Competitive Interests of Boys and Girls**

**Boys are generally more competitive by nature.** The researcher found out from her observations that the female students in Mr. Brown’s AP Calculus class were as competitive as the male students were. Everyday, the girls came to the classroom with a lot of questions on the previous night’s homework and made sure that all of them were answered. Their grades reflected that there was no gender difference in the achievements of the students. Thus, Mr. Brown’s stated belief that the female students in the AP class are as competitive as the boys was found consistent with the instructional practice. In the Liberal Arts Mathematics class, although there was no significant gender-difference in student grades, the boys were more vocal compared to the girls. They asked questions to the teacher more frequently as well as answered questions more frequently compared to the girls. In that respect, boys were a little more competitive than the girls in this class, which was consistent with Mr. Brown’s stated belief that boys are generally more competitive.
Conflicting Beliefs

On Behavioral Interactions with the Boys and Girls

In the first interview (2/17/2004) with the researcher, Mr. Brown made a statement, “Gender does not affect the way I interact with the students”. During the final interview (5/6/2004) with the researcher, Mr. Brown made another statement, which was completely contradictory to the previous statement. At this session, he stated, “As a man, I always respond to female student differently than I do to males and it’s not something that I would do intentionally. It’s just what I grew up with”. From the class observations, the researcher found out that his second stated belief was more consistent with his instructional practice. Mr. Brown was most of the time gentler with the female students compared to the boys.

On the Issue of Educational Equity

In the same interview session (5/6/2004) with the researcher, Mr. Brown made two different conflicting statements on the same issues. When he was asked to describe an equitable classroom, Mr. Brown stated, “It is impossible to ensure educational equity because you can’t give everybody what they need”. When he was asked how he ensured educational equity in his classroom, Mr. Brown stated, “Once you get to know your students and their needs, it is not that hard to give them what they need”. When the researcher asked Mr. Brown to explain this conflict, Mr. Brown explained:

It is very hard to explain attitudes and things like that. A lot of times when you talk about it, you sound vaguely sexist and you don’t mean to. So, I try not to differentiate as far as what to expect. But, a lot of times the way you approach things can be different. (Interview, 5/6/2004)

On Students’ Ability

The researcher found that Mr. Brown had two different conflicting beliefs about his female students’ ability. In the first interview session with the researcher, Mr. Brown stated, “Girls in my classes feel like they can do anything that the boys can do”. During the same session, Mr. Brown was asked about his student’s career plans. In response, Mr. Brown stated, “I think the girls in my AP Calculus class are very pleased that they
have come this far and they are thrilled that they can do it”, which is completely conflicting with the previous statement he made.

Survey Answers

During the informal conversations and formal interviews with the researcher, Mr. Brown repeatedly stated that there was no gender difference in students’ capabilities in his two classes although there were differences between the students from AP Calculus class and the Liberal Arts Mathematics class. To follow up on his statement, the questionnaire result is presented in two different tables below. Table 4.6 shows the result of students of same gender and same achievement-level from the two different classes. For simplicity, the result of each gender and achievement-level is grouped in pairs in this table. Table 4.7 on the other hand shows the gender difference in each of these classes. In table 4.7, answers concerning a male and a female student of the same level have been grouped in a pair. In both of the tables, MH stands for male from high achievement level, MM, stands for male from medial achievement level, and ML stands for male from the low achievement level. Similarly, FH stands for female from high achievement level, FM stands for female from medial achievement level, and FL stands for female from low achievement level. The answer choices for item 1 through 8 and 10 through 15 were true and false (T & F respectively in table 4.6 and 4.7). Item 9 and 10 however had a different format than the other 13 items (See Appendix A). Thus, the answer choices for them were A, B, C, and D as it appears in table 4.6 and 4.7.

Table 4.6
Mr. Brown’s Answers to the Survey:-Class-Wise Comparison

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56
Table 4.6- continued

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Table 4.7

Mr. Brown’s Answers to the Survey:- Gender-Wise Comparison

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</table>

The way these students were chosen for the questionnaire was very systematic. From each class, each of the student’s achievement level was determined by comparing their last semester’s mathematics grade with the average achievement level from their FCAT scores. Thus, two sources of mathematics grades determined their achievement level consistently. In that respect, there should not be any gender differences with the
mathematics achievement of a pair of same level student in a given class. The questionnaire result from Table 4.7 shows that Mr. Brown in fact had some differential beliefs toward the boys and girls in each of the classes. According to table 4.7, medial and low achieving female students were not good at computation although the equally achieving male students are in the Liberal Arts Mathematics class. In the same class, Mr. Brown believed that the medial level female student was not good at logical thinking although the equally achieving male student was. He also believed that mathematics was a difficult subject for the medial and low-level female students in the AP Calculus class compared to their male counterpart. Mr. Brown believed that mathematics was a difficult subject for the high achieving male student although it was not difficult for the equally achieving female student in the Liberal Art Mathematics class.

In the matter of using all the abilities, Mr. Brown thought that the high and low achieving male students from the AP class, and medial level female student in the Liberal Arts class did not use their capabilities as their counterpart did in each of their own classes. He also believed that the medial and low achieving female students’ and the high achieving male students from the Liberal Arts class had different level of endurance compared to their counterparts in their own classes. According to Mr. Brown, in the Liberal Arts Mathematics class, high level male and low level female students would not improve in mathematics next year compared to their counterparts; they would actually deteriorate.

Table 4.6 represents Mr. Brown’s beliefs on the differences of students of the same sex and same level from two different classes. Similar to Mr. Brown’s statement during the interview, there is a bigger difference between the students from the two different classes although they are of the same gender and achievement-level. According to table 4.6, Mr. Brown thought that the medial and low achieving female students were not good at computational skills although the equally achieving female students in the AP class were. He also thought that the low achieving male and medial and low achieving female students were not good at logical thinking although the equally achieving counterparts in the AP class were. Opposing to the AP Calculus male students from all three achievement-levels, for the Liberal Arts male students, mathematics was a difficult subject. Mr. Brown believed that in the Liberal Arts Mathematics class, the medial–level
male and the high and low-level female students did not use all their capabilities compared to their counter parts in the AP Calculus class. Compared to the AP male students in all levels, the Liberal Arts male students had little endurance. Mr. Brown also believed that in the next school year, the high and medial-level male and medial low-level female students would not improve in mathematics compared to the equally achieving students in the AP Calculus class. Compared to the students in the AP Calculus class, male students from all levels and medial and low-level female students in the Liberal Arts Mathematics class did not regard themselves as good at mathematics.

**Mr. Brown’s Beliefs at One Look**

Table 4.8
Mr. Brown’s Beliefs

<table>
<thead>
<tr>
<th>Stated Beliefs</th>
<th>Classroom Interaction &amp; Instructional Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Liberal Arts Math</td>
</tr>
<tr>
<td>Boys and girls’ problem solving approaches are different in mathematics</td>
<td>NC</td>
</tr>
<tr>
<td>There was no gender difference in his students’ performance</td>
<td>C</td>
</tr>
<tr>
<td>Girls in the lower–level courses worked harder than boys</td>
<td>C</td>
</tr>
<tr>
<td>Girls in the lower–level courses had more success than boys had</td>
<td>NC</td>
</tr>
<tr>
<td>Boys learnt mathematics differently than girls did</td>
<td>NC</td>
</tr>
<tr>
<td>He modified his instructional strategies according to the student’s learning needs</td>
<td>NC</td>
</tr>
<tr>
<td>There was no dramatic difference in boys and girls academic potential</td>
<td>C</td>
</tr>
<tr>
<td>Girls in his classes took criticism more personally.</td>
<td>C</td>
</tr>
<tr>
<td>He was gentler confronting a girl compared to a boy.</td>
<td>C</td>
</tr>
<tr>
<td>Boys were generally more competitive in the low-ability courses</td>
<td>C</td>
</tr>
<tr>
<td>In the higher-level course, girls were as competitive as the boys were</td>
<td>N/A</td>
</tr>
<tr>
<td>Girls usually used all their abilities, but boys did not</td>
<td>NC</td>
</tr>
</tbody>
</table>
Table 4.8- continued

<table>
<thead>
<tr>
<th>Stated Beliefs</th>
<th>Classroom Interaction &amp; Instructional Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Liberal Arts Math</td>
</tr>
<tr>
<td>Girls showed little persistence if math exercises became difficult</td>
<td>NC</td>
</tr>
<tr>
<td>Mathematics was more difficult for girls compared to boys in higher-level courses</td>
<td>N/A</td>
</tr>
<tr>
<td>Girls in lower level courses were not as good as boys were in computation</td>
<td>NC</td>
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</table>

Discussion

Because of large amount of time spent interviewing, observing, and informally conversing with Mr. Brown for six weeks, the researcher became familiar with some characteristics of his personality. It was very apparent to the researcher that Mr. Brown had completely two different attitudes toward the classes that the researcher observed. Not only Mr. Brown himself told the researcher that AP Calculus was his most favorite and Liberal Arts Mathematics was his least favorite class on numerous occasions, it was clear from his classroom practice and behavioral interactions that he had very different feelings about these two classes.

On a regular basis, when the students would be working on their class assignment, Mr. Brown went up to the researcher in the corner of the classroom and shared his thoughts about what went on that particular day. The subject matter in the Liberal Arts class was not a challenge for Mr. Brown. His biggest challenge in this class was class-management. He had to spend a large amount of time every single day to ask these students to behave properly. It was clear from his facial expressions that he got annoyed every time he was interrupted in the middle of his instruction by a student’s unexpected behavior. He looked unhappy and frustrated when students repeatedly disregarded him on behavioral issues. He was very honest with the researcher about his feelings toward teaching this course as he said that he only taught that class because he had to, not because he wanted to.
On the other hand, Mr. Brown’s personality was completely different in his 6th period AP Calculus class. He enjoyed teaching this class because delivering the instructing was the only issue here. The students were already motivated, they came to the classroom everyday with many questions on the homework and they wanted to get involved during the problem solving sessions. Mr. Brown was never interrupted with unexpected behaviors by this group of students. Thus, he grew a genuine fondness of these students. The researcher found that Mr. Brown liked it when something was perfect. The researcher also found that in the AP Calculus class, Mr. Brown took his role as a teacher much more seriously, and his beliefs about teaching and learning in general was mostly based on the culture of this class. As a result, Mr. Brown’s stated beliefs about the students in his AP class were mostly consistent with the classroom practice and behavioral instruction. On the other hand, the researcher found more inconsistencies between Mr. Brown’s Stated beliefs with his instructional practice and behavioral interaction in his Liberal Arts Mathematics class compared to the AP calculus class.

During each of the interviews with the researcher, Mr. Brown repeatedly stated that he believed that all his female students were as much capable as his male students were. He also stated that the gender of the students did not affect the way he taught them. Further more, he mentioned that gender stereotyping was a wrong thing to do and he was always against it. It was obvious to the researcher that Mr. Brown wanted to present himself as an unbiased person. The researcher asked Br. Brown about some of the inconsistencies found between his stated beliefs and the classroom practice and behavioral interaction. Mr. Brown acknowledged the inconsistencies and explained:

It is very hard to explain attitudes and things like that. A lot of times when you talk about it, you sound vaguely sound sexist and you don’t mean to. So, I try not to differentiate as far as what to expect. But, a lot of times the way you approach things can be different. After 35 years of teaching experience, I don’t see any difference in the boys and girls potential. But, I don’t know how to tell if there is any type of gender differences in a class. Always, as a man, I always respond to female students differently than I do to males and it’s not something that I would do intentionally. It’s just what I grew up with. It’s not that I expect different from them. I expect them to perform equally well. But, being a man, I would probably approach a female student differently than I would do with a male student. I don’t know how to explain it. Like I said, I don’t make any difference in my instructional practices. I don’t teach differently to a girl than I do to a boy. I don’t expect any difference in their performance, but, as a person, I
would react differently. That’s not something I do consciously, it’s all unconscious. (Interview, 5/6/2004)

The researcher felt that Mr. Brown was honest about his explanation about the inconsistencies between his stated beliefs with the classroom practice and behavioral interactions. Mr. Brown developed his stated beliefs throughout the cultural transmission of the society. Many of his predefined beliefs were changed because of his experience as a teacher. For example, Mr. Brown held some general beliefs about the students’ sex-roles (Boys are generally more competitive). After teaching his AP Calculus course and coaching girls’ basketball over the years, he observed that girls could also be competitive if they are given the opportunity. This way, he added new beliefs and modified previous beliefs because of contradictory examples. Some of Mr. Brown’s beliefs could not be compared to find the level of consistency with practice because of limitations of this study. Such beliefs were, ‘there were no gender difference in parental expectations’. Since the researcher did not observe any of the parent-teacher conferences, Mr. Brown’s stated beliefs on the parental expectations of boys and girls could not be confirmed or disconfirmed. As a result, the researcher categorized this belief as inconclusive.

The Case of Ms. Green

Biography

Ms. Green is a female math instructor at her mid twenties. She was born in south Florida and spent all her high school years there. Upon graduation from high school, she went to college in central Florida and had a bachelor degree in mathematics Education. After graduating from college, she taught at a high school in central Florida for one year. There, she taught Analysis of Function and Pre-Calculus to high school seniors. Then, she moved up to north Florida to teach middle grades, where she taught 6th and 7th grade AIP (Academic Improvement Program) students. After two years of teaching at the middle school, she decided to go back to high school teaching. She has been an instructor at her current institution, Rainbow High School for two years. Here, she has been teaching Algebra, Algebra 1A, and Algebra 2. Along with teaching fulltime at
Rainbow High school, Ms. Green is also going graduate school to have a Master’s degree in mathematics education.

Ms. Green grew up in a family where doing well in mathematics was highly inspired by her parents. She went to a private school until 7th grade and then enrolled into a public school system. In high school, she was enrolled in all honors courses, where her classmates were one year ahead of her. She took it as a challenge to impress the teachers and her classmates by her academic performance. In high school, mathematics was always her favorite subject. Her 2nd favorite subject was English.

It is kind of funny, because, they say if you are good at math, you are not good at English, it is always at the other end. But actually, math and English were my favorites than sciences and social studies. Because I am not good at memorization, and in math you don’t have to memorize, but in sciences and social studies, you have to memorize things. (Interview, 2/19/2004)

In high school, the instructors Ms. Green had for English, Mathematics and Social Studies were also her father and her brother’s high school teachers. She always felt comfortable with these teachers. As a result, she enjoyed these classes more. Her parents were always encouraging but never pressured her to do well in school, which made school a fun experience, not like chore. Being in all the honors classes, she also associated with only higher-level students who were highly motivated. Ms. Green had an impression in her mind that all the high school classes would be like her classes. Thus, she became interested in pursuing a teaching career in the future.

Ms. Green’s teaching experience in the 1st year was not good. She was only twenty-one year old and was teaching a group of student who were eighteen or older. The students did not want to see her as an authority figure since she was only a couple of years older than them. It was a very big challenge for Ms. Green to motivate these students to do anything. She wanted help from the administration, but they declined to do anything as long as the students were not physically hurting anyone or making noise in the hallway. Frustrated, Ms. Green decided to go back to school to get a different degree so she can change her career. She continued taking Accounting classes at night and taught at daytime for a year. Then she thought that maybe it was just one bad experience or just one bad school. So, she changed her mind about leaving teaching career and started to teach at a middle school.
At the middle school, Ms. Green taught mathematics to very low-ability students. She developed her teaching strategies from her experience of working with this group of students. She always tended to find the low-ability students in the classroom and bring the material down to their level. That way, everybody in the class would understand. By lower-level, she did not mean easy, she meant simplifying it out so she could communicate the knowledge to all levels of students.

My philosophy is that when you have a group of kids with different levels, if you don’t teach in the lowest level, you are going to miss, let’s just say that by teaching lower level, you get everybody. But if you are teaching at the higher level, only a few students will get it. But, you are missing all the kids down below. So, I try to teach both. I hit the lower level so they all get it. (Interview, 2/19/2004)

Ms. Green thought that her strategy for teaching was her biggest strength in teaching because to her, teaching is all about communicating the knowledge to all the students, not just to the top ones. As a weakness, she thought that she was not a very patient person. If she covered a material in the class, she expected the students to know the basics of it according to their ability level. When a student would not show any effort to learn the material and would fall behind, Ms. Green would get frustrated.

I am impatient. I think you need to have patience if you are a teacher, but I don’t have it. I think sometimes it comes from the immaturity that they have and also I see things as more easy than them. And if I have been teaching slope for 10 days and you still don’t know what slope is, I find that offensive. (Interview, 2/19/2004)

Ms. Green’s Findings

The findings from the case of Ms. Green consist of the results from class observations in both of her Algebra and Algebra 1A classes, Interviews, and teacher questionnaires. In this section, a description of each of the classes is provided, followed by the findings regarding stated beliefs, instructional practices and classroom interactions, survey result, and a discussion of the findings.

Observation Result

Ms. Green was observed in two of her classes three days a week for six weeks. These classes were her 1st period Algebra class and 3rd period Algebra 1A class. 1st
period Algebra was a higher-level course compared to the 3rd period Algebra 1A. Each of these observations was videotaped. The researcher coded each one of the observations in a chart consisting teacher-initiated teacher-student interactions, student-initiated teacher-student interactions, teacher-feedback, and student responses. An interaction was counted as the “teacher-initiated teacher-student interaction” every time the teacher asked a question or made a comment related to the learning topic directly to a male or a female student. Similarly, every time a student asked a question or made a comment related to the learning topic to the teacher was counted as the “student-initiated teacher-student interaction”. “Teacher feedback” (praise, negative comments) toward the students were the feedback from the teacher to the student concerning the learning topic. An example of praise would be saying “good job” when a student can answer a question correctly. Similarly comments such as, “not good” when a student fails to answer a question would be an example of negative comments. Each time a male or a female student answered a question posed by the teacher toward the whole class concerning the leaning topic, it was counted as “student response”. If more than one student answered such a question, the additional response(s) were counted too. This chart was completed to see if any patterns existed in the classroom. Besides completing the chart, the researcher wrote some field notes to make the chart more comprehensible for future analysis.

Algebra Class. Ms. Green’s 1st period Algebra class had twenty-nine students. Fourteen of them were male and fifteen of them were female students. Twenty-three of these students were 9th graders, four of them were 10th graders, and two of them were 11th graders. Students in this class worked both in groups and in individual settings. Ms. Green created a sitting chart for them to sit in groups and each group sat around a single table. The groups were mostly single sexed. Students in this class talked a lot with the teacher and other students. Most days, Ms. Green started the class with a short lecture (fifteen minutes) on the learning topic following some example problems. After that, the students worked on class assignments for the rest of the period.

Twelve observations took place in this classroom by the researcher from a specific place in the classroom. A video camera was placed above a bookshelf next to where the researcher observed the classroom from. The researcher was able to get the
full view of the classroom from this point without disturbing the natural classroom environment. The result from the twelve days of observation is given in Table 4.9

Table 4.9
Interaction Pattern Observed in Algebra

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<th>DATE</th>
<th>TEACHER INITIATED TEACHER-STUDENT INTERACTION</th>
<th>STUDENT INITIATED TEACHER-TEACHER INTERACTION</th>
<th>TEACHER FEEDBACK</th>
<th>STUDENT RESPONSE</th>
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<td>BOY</td>
<td>GIRL</td>
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<td>7</td>
<td>3</td>
<td>7</td>
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<tr>
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<td>3</td>
<td>9</td>
<td>7</td>
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<tr>
<td>Feb17</td>
<td>4</td>
<td>1</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
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<td>1</td>
<td>9</td>
<td>20</td>
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<tr>
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<td>7</td>
<td>10</td>
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<tr>
<td>Feb24</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>mean</td>
<td>2.25</td>
<td>2.67</td>
<td>5.10</td>
<td>8.25</td>
</tr>
</tbody>
</table>

The result from the observations in Table 4.9 shows that there is a small gender difference in most of the categories. The female students in this class had more teacher-initiated teacher-student interactions, more student-initiated student-teacher interactions, and more negative comments than the boys had. The occurrence of praise and negative comments were limited in number. On February 9, teacher-initiated teacher-student interactions were much higher for girls than was for boys. Ms. Green interacted with one particular student numerous times that day as she caught this student cheating on the class assignment and wanted to make sure that the student learns the material. All the students in this class were motivated to learn. They were well behaved and respectful to Ms. Green. Both the male and female students in this class always took part in mathematics related discussions. Besides talking during the classroom discussions, the girls often
went to Ms. Green to talk to her in private. Sometimes these private talks were concerning their personal life. The researcher only counted the interactions that were related to the learning topic during the classroom observations.

**Algebra IA Class.** Ms. Green’s 3rd period Algebra IA class had nineteen students. Eleven of them were male and eight of them were female students. Sixteen of these students were 9th graders, two of them were 8th graders, and one of them was a 10th grader. Students in this class worked both in groups and in individual settings. Ms. Green created a sitting chart for them to sit in groups and each group sat around a single table. The groups were mostly single sexed. Students in this class talked a lot with the teacher and other students. Ms. Green was very friendly to these students.

In a regular day, Ms. Green started the class with a short lecture (fifteen minutes) on the learning topic following some example problems. After that, the students worked on class assignments for the rest of the period. Fourteen observations took place in this classroom by the researcher from a specific place in the classroom. A video camera was placed above a bookshelf next to where the researcher observed the classroom from. The researcher was able to get the full view of the classroom from this point without disturbing the natural classroom environment. The fourteen days of observation in the Algebra IA classroom provided the following result:


date |
--- |
Feb2 |
Feb3 |
Feb5 |
Feb6 |
Feb9 |
Feb11 |
Feb12 |
Feb17 |
Feb18 |

**Table 4.10**
Interaction Pattern Observed in Algebra IA

<table>
<thead>
<tr>
<th>DATE</th>
<th>TEACHER INITIATED</th>
<th>STUDENT INITIATED</th>
<th>TEACHER FEEDBACK</th>
<th>STUDENT RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TEACHER-STUDENT</td>
<td>TEACHER-TEACHER</td>
<td>PRAISE</td>
<td>BOY</td>
</tr>
<tr>
<td></td>
<td>INTERACTION</td>
<td>INTERACTION</td>
<td>NEG. COMNT</td>
<td>BOY</td>
</tr>
<tr>
<td></td>
<td>BOY</td>
<td>GIRL</td>
<td>BOY</td>
<td>GIRL</td>
</tr>
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<td>1</td>
<td>1</td>
<td>17</td>
<td>4</td>
</tr>
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</table>
Table 4.10- continued

<table>
<thead>
<tr>
<th>DATE</th>
<th>TEACHER INITIATED TEACHER-STUDENT INTERACTION</th>
<th>STUDENT INITIATED TEACHER STUDENT INTERACTION</th>
<th>TEACHER FEEDBACK</th>
<th>STUDENT RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BOY</td>
<td>GIRL</td>
<td>BOY</td>
<td>GIRL</td>
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<tr>
<td>Feb27</td>
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<td>1</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>mean</td>
<td>4.36</td>
<td>1.57</td>
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<td>3.57</td>
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</tbody>
</table>

The result from the observations in Table 4.10 shows that there is large gender difference in all the categories favoring males. The researcher only counted the interactions that were related to the learning topic during the classroom observations. The students in this class were low-ability compared to Ms. Green’s 1st period Algebra class. The students in this class loved their teacher and they always talked about everything. Ms. Green was very friendly with the students as well. The boys in this class talked during both mathematics-related and mathematics-non-related discussions. The girls on the other hand took part mostly during non-mathematics related discussions, and hardly talked during mathematics related discussions. The boys have a much higher response rate on February 9. Ms. Green was reviewing some materials for the upcoming exam and was asking the students many questions. In response, the boys called out the answer almost every time.

Ms. Green’s Stated Beliefs

Ms. Green’s stated beliefs were defined by the researcher in the discussions she had with her over the course of two interviews and numerous informal conversations between them. All these interviews and conversations occurred between February 2 and May 7, 2004. The majority of this work was accomplished by consistently reviewing interview transcriptions and questionnaire responses, all the while taking notes on repetitions of words and ideas. These repetitions were then discussed with him in elaboration and finally were listed as Ms. Green’s stated beliefs.
On the Meaning of the Phrase “Gender Difference”

**Gender difference means the difference of personality of men and women.**

Ms. Green interpreted the phrase gender differences as the difference of personality that men and women have. When she thought of gender differences, she tended to think of it more on an emotional level than on the ability level. Being a female herself, and being good at math, she did not think that there could be any true difference of ability and achievement between men and women. Ms. Green saw women as being more emotional and men being less emotional. Ms. Green drew this conclusion from her teaching experience.

I don’t see why all girls can’t do well in school, doesn’t matter what class they are in. See, I think of gender differences, I think that girls are more emotional then boys. They show their feelings more than boys do. They are more sensitive. That could affect the way you treat them. But, that is the way I will see them more so than on their performance ability. (Interview, 2/19/2004)

On the Presence of Gender Differences in Mathematics

**I definitely think there is some kind of gender differences in mathematics.**

Ms. Green believed that gender difference in the field of mathematics has decreased over the years, but it still exists in our society. Her belief was completely based on her experience from her school years. Ms. Green never had a female professor for any of her mathematics or mathematics education courses in college. She knew that teaching has been a female oriented profession. Thus, she has seen women to teach at the k-12 level. When the level reached to a higher degree, the presence of female teachers dropped down dramatically. So, Ms. Green believed that there must be some gender differences in the field of Mathematics. When it came to her students, Ms. Green believed that she did not differentiate the student based on their gender, but she differentiated them based on their ability.

On Students’ Ability

**Girls generally put on more efforts.** Ms. Green believed that the students confidence in their self-ability was different in her two classes that the researcher observed. Their confidence in mathematics was based on their ability level, not on gender. In her first period Algebra class, the majority of the students thought that they could do well. In her 3rd period Algebra 1A class, students were less confident. Ms.
Green thought that their lack of confidence made them do poorly because they thought that they were not smart enough to do it, so they would not even bother to try. According to Ms. Green, the girls always put on more effort than the boys.

I always find that the girls try harder. The girls are the ones who are doing their homework, and they are ones who care about if their homework is neat, and they make sure that they have their books. And that’s what I see with the girls more than the boys. But, that could be a social thing than in math. You know, “it is not cool to carry around your math book when you are a boy” type thing. I don’t know about academic, but, from what I have seen, girls try harder.

(Interview, 2/19/2004)

**On Boys and Girls’ Learning Style**

**Learning style cannot be differentiated by sex.** When the researcher asked Ms. Green if she believed that boys and girls learn mathematics differently, Ms. Green’s reply was negative. She said that she never really put much thought into this matter, but from her teaching experience, no such difference stood out to her. She believed that there is certainly a difference between boys and girls attitude toward taking notes and using the notes. She also believed that the girls were more organized, because girls usually took neat and through notes, whereas boys just sat there and looked. As far as their learning style, Ms. Green did not think it could be differentiated by sex.

**On Students’ Academic Potentials**

**Potential is ability-dependent, not sex-dependent.** Ms. Green believed that the students in her 1st period had more academic potential than the students from her 3rd period class. She believed their potential did not depend on their sex, but it depended on their ability level in general. She thought that her 1st period students were higher ability and they liked to be challenged. If they could solve a tough problem, they would feel good about themselves and as a result, they would continue doing well. Ms. Green believed that her 3rd period students did not want to be challenged. She thought that a lot of them were lazy and they did not want to work at anything.

I believe that my 1st period kids have more potential than the 3rd period kids in general. I don’t think it is a gender thing as much as it is an ability and attitude thing. In my 1st period, they like it when I say, “this is going to be difficult but we can get through”. And, they think that if I get through this, then I must be something, and it’s a confidence boost. So, even it is not so difficult, I still say it. So, they can feel confident. With the lower level kids, I don’t think that they want to be challenged. They want to do the minimum thing to get by.
On Behavioral Interactions with Boys and Girls

I have more personable interactions with girls. Ms. Green believed that since she was a female herself, she had more personable interactions with her female students than with her male students. She thought the reason for that could be, she and her female students had similar interests. The girls felt comfortable to talk to her if they had any problems at home, with mathematics, or their social life. There were some girls in her classes who were not outspoken in front of the whole class. These girls would come to talk to her in person.

I have girls who talk to me about their boyfriends, these and that and the other. I don’t think that the girls ever feel uncomfortable talking about if they are having a problem with the math, I mean there are girls who can just sit in the class with a problem and not be outspoken about it. But, I always tell them that there is no stupid question because the person next to you could be thinking about the same question. I think I know them at a personable level and once you know them at a personable level, they are likely to come to talk about the school problems as well. (Interview, 2/19/2004)

On the Competitive Interest of Boys and Girls

Boys are usually more competitive. Ms. Green believed that the male students in both of her classes tended to be more competitive than the female students. In addition to that, Ms. Green believed that the boys were competitive with any student who is ahead of them. Boys in her classes always wanted to beat the others in grade. According to Ms. Green, if there was a girl who did better than a boy in the test, the boy would always want to see what she has gotten, or how she did better than him. On the other hand, girls are more satisfied with being competitive with themselves. Their idea is, if they did better in one test than they did in the last one, then they are happy. It is not because they beat another person, but because, they improved from the last time.

I think the boys are more externally competitive. Like when you give back the test, the girls are thinking how this effects my grades, how is it compared with how I did last time, how does it blah, blah, blah. And the boys want to know what the person next to him got. (Interview, 2/19/2004)

On Parents’ Expectations of Boys and Girls

Parental expectations are not gender-dependent. From her experience with the
parents’ of her students, Ms. Green did not believe that the parent’s expectations of their children depended on the children’s sex, although she believed that parents attributed boys and girls failure to different reasons. Most of the time, when a boy did poorly in mathematics, the parents would tell Ms. Green that it is because their son has ADHD (Attention Deficit Hyperactive Disorder). On the other hand, if a girl did poorly in mathematics, her parents would say that they were not good at mathematics either. They would make it sound like an excuse for their daughter not doing well. Ms. Green believed in this age group (14-15 year old), girls are usually more mature than the boys are. And the parents want to explain their sons’ immaturity by saying that they are suffering from ADHD. Ms. Green also mentioned that most of these boys have not been tested for ADHD. Their parents would just assume that they have it since they are immature.

During the parent-teacher conferences, I hear it all the time that with boys, their parents always say that their children are all ADHD. They are not always tested, and even if they are tested and they are on medication, it is not working. So, I have to wander, if it is what they say it is. I mean if you are on medication for something and it is not working, then maybe you need to adjust the medication or something else is wrong with you. (Interview, 2/19/2004)

On the Influence of a Teacher

Female teachers can be more judgmental toward girls. Ms. Green believed that a teacher is capable of influencing the students to be more outspoken, confident, and hardworking regardless of the student’s sex. Ms. Green also believed that a teacher could also have a negative effect on students. According to Ms. Green, if a teacher came to the classroom without any type of stereotypical views about gender, he or she could reach all the students. Similarly, if a teacher came to the classroom with pre-conceived biases toward certain groups, then that group of students would be deprived of getting an equal chance to learn. At her current institution, Ms. Green have seen some female teachers who were harder on the female students than on the male students. Ms. Green has heard them making comments such as, “The way the girls dress offends me.” Ms. Green believed that sometimes these teachers take out their anger on the girls by being harder on them in the classroom. As a result, sometimes these girls get frustrated, angry, loose confidence in themselves, and start doing poorly at schoolwork.
On Society’s Gender-Biased View

If you pay attention to these views, you might start believing them too. Ms. Green believed that gender-stereotype is an old-generation view. There are still people who believe in such things and make stereotypical remarks. If a person takes it seriously, then he or she might start believing in it too. That is why Ms. Green said that she never lets comments like those get to her.

Ms. Green’s Instructional Practice and Classroom Interactions

On the Meaning of the Phrase “Gender Difference”

Gender difference means the difference of personality of men and women. During her six weeks of observation, the researcher found that there was no significant difference in the male and female students’ achievement and efforts in Ms. Green’s 1st period Algebra class. During the class period, the students took part in the mathematics-related discussions. There were two girls, who always wanted to sit next to Ms. Green’s table. They talked to her quite often about different things. Ms. Green enjoyed talking to them. Her relationship with the girls in this class in general was more personal than the boys. Similar trend was found by the researcher in the 3rd period Algebra 1A class as well. The girls in this class always went to Ms. Green to talk about personal matters. Ms. Green had a very friendly relationship with the male students in this class as well, but their interaction stayed inside the classroom most of the time. The female students in this class were not as vocal as the female students from the 1st period.

In general, girls in both classes expressed more emotion when they got their test back. The boys looked indifferent when they got their test back. If any girl in either of the classes was confronted by Ms. Green about something, she got very upset and stayed upset for a long period of time. When the boys were confronted, they apologized and looked fine. Thus, Ms. Green’s belief about girls being more emotional was found consistent with the behavioral interactions in both of the classes.

On Students’ Ability

Girls generally put on more efforts. In both of Ms. Green’s classes, the researcher found that the female students were consistent with taking notes. In the 1st
period Algebra class, both the male and female students took part in the mathematics-related discussions. Both groups asked questions and answered questions. In the 3rd period Algebra 1A class, the boys talked during both mathematics-related and mathematics-non-related discussions. The girls on the other hand took part mostly during non-mathematics related discussions, and hardly talked during mathematics related discussions. They listened to the teacher or took notes while the boys asked questions or made reflection on the learning topic. Compared to the boys in both classes, the girls missed less number of exams or homework. The girls also came to the class with their books, whereas Ms. Green had to consistently remind some boys to bring their books to the classroom. Thus, Ms. Green’s stated belief that girls put on more effort was found consistent with the instructional practice

**On Boys and Girl’s Learning Style**

*Learning style cannot be differentiated by sex.* The female students in both of Ms. Green’s classes did well when they worked in all female groups or in a group that had more number of girls than boys. Sometimes Ms. Green assigned some quizzes in both of the classes for extra credit. She used to announce the name of the groups’ score the next day. From the quiz grades, the researcher saw a pattern that the groups who scored the highest were generally all female groups. The all-boys group’s score on the other hand was generally lower compared to the other groups. The researcher also found that when a group of all boys worked together, they talked a lot about non-math-related issues and fell behind on their quiz work. The all-girls groups worked together to finish up the work and a group member always took the responsibility to write all the answers neatly for turning in to Ms. Green. This pattern was consistent in both of the classes and showed a different pattern in boys and girls learning style. Thus, the researcher concluded that Ms. Green’s belief that “boys and girls learn mathematics in the same way” was not consistent with the classroom interactions.

**On Students’ Academic Potentials**

*Potential is ability-dependent, not sex-dependent.* The researcher found that Ms. Green’s stated beliefs that her students’ potential is ability-dependent, not sex-dependent was consistent with the instructional practice. The previous semester’s grade and the FCAT result revealed the student in the 1st period had more success compared to
the students from the 3rd period class regardless of student-gender. The students in the first period were more attentive and put more efforts on. Thus, the researcher concluded that Ms. Green’s stated beliefs about the student’s academic potential in the two different classes were consistent with the classroom practices.

**On Behavioral Interactions with Boys and Girls**

**I have more personable interactions with girls.** The researcher found that Ms. Green was friendlier with the students in her 3rd period Algebra 1A class compared to her 1st period Algebra. She chatted with the students in a regular basis in her 3rd period class. Their conversation included mathematics, TV programs, games, weather, any current issue with the school, etc. Ms. Green was more serious in her 1st period, and most of the conversation took place in that classroom was about mathematics. Regardless of whichever class it was, the female student had a special relationship with Ms. Green. They used to go up to her table and talk to her personally about different matters. They wanted to share with Ms. Green if something happy happened, they accomplished something special, or something was troubling them. They also talked to her about their grades in person. Thus, the researcher concluded that Ms. Green’s stated belief that ‘she had more personable interactions with her female students than with her male students’ was consistent with the classroom practice.

**On the Competitive Interest of Boys and Girls**

**Boys are usually more competitive.** The researcher found that the girls expressed more emotions in both of the classes when they got the test back. If they did well, they jumped up and down; if they did poorly, they looked sad, and asked Ms. Green how can it be made up. Boys on the other hand, did not express much emotion when they got their test back, although they looked around to see what their friend made. This behavior of boys was common in both of the classes. From these observations, the researcher concluded that Ms. Green’s stated belief that boys are competitive with other students and girls and competitive with themselves was consistent with the instructional practices.

**On Parents’ Expectations of Boys and Girls**

**Parental expectations are not gender-dependent.** Since the researcher did not observe any of the parent-teacher conferences, Ms. Green’s stated beliefs on the parental
expectations of boys and girls could not be confirmed or disconfirmed. As a result, the researcher categorized these beliefs as inconclusive.

**On the Influence of a Teacher**

From her six weeks of observation, the researcher saw that Ms. Green did not treat any of the students differently based on their gender. This was a consistent behavior in both of her classes. In both classes, no significant difference was found in the boys and girls’ abilities and confidence. However, the girls in the 3rd period class showed more effort than the boys. The researcher concluded that there could be more factors related to students’ learning attitudes. Ms. Green’s stated belief about the influence of a teacher on student’s learning attitudes was coded as inconclusive.

**Conflicting Beliefs**

**On Boys and Girls’ Learning Style**

*Learning style cannot be differentiated by sex.* During the first interview (2/19/2004) with the researcher, Ms. Green stated that she did not believe that boys and girls in her class learned any differently. In the Final interview session (5/7/2004) with the researcher, Ms. Green stated that girls in the class are more note-dependent. The researcher found conflicts between these two statements. If the girls depend on their notes to learn mathematics than boys do, then there must be some learning differences between these two groups.

**Survey Answers**

During the informal conversations and formal interviews with the researcher, Ms. Green firmly stated that she did not see any gender differences between the male and female students in any of her classes, although there were differences between the students from her 1st period Algebra class and 3rd period Algebra 1A class. In other words, she believed that there were differences between the students from the upper-level class and the lower-level class. To follow up on her statement, the questionnaire result is presented in two different tables below. Table 4.11 shows the result of students of same
gender and same achievement-level from the two different classes. For simplicity, the result of each gender and performance-level is grouped in pairs. Table 4.112 on the other hand shows the difference between male and female students’ in each of these classes. In table 4.12, answers on a male and a female student of the same level have been grouped in a pair. In both of the tables, MH stands for male from high achievement level, MM, stands for male from medial achievement level, and ML stands for Male from the low achievement level. Similarly, FH stands for female from high achievement level, FM stands for female from medial achievement level, and FL stands for female from low achievement level. The answer choices for item 1 through 8 and 10 through 15 were true and false (T & F respectively in table 4.11 and 4.12). Item 9 and 10 however had a different format than the other 13 items (See Appendix A). Thus, the answer choices for them were A, B, C, and D as it appears in table 4.11 and 4.12.

Table 4.11
Ms. Green’s Answers to the Survey:-Class-Wise Comparison

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<thead>
<tr>
<th>Class</th>
<th>Student</th>
<th>Q1</th>
<th>Q2</th>
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<th>Q4</th>
<th>Q5</th>
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Table 4.12
Ms. Green’s Answers to the Survey:- Gender-Wise Comparison

<table>
<thead>
<tr>
<th>Class</th>
<th>Student</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
<th>Q7</th>
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<th>Q9</th>
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<th>Q12</th>
<th>Q13</th>
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<th>Q15</th>
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From both the Algebra class and Algebra 1A class, the students were chosen for the questionnaire in a systematic manner. From each class, each of the student’s achievement level was determined by comparing their last semester’s mathematics grade with the average achievement level from their FCAT scores from the last three years. Thus, two sources of mathematics grades determined their achievement level consistently. In that respect, there should not be any gender differences with the mathematics achievement of a pair of students from the same level in a given class. The questionnaire result from Table 4.12 shows that Ms. Green in fact held some differential beliefs toward the boys and girls in each of the classes. According to table 4.11, there were some differences between the students from the 1st period Algebra class with the 3rd period Algebra 1A class.

According to table 4.11, Ms. Green believed that the low-achieving male and female students in the 3rd period Algebra in class were not good at computation although the equally achieving students in the 1st period Algebra class were good. For the 3rd period high and low-level male and medial-level female students, mathematics was a difficult subject although it was not difficult for the equally achieving student in the 1st period Algebra class. Ms. Green also believed that the low achieving male student in the
3rd period class was not good at logical thinking and too much was expected of him although it was the opposite for the equally achieving student in the 1st period Algebra 1A class. Additional effort was thought to be helpful for the high and medial-level male student in the 3rd period, where as, it did not have any effect on the equally achieving male students in the 1st period Algebra class. The same students in the 3rd period class were not believed to use all of their abilities although the equally achieving male students in the 1st period were.

Ms. Green believed that in her 3rd period class, high achieving male and medial and low achieving female students had little endurance compared to the equally achieving students in the 1st period Algebra class. In the 1st period Algebra class, the high achieving male and female students were believed to do better due to ability, whereas the equally achieving student from the 3rd period was believed to do better due to increased effort. The low achieving male student and medial achieving female student in the 1st period class was believed to do better due to increase effort, whereas the low achieving male from the 3rd period class was believed to do better if the test was too easy and the medial level female student from the 3rd period class was believed to do better due to ability. The 3rd period high and low achieving female students were believed to do worse in the next test due to the test being too hard, whereas the equally achieving students in the 1st period class were believed to do worse in the next test due to lack of effort. Ms. Green also believed that the high achieving male in the 3rd period would deteriorate next year unlike the high achieving male in the 1st period class.

Table 4.12 represents the male and female students of the same achievement level from the same class in a pair and compares the teacher’s beliefs on them. According to table 4.12, the low achieving male from the 3rd period and the low achieving female from the 1st period were not believed to be good at computation unlike the low achieving male from the 3rd period and the low achieving female from the 1sr period respectively. The low achieving female in the 1st period was believed to not good at logical thinking unlike the male counterpart in the same class. For the high achieving male student in the 3rd period, mathematics was considered as a difficult subject unlike the female counter part in the same class. Mathematics was also considered as a difficult subject for the medial
and low achieving female student in the 1\textsuperscript{st} period, but not for their male counterparts in the same class.

Ms. Green believed that effort was helpful for the high achieving male unlike the equally-achieving female in the 3\textsuperscript{rd} period class. Effort was also believed to be helpful for the 1\textsuperscript{st} period medial achieving female, but not for the equally achieving male. In the 3\textsuperscript{rd} period class, the high and medial achieving males were not believed to have used all their capabilities unlike the high achieving female students, and in the 1\textsuperscript{st} period class, the medial achieving female student was not believed to have used all her capabilities unlike the equally achieving female student in the same class. Ms. Green believed that the 3\textsuperscript{rd} period high and low achieving males and medial achieving female students had a little endurance compared to the high and low achieving females and medial achieving male students in the same class.

In the 1\textsuperscript{st} period, the medial and low achieving male students were believed to do well in the next test because of their ability, whereas the medial and low achieving female students were believed to do well because of increased effort. In the 3\textsuperscript{rd} period, the high and the low achieving female students were believed to do worse in the next mathematics test for the test being hard, whereas their male counterpart were believed to do worse because of lack of ability. The 3\textsuperscript{rd} period high and low achieving male students were expected to not improve but deteriorate in the next school year unlike their female counterparts in the same class. According to Ms. Green, the medial level girls in both 1\textsuperscript{st} and 3\textsuperscript{rd} period did not think they could perform well and were good students of mathematics unlike their male counterparts of the same achievement level.

**Ms. Green’s Beliefs at One Look**

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**Table 4.13**

Ms. Green’s beliefs

<table>
<thead>
<tr>
<th>Stated Beliefs</th>
<th>Classroom Interaction &amp; Instructional Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls were more emotional than boys were</td>
<td>Algebra 1A</td>
</tr>
<tr>
<td></td>
<td>C</td>
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</tbody>
</table>

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Table 4.13- continued

<table>
<thead>
<tr>
<th>Stated Beliefs</th>
<th>Classroom Interaction &amp; Instructional Practices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Algebra 1A</td>
</tr>
<tr>
<td>There was no gender difference in student achievement</td>
<td>C</td>
</tr>
<tr>
<td>Girls put on more efforts than boys did</td>
<td>C</td>
</tr>
<tr>
<td>There was no difference in boys’ and girls’ mathematics learning style</td>
<td>NC</td>
</tr>
<tr>
<td>Students’ academic potential was ability-dependent, not gender-dependent</td>
<td>C</td>
</tr>
<tr>
<td>She had more personable interactions with the girls compared to the boys</td>
<td>C</td>
</tr>
<tr>
<td>Boys were more competitive with other students</td>
<td>C</td>
</tr>
<tr>
<td>Girls were competitive with their own-self</td>
<td>C</td>
</tr>
<tr>
<td>Girls showed little persistence if math exercise became difficult</td>
<td>NC</td>
</tr>
<tr>
<td>Boys did not use all their abilities in lower level classes</td>
<td>C</td>
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<tr>
<td>Mathematics was more difficult for girls compared to boys in higher level classes</td>
<td>N/A</td>
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</table>

Discussion

Because of the large amount of time spent interviewing, observing, and informally conversing with Ms. Green for six weeks, the researcher became familiar with some characteristics of her personality. The researcher found Ms. Green to be very modern in her views. She was grown up in a small family with only one brother, and her parents treated her no differently than they treated her brother. She was also good at mathematics and was always encouraged by her family and teachers to become successful in mathematics. Because of her background, she was very sure that there is no difference in boys and girls ability in mathematics. On numerous occasions, Ms. Green stated to the researcher that when she saw a student, she saw his or her ability, not gender.

Ms. Green was very popular among the students in both of the classes although she took slightly different roles in these two classes. In her 1st period Algebra class, she was a little more serious compared to her 3rd period class. In 1st period, students were
more attentive and motivated to learning. So, Ms. Green spent more time on lecture, and problem solving. She also was able to engage these students in mathematical discussions. It was very clear that there was no difference in the boys and girls achievement in this class. In the 3rd period Algebra 1A class, Ms. Green appeared friendlier with the students. This could have been because of the student’s personality. The students here, especially the boys liked to talk a lot about everything. She had a more personable relationship with the female students. Above all, she looked genuinely interested in each and every one of her students, and seemed to be very familiar with the student culture. The researcher concluded that Ms. Green’s close relationship with her students and her being familiar with the culture helped her to know the true nature of her students.

The gender-related beliefs Ms. Green stated during the interview sessions and informal conversations with the researcher were found consistent for the most part with the teaching practice and classroom interactions. However, when the researcher examined Ms. Green’s beliefs toward the male and female students, which was expressed in the teacher-survey answers, a number of beliefs were found inconsistent with the student’s characteristics and backgrounds. Since each of the students were chosen for the questionnaire in a systematic manner, there should not have been any gender differences with the mathematics achievement of a pair of male and female students from the same achievement-level in a given class. From each class, each of the student’s achievement level was determined by comparing their last semester’s mathematics grade with the average achievement level from their FCAT scores from the last three years. Thus, two sources of mathematics grades determined their achievement level consistently. According to Ms. Green’s survey answers however, the male and the female students of the same achievement-level did not have equal capabilities.

Some of the inconsistencies found between her survey answers and students academic background were: the low achieving male from the 3rd period and the low achieving female from the 1st period were not believed to be good at computation unlike the low achieving male from the 3rd period and the low achieving female from the 1st period respectively. The low achieving female in the 1st period was believed to not good at logical thinking unlike the male counterpart in the same class. For the high achieving
male student in the 3rd period, mathematics was considered as a difficult subject unlike the female counter part in the same class. Mathematics was also considered as a difficult subject for the medial and low achieving female student in the 1st period, but not for their male counterparts in the same class. When the researcher asked Ms. Green to explain these inconsistencies, she replied that those particular students might have improved or deteriorated since the last exam, so it was hard for her to answer those questions accurately. She also added that maybe she had not been thoughtful enough to answer questions about these students. Ms. Green recognized that she needed to be more reflective about her teaching practice and student learning.

Some of Ms. Green’s beliefs could not be compared to find the level of consistency with her practice because of limitations of this study. Such beliefs were:

1. There must be some gender differences in college-level mathematics.
2. Female student’s parents’ attribute their children’s failure in mathematics to their own failure in the subject matter, whereas male students’ parents attribute their children’s failure in mathematics to learning disorders.
3. Female teachers could be more judgmental toward girls compared to boys.
4. Paying attention to society’s gender-stereotypical views might affect female student’s achievement.

To confirm or disconfirm these beliefs, the researcher needed to have field data from other sources, which was not a part of this research design. As a result, the researcher categorized these beliefs as inconclusive.
CHAPTER 5

SUMMARY AND IMPLICATIONS

This chapter provides an overview of the purpose, methodology, findings, and limitations of this study and presents implications for mathematics education.

Purpose of the Study

Motivation

Research indicates that beliefs held by teachers influence their perceptions and judgments, which in turn, affect their behavior in the classroom (Ashton, 1990; Ashton & Webb, 1986; Brookhart & Freeman, 1992; Buchmann, 1984; Clark, 1988; Dinham & Stritter, 1986; Munby, 1982, 1984; Nespor, 1987; Pajares, 1992; Tabachnick, Popkewitz & Zeichner, 1979; Weinstein, 1988, 1989; Wilson, 1990). It has also been found that there could be conflicts between teachers’ stated beliefs and their instructional practices in the classroom (Brown, 1985; Cooney, 1985, Garrahy, 2001). According to a large number of studies, there is a gender difference in male and female students’ mathematics achievement scores (e.g., Hyde, Fennema, & Lamon, 1990; Kimball, 1989; Wilder, 1996; Wilder & Powell, 1989; Willingham & Cole, 1997). Along with achievement, female students’ self-confidence in their achievement has also been found different than their male counterparts. Previous research suggested that insights into teachers’ beliefs and behaviors related to gender may lead to deeper understanding of gender differences in mathematics as we learn more about the mental life of teachers and students and how this influences daily decisions about learning mathematics.

To understand how teachers’ gender-related beliefs might influence mathematics teaching and learning, one has to first take into account what specific gender-related beliefs are held by teachers and how consistent these beliefs are with their instructional practices. For this reason, the researcher began this investigation in the fall semester of
2003. Her goal was to understand the specific beliefs that are held by high school teachers about gender differences in mathematics education, and the extent of consistency between these stated beliefs and the instructional practices and classroom interactions.

The researcher chose to examine high school teacher’s beliefs for two reasons. First, the result from the Third International Mathematics and Science Study (TIMSS, 1995) indicated that the gender difference was more significant at the high school level than it was at the elementary level. Secondly, no single research has been documented on high school teachers’ gender-related beliefs. Besides choosing participants from the high school level, the beliefs of the participants were examined in two different levels of classes to see if teachers’ gender-related beliefs about a higher-level class differed from the beliefs about the lower-level class. Previous research indicated that female students’ achievement and confidence in mathematics decreases as they move toward higher-level courses.

It is often the case that teachers are not fully aware of their beliefs. The researcher intended to make Mr. Brown and Ms. Green conscious of their own beliefs, which could help them to be more reflective about their instructional practices and classroom interactions, and thus promote equity of education for all their students. In this study, both Mr. Brown and Ms. Green expressed to the researcher that this research made them think and evaluate their stated beliefs along with their instructional practices. It also made them think of issues important for student learning, that they have never thought about before. Both of them found that it was an eye opener and would help them to be more reflective in their instructional practice and classroom interactions with the students.

**Research Questions**

Using multiple sources of data, the researcher endeavored to answer two research questions in this study:

i) What specific beliefs do high school teachers hold about the relationship of gender to the teaching and learning of mathematics?

ii) What is the extent of consistency between teachers’ stated beliefs about gender and instructional practices and classroom interactions?
Methodology

To answer the research questions, the researcher chose five high school mathematics teachers from a specific school as the participants in this study. This was a convenience sampling. Among the five participants, the researcher selected two teachers for case studies based on their availability and cooperativeness. These two teachers were Mr. Brown and Ms. Green. After the subjects were selected, the researcher selected two different courses taught by Mr. Brown and Ms. Green, and one single class taught by each of the other three teachers. The two courses were purposefully chosen for Mr. Brown and Ms. Green, so each of them would end up with one upper level and one lower level class. For the other three teachers, one course was selected randomly. Once the courses were selected, each of the mathematics teachers completed the questionnaire (see Appendix A) on six of their selected students from each of the classes in order to elicit their stated beliefs about gender differences in mathematics.

Once the researcher chose Mr. Brown and Ms. Green to be the final participants for the case studies, each of them were observed in both of their upper and lower level classrooms for three times a week for up to six weeks in order to determine how consistent the teachers’ stated beliefs were with their classroom practice. Each of these observations was videotaped and a chart (see Appendix B) consisting of teacher-initiated teacher-student interactions, student-initiated teacher-student interactions, teacher-feedback, and student responses was completed to see if any patterns existed in the classroom. To elaborate data on the two teachers’ stated beliefs and to address the degree of consistencies and inconsistencies in their stated beliefs with their instructional practices and behavioral interactions, two formal interviews were conducted. Along with the formal interviews, informal conversations between the teachers and the researcher took place during the six weeks of observations for clarification and elaboration on lessons observed.

During each of the class observations, the researcher wrote a memo about any incident, or a pattern of behavior that stood out to her. In the next observation sessions, she observed if those patterns were reoccurring in the classroom, and if the same type of behavior existed in the other class taught by the teacher. Once the researcher was able to
establish any reoccurring pattern in the classrooms, she started to find out why this was happening. The researcher tried to find these answers by going over the videotaped observation sessions, asking the teacher for an explanation during their informal conversations right after the class, and in the formal interviews. After every revision of the transcriptions of the videotaped observations, interview data, and observation notes, the researcher reviewed the research questions and the foreshadowed problems, guiding her further investigation. Notes were made by the researcher on the questions that she wanted to ask the teacher on their following conversations and interviews, and triangulate the results. One data set was always compared with the next data set.

After analyzing the data from the teacher questionnaires, the researcher compared the result with the result from a previous study by Tiedemann (2000a) to see if the high school teachers in this study held similar beliefs to the beliefs held by Tiedemann’s elementary teachers. The results from the teacher survey were also used in data triangulation. After comparing the results from the different data sets, the researcher was able to categorize Mr. Brown and Ms. Green’s stated beliefs and find the level of their consistency with the instructional practices and classroom interactions.

**Findings**

Primarily, both of the cases in this study stated that they did not take into account the gender of their students when teaching. As the researcher asked them more specific questions about their gender-related beliefs, the teachers started to reveal the beliefs that they held toward their male and female students, which was always not the same. The extent of the consistency between the two teachers’ stated beliefs and their instructional practices and classroom interactions varied to certain degrees. The result from the teacher survey revealed that the five participants in this study held similar gender-related beliefs to the elementary teachers’ beliefs in Tiedemann’s (2000a) study.

In this current study, the five high school teachers, who took part in the teacher survey commonly believed in three of the five conclusions made in Tiedemann’s (2000a) study. The participants in this study believed that medial and low achieving girls were less logical than equally achieving boys. It was also a common belief that medial and
low level girls exerted relatively more effort to achieve the level of actual achievement in mathematics. They also believed that mathematics was more difficult for medial and low achieving girls than equally achieving boys. Although the teachers commonly held these three beliefs toward the medial and low-level students, Tiedemann’s participants held these beliefs toward the medial-level students only. The other two conclusions made in Tiedemann’s study (girls profited less than boys from additional effort; and with regard to girls, teachers attributed unexpected failure more to low ability and less to lack of effort than boys) were not common beliefs of the five participants in the teacher survey in this study.

From the survey answers, formal interviews, and informal conversations with Mr. Brown and Ms. Green, the researcher was able to find their stated beliefs on gender differences in mathematics. The result shows that Mr. Brown’s gender-related stated beliefs were as follows:

1. There was no gender difference in his student achievement.
2. Boys and girls’ problem solving approaches are different in mathematics
3. Girls in the lower–level courses worked harder than boys.
4. Girls in the lower–level courses had more success than boys had.
5. Boys learnt mathematics differently than girls did.
6. He modified his instructional strategies according to the student’s learning needs.
7. There was no dramatic difference in boys and girls academic potential.
8. Girls in his classes took criticism more personally.
9. He was gentler confronting a girl compared to a boy.
10. Boys were generally more competitive than girls in the low-ability courses.
11. In the higher-level course, girls were as competitive as the boys were.
12. Girls could improve their achievement by increased efforts, not by abilities.
13. Girls usually used all their abilities, but boys did not.
14. Girls showed little persistence if math exercises became difficult.
15. Mathematics was more difficult for girls compared to boys in higher-level courses.
16. Girls in lower level courses were not as good as boys were in computation.
After observing Mr. Brown in both of his classrooms for six weeks, the researcher was able to determine whether or not his stated beliefs were consistent with his instructional practice and behavioral interactions with his students. The researcher observed that although there was a difference between boys and girls’ behavioral pattern concerning mathematics in the higher-level (AP Calculus) class, there was no visible difference in the boys and girls’ behavioral pattern concerning mathematics in the Liberal Arts mathematics class. Mr. Brown’s stated belief that ‘girls in his lower–level course had more success than boys had’ was found inconsistent. In the lower level class, his belief that ‘boys and girls learned mathematics differently’ was found not consistent, although it was consistent in the upper-level class.

Mr. Brown stated that he modified his instructional strategies according to the students’ learning needs. His statement was found consistent in the upper-level class but not in the lower-level class. His belief that ‘girls usually use all their abilities, but boys don’t’ was found inconsistent in both if the classes. In the higher-level class, Mr. Brown’s stated belief that ‘girls showed little persistence if math exercise became difficult’ was found consistent in the higher-level course, although it was found inconsistent in the lower-level class.

The stated beliefs that were found consistent with Mr. Brown’s instructional practices and classroom interactions in his two classrooms were the following:

1. There was no gender difference in student achievement
2. Girls in his lower–level courses worked harder than boys
3. There was no dramatic difference in boys and girls academic potential
4. Girls took criticism more personally
5. He was gentler confronting a girl compared to a boy
6. Boys were generally more competitive than girls in the low-ability courses
7. In the upper-level class, girls were as competitive as the boys were
8. In higher level courses, mathematics was more difficult for girls compared to boys

A few of Mr. Brown’s stated beliefs were concluded as inconclusive by the researcher since there was not enough data to confirm or disconfirm them. Such beliefs were ‘girls could improve their achievement by increased efforts, not by ability’, and
‘Parental expectations were not gender-differentiated’. The research design for this study did not include working with the students directly. The researcher decided that the observation data itself was not sufficient enough to conclude whether or not girls could improve their achievement by increased efforts or by abilities. The researcher was also not present during any of the parent-teacher conferences. Thus, she was not able to confirm or disconfirm whether or not the parental expectations differentiated based on the students’ gender.

In the case of Ms. Green, the researcher identified the following as her gender-related beliefs:

1. Girls were more emotional than boys were
2. There was no gender difference in student achievement
3. Girls put out more effort than boys did
4. There was no difference in boys’ and girls’ mathematics learning style
5. Students’ academic potential was ability-dependent, not gender-dependent
6. She had more personable interactions with the girls compared to the boys
7. Boys were more competitive with other students
8. Girls were competitive with their own-self
9. Girls showed little persistence if math exercises became difficult
10. Boys did not use all their abilities in lower level classes
11. Girls were more likely to improve next year compared to boys in lower level classes
12. In higher level classes, mathematics was more difficult for girls compared to the boys

After observing Ms. Green in her Algebra, and Algebra 1A classrooms for six weeks, the researcher was able to determine whether or not her stated beliefs were consistent with her instructional practice and behavioral interactions. The researcher found that Ms. Green’s stated belief that ‘there was no gender difference in boys’ and girls’ learning style’ was inconsistent with the students’ learning style in both of the upper and lower-level classes. Her belief that ‘girls showed little persistence if mathematics exercise became difficult’ was also found inconsistent with the girls’ behavior in both of the classes. Her stated belief that ‘mathematics was more difficult for
Girls compared to boys in higher level classes’ was also found inconsistent with the girl’s behavior in her higher-level class. Ms. Green’s stated beliefs that were found consistent with the instructional practices and behavioral interactions in the classrooms were the following:

1. Girls were more emotional than boys were
2. There was no gender difference in student achievement
3. Girls put on more efforts than boys did
4. Students’ academic potential was ability-dependent, not gender-dependent
5. She had more personable interactions with the girls compared to the boys
6. Boys were more competitive with other students
7. Girls were competitive with their own-self
8. Boys did not use all their abilities in lower level classes

A few of Ms. Green’s stated beliefs were concluded as inconclusive by the researcher since there was not enough data to confirm or disconfirm them. Such beliefs were as follows:

1. There must be some gender differences in college-level mathematics
2. Female student’s parents’ attribute their children’s failure in mathematics to their own failure in the subject matter, whereas male students’ parents attribute their children’s failure in mathematics to learning disorders
3. Female teachers could be more judgmental toward girls compared to boys
4. Paying attention to society’s gender-stereotypical views might affect female student’s achievement

To confirm or disconfirm these beliefs, the researcher needed to have field data from other sources, which was not a part of this research design. As a result, the researcher categorized these beliefs as inconclusive.

The researcher found that both Mr. Brown and Ms. Green had some stated beliefs in common:

1. There was no gender difference in the student achievement
2. There was no dramatic difference in boys and girls academic potential
3. Boys were generally more competitive
4. Girls usually used all their abilities, but boys did not
5. Girls put out more effort than boys did
6. Girls were more emotional than boys were
7. Girls showed little persistence if math exercises became difficult
8. In higher level classes, mathematics was more difficult for girls compared to the boys

Both Mr. Brown and Ms. Green had some conflicting beliefs about gender-related differences toward the students in their classrooms. When the researcher asked them to explain why they had conflicting views on the same topic, Ms. Green explained that she just got used to coming to class and teaching everyday without putting much thought on the little things. She also stated that lack of reflection on students’ behavior and learning style did not prepare her for some of the questions she was asked. Ms. Green also explained that she found every student in her class was different from each other. Thus, it was hard for her to generalize them based on their gender. Mr. Brown explained that it was also hard for him to think about all the students while making a generalized comment. He also stated that it was hard for him to explain his beliefs and attitudes.

**Discussion**

The findings from the classroom observations indicated that there was a small gender difference. Table 5.1 presents the average number of interactions between the teacher and the students per observation. According to table 5.1, there is a gender difference in both of the higher and lower-level classes to a certain degree. The gender differences in the upper level classes taught by both of the teacher are smaller than the gender difference in the lower level courses. Moreover, the gender differences in the upper level courses do not show any consistent pattern. In the AP Calculus class, girls had more student-initiated teacher-student interactions and student responses than the boys had. In the Algebra class, girls had more teacher-initiated teacher-student interactions and student-initiated teacher-student interactions than the boys had. Girls in these two upper level courses received more negative comments from the teacher. On the other hand, there is a consistent pattern in the gender difference in both of the lower level classes. In all the categories, boys had more interactions with the teachers than the girls.
had. According to the researcher, the female students’ interaction rate with the teacher in the upper level courses are higher than the female students’ interaction rate with the teacher in the lower level courses is possibly due to the high level of confidence in the students in the higher level courses. This assumption is related to Tarter and Fennema’s (1995) findings about confidence. Tartre and Fennema identified confidence as the affective variable most consistently related to mathematics achievement. Further studies on student’s gender-related beliefs may reveal some interesting explanation for the female students’ higher level of student-initiated teacher-student interaction in the upper level classes and low level of student-initiated teacher-student interaction in the lower level classes compared to the male students.

Table 5.1
Average classroom interactions

<table>
<thead>
<tr>
<th>Teacher/Class</th>
<th>TEACHER INITIATED</th>
<th>STUDENT INITIATED</th>
<th>TEACHER FEEDBACK</th>
<th>STUDENT RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TEACHER-STUDENT INTERACTION</td>
<td>TEACHER STUDENT INTERACTION</td>
<td>PRAISE</td>
<td>NEG. COMNT</td>
</tr>
<tr>
<td></td>
<td>BOY</td>
<td>GIRL</td>
<td>BOY</td>
<td>GIRL</td>
</tr>
<tr>
<td>Mr. Brown</td>
<td>0.85</td>
<td>0.38</td>
<td>7.10</td>
<td>11.31</td>
</tr>
<tr>
<td>AP Calc.</td>
<td>0.93</td>
<td>0.43</td>
<td>3.43</td>
<td>1.57</td>
</tr>
<tr>
<td>Liberal Arts</td>
<td>2.25</td>
<td>2.67</td>
<td>5.10</td>
<td>8.25</td>
</tr>
<tr>
<td>Ms. Green</td>
<td>4.36</td>
<td>1.57</td>
<td>13.42</td>
<td>3.57</td>
</tr>
</tbody>
</table>

The findings of this study suggest that Mr. Brown and Ms. Green’s stated beliefs about the relationship of gender to the teaching and learning of mathematics were for the most part consistent with their instructional practices and classroom interactions. However, some of their stated beliefs were not always consistent with their instructional practices. Mr. Brown’s beliefs were more consistent with his instructional practice in the upper-level classroom compared to his instructional practice in the lower-level
classroom. The consistencies and inconsistencies of Ms. Green’s beliefs were almost evenly distributed in both of her classes. Both Mr. Brown and Ms. Green thought that being used to teaching in a certain way and a lack of reflection on boys and girls’ behavior and learning styles could be the reason for the inconsistencies between their beliefs and practices.

It was obvious that Mr. Brown was frustrated with his 4th period Liberal Arts Mathematics class. The students’ behavior reflected their lack of interest in the class. Only four boys and two girls in this classroom participated as active learners. They talked and moved around in the classroom during lecture sessions. Mr. Brown had to repeatedly ask the students to be quiet. If any girl was disturbing the whole class, Mr. Brown was hardly harsh with her in front of everybody. Instead, he asked the whole class to behave. If a boy did the same, he would ask him to stop in front of the whole class most of the time. Mr. Brown never asked questions to any other girls but the two girls who appeared as active learners. In every single informal conversation and in the formal interviews with the researcher, Mr. Brown told her how frustrated he was with this class and the students’ unwillingness to do anything.

Mr. Brown had a completely different attitude in his AP Calculus class. He looked happy, energetic, and more personable with the students. He took an equal interest in all the students as he asked them questions on a regular basis. He also noticed if any student was late or missed a class, and expressed concern about him/her. The students were all active learners in this class. Boys mostly took part in the problem solving discussions, whereas girls generally discussed school issues and personal issues in the classroom (with Mr. Brown and the other students). One female student in particular asked a lot of questions. Sometimes, her questions were not directly related to the homework problems, it was more related to the subject matter itself. The girls were sometimes frustrated if they could not solve the homework problems and they expressed their frustration much more than the boys did. This attitude of the female students relates to Fennema and Sherman’s (1977, 1978) findings. Fennema and Sherman reported that female students often show less confidence than male students in their ability to do mathematics even when there is no gender difference in mathematics achievement.
The researcher found that Mr. Brown was much more organized in planning the lessons in his AP Calculus classroom compared to his Liberal Arts Mathematics classroom. To Mr. Brown, the subject matter in his AP calculus was challenging and fun, whereas the subject matter in the Liberal Arts class was not challenging at all. He spent more time getting to know all the students in his AP class. He enjoyed teaching this class and had a more personable relationship with the students. Compared to his role in the AP class, Mr. Brown took his role in the Liberal Arts Mathematics classroom as more like a chore. Moreover, the Liberal Arts Mathematics class was almost twice as large as the AP class. Thus, he did not know all the Liberal Arts students at a personal level as he did the AP students. As a result, he was more familiar with the students’ behavior and learning styles in the AP class compared to the Liberal Arts Mathematics class.

Ms. Green was a popular teacher in both of her upper and lower level classes. However, she had a friendlier relationship with her lower level Algebra 1A class compared to her upper level Algebra class. In the upper-level class, the students spent most of the time learning and having discussions about the learning topic, while the lower-level class spent a lot of time talking about non-mathematics related topics. Boys in both classes missed quizzes or tests more frequently than the girls did. The girls in the lower-level class were very vocal during the non-math related discussions, but not during the math-related discussions. The girls’ response rate in this class was lower than the boys on a regular basis.

The girls in both classes liked to sit closer to Ms. Green. When Ms. Green gave a class assignment, and everybody worked on it, the female students would come over to Ms. Green, and share something personal with her. Ms. Green showed a lot of interest while listening to them. Sometimes, they used to show her their accomplishments, drawings, story writings, awards, etc. Ms Green congratulated them, and inspired them to do better. However, if a student did something bad, Ms. Green confronted him or her the same way regardless of his/her gender. Regardless of the class size, Ms. Green knew each one of the students in both of the classes equally well.

Of the two teachers, Ms. Green was more consistent with her stated beliefs on the relationship of gender in the teaching and learning of mathematics to her instructional practices and classroom interactions. Duffy and Anderson (1984) noted that factors such
as classroom management and routines, and teacher-student respect proved to be the foundation upon which teachers based many instructional decisions. Therefore, Mr. Brown and Ms. Green’s stated beliefs might have varied for different classes, and for the male and female students. Garrahy (2001) suggested that reflections play a big role on the consistency of teachers’ beliefs and practice. As an explanation for the inconsistencies between the stated beliefs and classroom practice, Ms. Green stated that the reason could be the lack of reflection on her teaching and student learning. By reflection, she meant understanding, and examining a lesson after it took place in her classroom and using that knowledge to plan the following lessons.

The beliefs of these teachers were based upon their personal experiences as students and as teachers as well as from reading educational research. This finding was parallel to Sigel’s definition of beliefs that “beliefs develop through personal experiences”. Mr. Brown and Ms. Green entered their job with some pre-existing beliefs. Some of these beliefs were modified as the teachers were presented with counter examples throughout their teaching career. For example, Mr. Brown primarily believed that boys were more competitive than girls were. As a coach of the female student’s basketball team, and teaching upper level courses such as AP calculus, he saw that girls also could be competitive. Thus, he modified his belief to “girls can be as competitive as boys given equal opportunity”. This finding is parallel to Green’s statement made in 1971 that “beliefs might change by encountering counter examples”.

Teachers’ personal experience was a strong basis for the two teachers’ beliefs and classroom practices in this study. Mr. Brown, who was in his mid fifties, had more traditional views about gender and mathematics. On the other hand, Ms. Green, who was in her mid twenties, had very contemporary views about gender and mathematics. In her own schooling experience, Ms. Green did not experience any stereotypical treatment from her family and teachers. Thus, she developed beliefs that are ability oriented, not gender oriented. She also liked to present herself as a role model for the female students in her class. Thus, teachers’ personal experience, age, and gender were also contributing factors in the development and implementation of their beliefs.

One might question, “if the stated beliefs are not consistent with the teaching practices, how do we know what are their actual beliefs?”. Although the majority of the
researchers defined belief as a major determinant of behavior, the inconsistencies between beliefs and behavior in this study proves that beliefs are not always positively related to behavior. There are other issues one needs to consider. Such as, the teachers’ personal relationship with the group of students, their knowledge of this group of students’ characteristics, and above all, being conscious or unconscious about personal beliefs can affect the teachers’ behavior. In this study, Both Mr. Brown and Ms. Green had different types of beliefs about the higher-level classes and the lower level classes. Sometimes they were more familiar with one group of students than the others because of having had them for previous courses. Sometimes, Mr. Brown and Ms. Green were unconscious of their beliefs until the researcher pointed it out to them. It is possible that these teachers held more unconscious beliefs, which are affecting their behavior. This suggests that researchers need to pay close attention to the definition of beliefs and explore the related factors affecting the consistency (or inconsistency) between beliefs and behavior.

**Limitations**

There were a few limitations in this study. The participants were aware of the social desired behavior about gender-differences in mathematics education. Thus, it is possible that they might have not been honest with the researcher stating their gender-related beliefs. The researcher tried to overcome this problem by using multiple sources of data. Data recorded from teacher questionnaires, formal interviews, and informal conversations were employed to define teachers’ stated beliefs. As the participants revealed some gender-related issues related to the parents, and other math and science teachers, the researcher felt that observations in the parent-teacher conferences and other math and science classrooms would have proved a more complete picture of the school culture, so teacher’s stated beliefs could be more accurately confirmed or disconfirmed. A larger sample size would have allowed the researcher to compare the survey results to the findings from Tiedemann’s (2000a) study instead of just considering how the five participants in this study fit into Tiedemann’s findings. The researcher’s lack of experience in conducting qualitative research was also a limitation in this study.
Implications

This study has strong implications for mathematics teacher education, given the first principle of National Council of Teachers of Mathematics is to ensure equity of mathematics education for all students. The results of this study can be used for improving the professional development of both in-service and pre-service teachers. This information can be beneficial to educators as a means of comprehending what gender-related beliefs might affect teachers’ instructions, and how teachers can promote equity of education for all their students regardless of the student-gender. Different forms of reflections on teaching and learning need to be examined to see how teachers can be more consistent with their professed beliefs and their instructional practices.

Besides the field of mathematics, the findings of this research can be used in other areas of curriculum where gender differences could be an obstacle to reach equity of education. It was stated in chapter 3 that there is a gender difference in science favoring males and in English favoring females. This current research can be helpful to inquire teachers’ stated beliefs and the level of consistencies of these beliefs with the classroom practices. Besides other areas of curriculum, teachers’ gender-related beliefs need to be investigated through all K-12 grade levels.

Along with the two participants, the researcher herself has come to see the benefits of being reflective as a teacher. Further research needs to be done to find how and what forms of reflections can help teachers to promote gender equity in the classroom. More data sources, such as student-interviews will help the researcher get a more complete picture of the classroom culture. Teacher education would benefit from longitudinal studies on teachers’ beliefs and practices over the course of several years, from the beginning of the pre-service teacher program through the first few years of teaching.
APPENDIX A

MATHEMATICS TEACHER SURVEY

Student:                                                                 Course:

Please select one of the given choices for each of the following statements.

1. She/he is good in computation. a) True b) False
2. She/he is good at logical thinking. a) True b) False
3. Mathematics is a difficult subject for her/him. a) True b) False
4. Sometimes too much is expected of her/him. a) True b) False
5. If she/he would make an effort, she/he would perform better. a) True b) False
6. She/he uses all her/his mathematics abilities. a) True b) False
7. With specific encouragement her/his level of performance in mathematics can be improved. a) True b) False
8. She/he shows little persistence, if the math exercise is considered to be difficult. a) True b) False
9. If she/he does considerably better in the next math test than expected, the reason is:
   a) Good ability. b) Increased effort. c) The test was rather too easy. d) She/he was lucky.
10. If she/he does considerably worse than expected, the reason for this is:
    a) Lack of ability. b) Lack of effort. c) The test was rather too hard. d) She/he had bad luck.
11. She/he will most probably improve next school year. a) True b) False
12. She/he will most probably deteriorate next school year. a) True b) False
13. She/he thinks she/he can perform well in mathematics. a) True b) False
14. She/he is content with her/his performance. a) True b) False
15. She/he regards herself/himself as a good student of mathematics. a) True b) False
### APPENDIX B

**OBSERVATION TRANSCRIPTION CODE**

<table>
<thead>
<tr>
<th>DATE</th>
<th>TEACHER INITIATED TEACHER-STUDENT INTERACTIONS</th>
<th>STUDENT INITIATED TEACHER-STUDENT INTERACTIONS</th>
<th>TEACHER FEEDBACK</th>
<th>STUDENT RESPONSE</th>
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<td>BOY GIRL</td>
<td>PRAISE</td>
<td>BOY GIRL</td>
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<td></td>
<td>NEG. COMNT</td>
<td>BOY GIRL</td>
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APPENDIX C

TEACHER INTERVIEW QUESTIONS

1. How long have you been teaching?
2. Where were you born?
3. Where did you grow up/ went to high school?
4. Where did you go to college?
5. What did you study in college?
6. What did you do after graduation?
7. What are the places you worked at?
8. What are the subjects that you have taught?
9. What inspired your career choice?
10. How did you like teaching in the beginning?
11. Did you have a favorite subject in high school?
12. What was special about this subject? Did it change over time?
13. What course do you like to teach the most? Why?
14. What course do you not like to teach? Why not?
15. What are your strengths as a teacher?
16. What are your weaknesses as a teacher?
17. What should be the role of a teacher in his classroom?
18. Do you recall differential treatment or feelings of differential treatment based on your sex, in your own schooling experience?
19. What is your interpretation of the phrase “gender differences”?
20. Do you believe that gender differences exist in mathematics education?
21. Overall, how do you think the boys and girls in your classroom perceive their academic abilities?
22. Do you believe that boys and girls in your class learn mathematics differently?
23. How would you describe the academic potential and abilities of girls and boys in your class?
24. What type of interests do the boys and girls in your class have?
25. Would you describe the types of behavioral interactions you have with boys and girls?
26. Are there adjectives you would use to describe the boys and girls in your classroom?
27. Is there a difference in the competitive interests of the girls and boys?
28. Are there areas in the curriculum where you find boys and girls competitive?
29. Would you tell me a little bit about your teaching strategies?
30. Was there anything in particular that influenced your development of these strategies?
APPENDIX D

FINAL INTERVIEW QUESTION FOR MR. BROWN

1. Why do you become a Mathematics teacher instead of a Science teacher?
2. In what ways you think that gender differences might become visible in the classroom?
3. How would you describe an equitable classroom for the students?
4. How can you tell if gender differences exist in a classroom?
5. Do you believe that girls should be as much challenged as the boys?
6. Do you challenge all your female students?
7. Growing up, who was your idle?
8. In our last interview, you mentioned that boys and girls learn differently. You also said that you develop your teaching strategies according to the need of the students. Over the years, did you have to change/develop any teaching strategies to fit the female student’s learning needs?
9. Imagine a mathematics classroom where both boys and girls show equal achievement, interest, attention, motivation, and enthusiasm to learn. If you are the teacher of this class, what type of instructional strategies have you taken to promote this equitable class environment?
10. What is your reaction when people say, “Boys don’t like girls who knows too much math”?
11. What is your reaction when people say, “It’s not cool for boys to carry around math books”? 
APPENDIX E

FINAL INTERVIEW QUESTIONS FOR MS. GREEN

1. How did you like teaching in the beginning?
2. What is the best thing about being a teacher?
3. What is the worst thing about being a teacher?
4. What course do you like to teach the most? Why?
5. What are your strengths as a teacher?
6. What are your weaknesses as a teacher?
7. What should be the role of a teacher in his classroom?
8. Do you believe that boys and girls learn math differently?
9. Do you believe that female students in general perform better in math if they are taught by a female teacher?
10. From my observations in your classroom, it seemed to me that the girls in your 3rd period are more vocal during a non-math-related discussion compared to the boys. Do you agree with that?
11. How would you describe an equitable classroom for all the students?
12. Do you believe that girls should be as much challenged as the boys?
13. Do you challenge all your female students?
14. In our last interview, you mentioned that the society believes that girls are generally good at English, and boys are good at math. What is your reaction to that?
15. Imagine a mathematics classroom where both boys and girls show equal achievement, interest, attention, motivation, and enthusiasm to learn. If you are the teacher of this class, what type of instructional strategies have you taken to promote this equitable class environment?
16. What is your reaction when people say, “Boys don’t like girls who know too much math”?
17. What is your reaction when people say, “It’s not cool for boys to carry around math books”? 
18. From my observation, I found that you had the most frequent interaction with two of your students in the two classes. One of them is Jessica in your 1st period class, and the other one is Rick in your 3rd period class. Would you tell me a little about their ability, interest, efforts and attitude?
APPENDIX F

HUMAN SUBJECT APPROVAL
Office of the Vice President  
For Research  
Tallahassee, Florida 32306-2763  
(850) 644-8673  FAX (850) 644-4392

APPROVAL MEMORANDUM  
Human Subjects Committee  

Date: 11/7/2003  

Sraboni Ghosh  
159 Herlong Drive #3  
Tallahassee, FL 32310  

Dept.: Middle and Secondary Education  

From: David Quadagno, Chair  

Re: Use of Human Subjects in Research  
Teachers' beliefs on Gender Differences in Mathematics Education  

The forms that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be exempt per 45 CFR § 46.101(b)(2) and has been approved by an accelerated review process.  

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.  

If the project has not been completed by 11/8/2004 you must request renewed approval for continuation of the project.  

You are advised that any change in protocol in this project must be approved by resubmission of the project to the Committee for approval. Also, the principal investigator must promptly report, in writing, any unexpected problems causing risks to research subjects or others.  

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols of such investigations as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.  

This institution has an Assurance on file with the Office for Protection from Research Risks. The Assurance Number is IRB00000446.  

Cc: Dr. Elizabeth Jakubowski  
HSC No. 2003.400
APPENDIX G

INFORMED CONSENT FORM
INFORMED CONSENT FORM

I freely and voluntarily and without element of force or coercion, consent to be a participant in the research project entitled “Teachers’ Beliefs on Gender Differences in Math Education.”

This research is being conducted by Sraboni Ghosh, who is a Doctoral candidate at Florida State University. I understand the purpose of her research project is to better understand teachers’ beliefs on gender differences in mathematics education and how these beliefs relate to teaching practices. I understand that if I participate in the project I will be asked questions about the beliefs I have about gender differences in my math classes, how I developed these beliefs, and my own experience as a teacher and a student related to gender differences.

I understand I will be asked to fill out paper and pencil questionnaires. I may also be asked to participate in multiple interviews with the researcher. There will be no more than 5 interview sessions and the sessions will be no longer than 1 hour long. I may be observed in my classrooms five times a week for the entire fall and spring semester of the year 2003. I understand that for the accuracy of the data collection, each of the interview sessions and classroom observations will be video taped by the researcher. These tapes will be kept in a locked filing cabinet, I understand that only the researcher will have access to these tapes and they will be destroyed by 8/25/2005. If I participate in the interviews, there will be no monetary reward. It will only help me to recognize my beliefs about my male and female students and promote educational equity in my classrooms.

I understand my participation is totally voluntary and I may stop participation at anytime. All my answers to the questions will be kept confidential to the extent allowed by law and identified by a subject code number. My name will not appear on any of the results. No individual responses will be reported. Only group findings will be reported. I also understand there is no physical risk involved with this research project.

I understand that this consent may be withdrawn at any time without prejudice, penalty or loss of benefits to which I am otherwise entitled. I have been given the right to ask and have answered any inquiry concerning the study. Questions, if any, have been answered to my satisfaction.

I understand that I may contact Ms. Sraboni Ghosh, Graduate Student, Florida State University, Middle and Secondary Education, MCH 219, (850) 644-8433, and The Human Subject Committee, 2035 E. Paul Dirac Drive, Box 15, 100 Siger Building, Innovation Park, Tallahassee, FL 32310, (850) 644-8633, for answers to questions about this research or my rights. Group results will be sent to me upon my request.

I have read and understand this consent form.

(Participant) (Date)
REFERENCES


BIOGRAPHICAL SKETCH

Sraboni Ghosh, daughter of Sunil and Namita Ghosh was born in Bangladesh in 1976. She spent her high school years in Dhaka, Bangladesh. Upon graduation from high school, she came to the United States for higher education. She earned her undergraduate degree in mathematics from Troy State University, Troy, Alabama in 1999. She started her graduate studies at Florida State University in 2000 and earned her Masters’ degree in mathematics education prior to entering the doctoral program.

Sraboni Ghosh’s teaching experience is mostly based on her years at the Florida State University as a student instructor in the mathematics education program. She has also worked in a teacher preparation program for three years during her graduate studies. Her research interests are teachers’ beliefs and knowledge, student motivation, and mathematics anxiety. Sraboni Ghosh is married to Dr. Nirmol K. Podder. Upon finishing her doctoral degree, Dr. Ghosh will join North Georgia College and State University as an assistant professor.