TEACHERS’ BELIEFS, GENDER DIFFERENCES
AND MATHEMATICS

by

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ABSTRACT

The major focus of this study is to explore, using the 1990 British Columbia Mathematics Assessment data at the Grade 7 level, gender differences in mathematics teachers' beliefs. As well, this study compared these differences to gender differences of students' beliefs found in the same data.

The theoretical rationale for this study is based on a model devised by this researcher, namely the Modified Cognitively Guided Instruction (CGI) Research Model, which is the combination of the Cognitively Guided Instruction Research Model (Fennema, Carpenter, and Peterson, 1989) and the Autonomous Learning Behavior (ALB) Model (Fennema & Peterson, 1985).

Two way ANOVA as well as planned comparisons (t-test) were used to investigate gender differences within and across a random sample of two status groups (teachers and students). The analysis of the data suggested several conclusions.

First, male and female teachers are more similar than different with respect to their beliefs regarding the importance and difficulty of selected mathematics topics. And, Numbers and Operations was the only topic under study in which male and female teachers differed significantly. Male teachers rated Numbers and Operations more important than female teachers.
Second, gender differences existed only in students' beliefs about the difficulty of Geometry, and Numbers and Operations. Female students, compared to male students, believe Geometry and Numbers and Operations more difficult.

Third, the findings of this study show that the gender differences within each status group are similar. In addition, significant gender difference was found only in overall male's and female's (regardless of their status) beliefs about the importance of Numbers and Operations. Males rated Numbers and Operations significantly more important than females. Further research which directly investigates gender differences in teachers' beliefs and students' beliefs is suggested, as well as further research into relationships between gender differences in teachers' and students' beliefs.
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CHAPTER 1

THE PROBLEM

Introduction

In mathematics, as in other cognitive fields, affect can play an important role in how students approach the learning of content and their decisions about how much content they will need in the future (Reyes, 1984). According to the *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, 1989), women and minorities study less mathematics and are seriously underrepresented in careers which use science and technology. Also, these researchers contend that mathematics has been a critical filter for employment and full participation in society.

Because of the belief that there should be equity for females and males in mathematics education, gender differences in mathematics have been studied intensely for more than 20 years. Here, the term “gender differences” is used to refer to “non-biological characteristics, psychological features or social categories” (Deaux & Major, 1987). The findings of some gender studies indicate that significant differences in mathematics achievement in favor of males appear by late adolescence.

Although many factors contribute to gender differences in the outcomes of mathematics education, “there is no doubt that schools are major influences” (Fennema, et al. 1990). Among various dimensions of schools that have been investigated as partial explanation for these gender differences are stereotypes in textbooks (Northam, 1986), teachers’ attention during mathematics instruction (Leder, 1987), student engagement in mathematical tasks (Fennema & Peterson, 1987), the structure and organization of classrooms (Hallinan & Sorenson, 1987), and teachers’ gender (Fennema and Leder, 1990; Burton, 1990). While each of these lines of research has added to the knowledge about the influence of important educational components, little is known about teachers’ beliefs about mathematics, males, and females. As more evidence is gathered about teachers’ cognitions, the importance of teachers’ beliefs is increasingly recognized.

It is obvious that what teachers do is directed in no small measure by what they think. Moreover, it will be necessary for any innovation in the context, practices, and technology of teaching to be mediated through the

Nevertheless, compared to the limited knowledge of teachers’ beliefs about mathematics, even less is known about the gender differences in teachers’ beliefs about mathematics. That is, while there appears to be consensus that teachers’ beliefs as well as teachers’ gender are important, the gender differences in their beliefs are unclear.

Therefore, the major focus of this study is to explore gender differences in so far as these are reflected in mathematics teachers’ beliefs. A secondary purpose is to study how these differences compare with gender differences of students’ beliefs. The database used in this study is the 1990 British Columbia Mathematics Assessment data.

In the spring of 1990, the British Columbia Ministry of Education conducted the fourth British Columbia Mathematics Assessment. Approximately 120,000 students and about 4,500 teachers in B.C. participated in the assessment. The objective of the assessment was “to collect information about what students are being taught and what they are learning, and to make that information available to everyone who has an interest in the outcomes of education in this province” (Robitaille, 1991).
The B.C. Assessment gathered detailed information from schools in British Columbia concerning students' achievement, beliefs and opinions about a number of topics of contemporary interest, and the opinions and beliefs of the mathematics teachers. Although five years has passed, when considering the large scale and the high reliability of the British Columbia Mathematics Assessment, using the 1990 B.C Mathematics Assessment database for this study is valid.

The target population of this study will be grade 7 students and grade 7 mathematics teachers whose classes were involved in the assessment. Grade 7, the last year of elementary school is an important crossroads in the academic careers of students (Robitaille, 1991) and is selected for this study because at this level significant gender differences in mathematics achievement begin to appear, and because the database reveals a better balance between the number of male teachers and female teachers at this level than at grades 4 or 10, the other points at which provincial assessment occurs.

**Purpose and Nature of the Study**

**Purpose**

The main purpose of this study is to explore the extent to which gender differences affect mathematics teachers’ beliefs about the
importance and difficulty of selected mathematics topics. Furthermore, the study examines gender differences in students’ beliefs about the importance and difficulty of those same mathematics topics.

Gender differences in teachers’ beliefs toward mathematics are then compared with gender differences in students’ beliefs toward mathematics. Finally, the study researched the overall gender differences (regardless of the status) in beliefs about mathematics. To address this last issue, males/females beliefs about the importance of selected mathematics topics are investigated.

Research Questions

This study will be guided by the following questions:

1a). Do male and female mathematics teachers differ in beliefs about the importance of selected mathematics topics?

1b). Do male and female mathematics teachers differ in beliefs about the difficulty of teaching selected mathematics topics?

2a). Do male and female students differ in beliefs about the importance of selected mathematics topics?

2b) Do male and female students differ in beliefs about the difficulty of selected mathematics topics?
3. Are gender differences in teachers reflected in their beliefs about the importance of selected mathematics topics different from gender differences in students regarding the importance of these topics?

4. Do males and females (regardless of their status) differ in their beliefs about the importance of selected mathematics topics?

Theoretical Rationale

The theoretical rationale for this study is based on a model devised by the researcher, namely the Modified Cognitively Guided Instruction (CGI) Research Model, which is the combination of the Cognitively Guided Instruction Research Model (Fennema, Carpenter, and Peterson, 1989, p. 204) and the Autonomous Learning Behavior (ALB) Model (Fennema & Peterson, 1985).

In 1985, Fennema and Peterson developed the ALB Model (see Fig. 1) as a possible explanation of gender differences in mathematics. This model hypothesizes a relationship between teachers and gender differences of students in mathematics. It indicates that one component of the external influences which effect the development of gender differences is teacher influence on both students' internal motivational beliefs and on students' participation in classroom learning activities. (Fennema, 1990).
However, the concentration of the ALB model is on students’ learning processes. The model does not explicitly deal with the relationship between teachers’ beliefs and students’ beliefs. It simply suggests that teachers are an external influence on students’ belief systems and behaviors.

Five years later, Fennema, Carpenter, and Peterson proposed another model called the Cognitive Guided Instruction (CGI) research model, shown in Figure 1. The CGI Research Model is designed to show how teachers’ knowledge and beliefs influence learning. According to the researchers (Fennema, 1990), the final outcome, gender differences in mathematics, is directly influenced by children’s cognitions and behaviors, which in turn are influenced by classroom instruction. ... classroom instruction is
determined by the decisions that teachers make, which are directly influenced by their knowledge and beliefs (Fennema, pp. 171).

The CGI research model focuses on demonstrating the linkage between teachers’ and students’ cognitions, behaviors, and gender differences in mathematics, but the category of students’ beliefs is no longer explicit in this model.

![Diagram of Cognitively guided instruction research model]

**Fig. 1. 2. Cognitively guided instruction research model**

Hypothesizing a connection between teachers’ beliefs and students’ beliefs, this researcher integrated the ALB model and CGI research model to incorporate the theoretical advantages of each model (see Fig. 1. 3). A description of the modified model follows.
Classroom instruction directly influences students' cognitions and in turn, behaviors, and furthermore, classroom instruction is determined by teachers' knowledge, beliefs, and decisions (Fennema, 1990). As a consequence, this researcher locates the teachers' knowledge, beliefs, decisions, and classroom instructions found in the CGI research model within the teachers' external influences found in the ALB model (see Fig. 1.3).

Second, the students' "internal belief system" found in the ALB model is altered to explicitly include "students' beliefs" found in the CGI research model. As Fennema claimed, the students' cognitions and beliefs have a profound effect on gender differences in mathematics (Fennema, 1990).

Third, besides students' beliefs and cognitions, students' behavior is an important factor that affects gender differences in mathematics (Fennema, 1990). The "students' behaviors" as found in the CGI research model is altered in the modified model to include "students' autonomous learning behaviors" as shown in the ALB model.

Bringing together the CGI model and the ALB model gives us the "modified CGI model" (see Fig. 1.3). This modified CGI model suggests a theoretical connection between teachers' beliefs and students' beliefs.
Fig. 1.3 Modified CGI research model

Since this theoretical model suggests that teachers' beliefs influence both students' achievement in mathematics and students' beliefs about mathematics, and since gender differences have been found in both these aspects, it seems to follow that there may be gender differences in teachers' beliefs about mathematics. This leads to the assumption that the gender of teachers may be an important variable with respect to their beliefs. Because little research dealing directly with teachers' beliefs has
included gender as a variable, this study’s major focus is gender differences in teachers’ beliefs toward mathematics.

**Significance of the Proposed Study**

The educational environment is composed of many factors, such as texts, materials, teachers, and organizations. According to Fennema (1990), among these factors, one of the most important is the teacher. All of the teachers’ actions and words have a bearing, either directly or indirectly, on students’ learning of mathematics.

Previous research has examined the influence of teacher gender on student achievement. For example, some suggest that men are more capable than women in teaching mathematics (Saha, 1983), others argue that students favor female mathematics teachers (Mwamwenda, 1989). Warwick and Jatoi (1994) conclude that teacher gender has a much stronger influence on the mathematics achievement of students than student gender. Studies of teachers’ beliefs have investigated teachers’ general conceptions of their roles (Munby, 1983), their general beliefs about curriculum (Bussis, Chittenden, & Amarel, 1976), and their beliefs about the nature of mathematics (Grossman, Wilson, & Shulman, 1989). Little attention has been given to examining the gender differences of teachers’ beliefs toward mathematics. Bearing in mind, that teachers’ thinking plays
an important part in teaching, one can see the necessity of examining gender differences in teachers’ beliefs. The information obtained may contribute to the present understanding of teachers’ beliefs and gender differences in mathematics and may suggest future studies in the area. In addition, the study is expected to produce findings of interest from practical perspectives because the information gathered can be important not just to mathematics educators and teachers but to anyone concerned with the participation and achievement of students, (in particular, females) in mathematics.
CHAPTER 2

LITERATURE REVIEW

Introduction

Research on gender related differences and affective variables in mathematics education has been conducted from a variety of perspectives. Despite the vast body of literature dealing with gender differences, little research in mathematics education has explored gender issues with respect to teachers’ beliefs. Research reviews in gender and mathematics indicate that no investigations have been conducted to determine if male and female teachers hold different beliefs about mathematics (Leder, 1992; Oakes, 1990; Fennema, 1994). This chapter, therefore, contains a review of literature which is concerned with teacher gender including those not directly dealing with teacher beliefs. Furthermore, some studies related to teachers’ beliefs (although they may not consider gender as a variable) will be discussed.

Mathematics, Teacher and Gender

Teachers play a crucial role in implementing school policies, whatever the formal organization of the setting in which mathematics is taught (Fennema, 1990). In theory, most teachers believe education should be a liberating and democratic influence (Skolnick, Langbort, & Day, 1982), but
in practice mathematics teachers still seem to reinforce traditional behavior and occupational plans for both males and females independent of where student interest or talent may lie (Eccles & Hoffman, 1984), and at times they seem to actively discourage nontraditional (e.g. mathematical) female interests (Fox, Brody, & Tobin, 1985).

Unlike the ongoing interest with gender differences in students' mathematics learning, teacher gender has not been dealt with in a substantial way in the educational literature. However, previous research has examined the influence of teacher gender on student achievement. Saha (1983) suggests that "whether a teacher is male or female does make a difference for student achievement"(p.79). He concludes that in general males are more capable than females in teaching mathematics and science. That is, students with male teachers have better achievement in mathematics and science than those with female teachers. Studies conducted by Carnoy (1971) and Klees (1974) had similar findings. By analyzing the data from the first national survey of primary schools in Pakistan, Warwich and Jatoi (1994) argue that in Pakistan, teacher gender has a much stronger influence on the students’ mathematics achievement than student gender. In addition, a gender gap favoring male teachers shows up most clearly in rural schools (Warwich & Jatoi, 1994). In
contrast, Mwamwenda & Mwamwenda (1989) found that students of female teachers had significantly higher achievement scores in mathematics and other subjects than those taught by male teachers. Similarly, Ryan (1972) claimed that female teachers rather than male teachers were more effective in urban schools.

Duval (1980) took a different approach to explore gender differences in student achievement. She examined teachers' grading behavior on a geometry examination for evidence of teacher bias. Extensive analysis of the returned, scored papers revealed no differences in the scores given to males or females. Wiles (1992) advanced this approach by analyzing 96 scored papers of middle-grade-level (4th, 5th, and 6th grades) students' work in mathematical problem solving. The results were consistent with previous research. He concluded that the gender of teacher was not significant as a main effect or in interaction with student gender. That is, the scores given by male or female teachers showed no significant differences. Additionally, male or female teachers illustrated no bias on grading behavior toward male or female students. As a whole, then, the results to date demonstrate no correlation between teacher gender on grading behavior and gender differences in students' achievement.
The impact of teacher gender on student attitude and beliefs, and gender-related teacher-student interaction were other gender-related issues reported in the literature. Mallam (1993) observed that there was a significant difference between the attitudes toward mathematics of females taught by male teachers and of females taught by female teachers. The results are consistent with research done by Lee and Lockheed (1990) which indicated more positive attitudes toward mathematics were demonstrated by females taught by female teachers. This seems to support the statement made by Shape (1975) that having male teachers could discourage females from studying mathematics. Furthermore female mathematics teachers could serve as role models for females to actively pursue mathematics. By comparing teacher and student perceptions of eight facets of the mathematics classroom environment: difficulty, speed, inquiry, diversity, satisfaction, competitiveness, formality, and goal direction, in Israeli junior high schools, Ben-Chaim, Fresko, and Carnell (1993) discovered that female teachers more than male teachers tended to perceive the classroom learning environment differently from their students. Female teachers thought differently than their students about inquiry, difficulty, and diversity. Male teachers’ perceptions, on the other hand, differed from students’ perceptions with respect to speed. That is, male
teachers tended to rate pace of instruction slower than did their students. Research (Ben-Chaim, Carmeli, & Bruckheimer, 1987; Fresko, Carmeli & Ben-Chaim, 1989) illustrates that difficulty ratings increased with grade level: this occurred both with respect to students’ ratings as well as with respect to teachers’ ratings. This means, higher grade students, along with their teachers, tended to rate learning mathematics as more difficult than did lower grade students and their teachers.

Findings from numerous studies (Fennema & Sherman, 1977,1978; Foxman, 1988; Hanna, 1988; Jungwirth, 1991) that deal with interaction in the mathematics classroom come to a typical pattern: in nearly every observation category teacher - male student interactions are more frequent than teacher - female student interactions. Among these studies Jungwirth (1991) concludes that over long periods the gender of the participants in the mathematics class does not play a role in classroom interaction. Both female and male teachers and students act so that the typical patterns are established. Overall, female and male teachers are much more similar to each other than different (Brophy, 1985). There are, however, modifications of the ordinary interaction patterns. For example, female teachers tend to be more student-centered, indirect and supportive of students than male teachers.
Gender differences in students' ratings of teachers at the postsecondary level have been investigated as well. With respect to teacher gender, numerous past studies have offered little support for overall male or female superiority (Basow & Howe, 1987; Wigington, Tollefson, & Rodriguez, 1989; Winocur, Schoen, & Sirowatka, 1989). However, some research studies (Basow & Silberg, 1987; Hancock, Shannon, & Trenthan, 1993) argue that male teachers received a higher global rating than female teachers; while others (Kaschak, 1981; Basow & Howe, 1979) found that female teachers received more favorable evaluations than male teachers. Furthermore, interaction between teacher and student gender is reported. For instance, Ferber & Huber (1975) found that female students evaluated female teachers more favorably than they did male teachers, whereas the lowest ratings came from male students rating female teachers. Lombardo and Tocci (1979) suggested that male teachers were perceived as more competent than female teachers by male students, while female students showed no such gender preference. Basow & Silberg (1987) also found an overall significant student gender and teacher gender interaction in the ratings. Specifically, male students gave female teachers significantly poorer ratings than they gave male teachers; female student ratings of female teachers were higher than those of male students. In general,
however, the teacher/student gender interaction in student ratings of
teachers remains open to debate; since some studies show little or no
evidence of gender interactions (Elmore & LaPointe, 1975; Wilson & Doyle,
1976), while others have demonstrated evidence of variables on which
students rated teachers of the opposite gender more highly (Tieman &
Rankin-Ullock, 1985; Basow & Silberg 1987), or preferred the teachers of
the same gender (Ferber & Huber, 1975; Hancock, Shannon, & Trentham,
1993).

**Teachers’ Beliefs and Mathematics**

Teachers’ beliefs have attracted considerable research attention.
Studies of teachers’ beliefs in mathematics education have investigated
teachers’ general conceptions of mathematics teaching and learning (Ball,
1990; Cobb, Wood, & Yachel, 1990, 1992), their general beliefs about
curriculum (Bussis, Chittenden, & Amarel, 1976), and their beliefs about the
nature of mathematics (Grossman, Wilson, & Shulman, 1989; Ernest,
1988). Fennema et al. (1990) and Fennema (1990) point out differences in
teachers’ expectations of female students and male students which lead the
teachers to overrate the males’ mathematical capability and to underrate the
females’. The responses of a sample of first-grade teachers led Fennema
(1990) to conclude that teachers tended to explain males’ success in
mathematics in terms of ability more often than they did for females; success was described more often in terms of effort for females than males. Furthermore, when males fail in mathematics, teachers have indicated that it is because the teachers failed to help them. In addition, teachers frequently have higher educational expectations for boys than for girls (Good, Sikes, & Brophy, 1973; Hiltion & Berglund, 1974), and believe that boys are better than girls at mathematics (Casserly, 1980). Casserly (1975) reported that teachers in a secondary school often became fearful that the females would fail and become emotionally upset if the females were unable to solve difficult mathematics problems. The results from the same study show that female students themselves reported that the teacher appeared to believe that mathematical problem solving was not useful for them. Indeed, Reyes and Stanic (1988) suggest that the important teacher beliefs that influence the development of gender differences in mathematics are their attitudes about "the aptitudes of students and the appropriateness of their achieving at a high level in mathematics that differs on the basis of ...sex" (p. 30). In 1985, Pratt conducted a study comparing selected teacher beliefs and verbal behaviors among secondary mathematics and science teachers. Teacher beliefs that Pratt investigated were discerned from the Responsibility for Student Questionnaire which deals with teacher
responsibility assumed for student success and failure. He defined "teacher verbal behavior" as: indirect behaviors (teacher praise, acceptance of student responses or behavior, and expanding upon student thoughts), and direct behaviors (directing students, correcting student answers or behavior, and criticizing students). Comparisons by subject taught (mathematics, science) and grade level (junior high, senior high) indicate that the sample was statistically uniform in teacher beliefs about student success and failure. That is, there were no significant interactions among those variables. However, female teachers showed significantly higher incidences of indirect behavior and combined indirect-direct behavior.

The literature on gender differences of teachers indicates that there is much overlap in the mathematical teaching of males and females, but the actual effects of teacher gender and student gender in mathematics are unclear. In addition, gender differences with respect to teachers' beliefs about mathematics have not been extensively researched in the literature. This study, then, explores whether there are gender differences in teachers' beliefs about the importance and difficulty of mathematics.

**Mathematics, Student, and Gender**

The divergence between males' and females' achievement and enrollment patterns in mathematics has prompted studies aimed at offering
some remedies or at least some possible explanation for these differences. Although it has been generally accepted that these differences exist in mathematics learning, the proposed underlying causes of this situation are varied. Some researchers argue that society is at fault (Marsh et al, 1989; Leder, 1991; Hanna et al, 1988), while others argue that females are destined by their gender to be distinct from males (Vandenberg & Kuse, 1979; Peterson, 1979; Benbow & Stanley, 1980). It is this complexity of underlying causes which prevents simple solutions to the problem.

The search for factors accounting for gender differences in mathematics performance has covered many areas of research from physiology to educational practices (Badger, 1981). Whether the differences are innate, learned, or the result from a combination of factors remains inconclusive, and will not be elaborated in this review. Instead, particular emphasis is placed on research into the influence of and gender differences found with respect to students’ internal belief factors.

"Internal belief factors" include such variables as feelings, beliefs, and attitudes. The list of variables is complicated as the possible interactions are, in practical terms, limitless over time and age. It is worth noting that the different variables overlap and interact.
Confidence in learning mathematics and achievement seem to be correlated (Meyer & Koehler, 1990; Reyes, 1984; Schoenfeld, 1989). At both the middle and high school levels, researchers indicated that, males consistently have more self-confidence in their ability to learn mathematics than females do at equal achievement levels (Fennema & Sherman, 1978; Lantz & Smith, 1981). For females, this can lead to a cycle of failure, with reduced expectations and achievement following reduced effort over time. Woleat, Pedro, Becker and Fennema (1980) found that females at all achievement levels more strongly attributed failure to lack of ability, and success to effort or circumstance. For males, the situation is reversed; i.e. they tend to attribute success to ability and failure to lack of effort or circumstance. It therefore appears that females feel less in control of their mathematical learning and are less apt to persist. Meyer and Koehler (1990) state that confidence in mathematics is reflected by students' continued participation in mathematics course taking and career aspirations in quantitative fields. Although confidence seems to be more highly related to achievement than any other affective variable (Fennema, 1984), there is nothing in the literature concerning how such feelings are developed.

Another area where the relationship of gender differences in mathematics with achievement is not clearly understood is stereo-typing of
mathematics. Mathematics, when stereo-typed, is seen as a male achievement domain by both male and female students (Zimmerer & Bennett, 1987; Bockell & Lebonc, 1981). Hilton and Berglund (1974) in their study found that males regarded mathematics as more useful and more interesting than females. Fennema and Sherman (1977) also studied sex-role socialization as manifested by students' assessment of the usefulness of mathematics and the degree of agreement that mathematics is a male domain. The females in their study did not agree that mathematics is a male domain. However, the females were less convinced than the males that mathematics would be useful to them personally. Females, surprisingly, do not always characterize participation or competence in mathematics as unfeminine (Eccles-Parsons, 1984). Furthermore, it seems that mathematics being perceived as a male domain might not be important as a predictor of later achievement (Meyer & Fennema, 1986).

There is also a significant positive correlation between the perceived usefulness and importance of mathematics for future goal attainment and mathematics participation and achievement by students (Fennema & Sherman, 1977, 1978; Meece, Parsons, Kaczala, Goff, & Futterman, 1982; Meyer & Koehler, 1990). Armstrong and Price (1982) found that both male and female students ranked usefulness of mathematics as the most
important reason in their decision to take more mathematics courses. Studies indicate that high school females generally tend to consider mathematics as less essential to their plans and possibilities than males (Fox, 1977; Fennema & Sherman, 1977, 1978; Eccles, 1983). Research reviewed by Hyde, Fennema, Ryan, Frost, And Hopp (1990) and Reyes (1984) show that male students perceived mathematics to be more useful to them than did females. Schoenfeld (1989), however, claims that students study mathematics for intrinsically valuable reasons rather than for extrinsic reasons, and that both the students and their parents believe that it is quite important to do well in mathematics. Fox (1977) also looked at students' general enjoyment of mathematics and found that gender differences were small, with a low but significant correlation with achievement. However, since students may enjoy subjects in which they perform well or vice versa, no definite conclusion can be drawn about the direction of causation for both enjoyment and perceived difficulty of mathematics (Leder, 1990, p. 614).

The motive to achieve is assumed to be "a major determinant of an individual's efforts to attain success" (Leder, 1990, p.615). Working within the expectancy-value model of motivation, McClelland, Atkinson, Clare and Lowell (1953) largely confirmed that achievement motivation was
influenced by three major variables: the individual's need for achievement, the expectation that the desired goal was attainable, and the value attached to the goal. On the other hand, the way in which a student attributes causation for success and failure is an affective variable of gender differences in mathematics. According to Weiner (1974), task difficulty is one reason people give for their successes and failures. A study done by Wolleat, Pedro, Becker, and Fennema (1980) compared attribution patterns with achievement scores for 647 female and 577 male secondary school students enrolled in college preparatory algebra and geometry classes in ten high schools. They found that females attributed failure experiences in mathematics, more strongly than did the males, to a lack of ability or to the difficulty of the task. Research (Eccles-Parsons, Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1985) also indicates that females tend to rate mathematics as more difficult than males. It has been argued that students who believe they are unable to succeed in school - those who have "learned helplessness" - tend to choose tasks they perceive to be either very easy or very difficult (Covington & Beery, 1976). On easy tasks, success is assured. When failure occurs on a very difficult task, it can be attributed to the unreasonableness of the task, thus avoiding the feared conclusion that failure resulted from low ability. Both Dweck & Gilliard (1975) and
Nickolls (1975) found females exhibiting more learned helplessness than males.

**Summary**

The literature on gender differences of teachers indicate that there is much overlap in the mathematical teaching of males and females, but where gender differences occur, the results are inconclusive. The actual effects of teacher gender and student gender in teaching and learning mathematics are unclear.

Much research illustrates that internal belief factors could account for gender differences in students' mathematics achievement and participation. Confidence, stereotyping, perceived importance and usefulness, and task difficulty are closely related to students' mathematics achievement and participation. On the average, the gender gap is in favor of males.

This study compares the population distributions of males and females in grade 7 in British Columbia with the view to determine the nature of gender differences in both teachers' and students' beliefs about the importance and difficulty of mathematics topics.
CHAPTER 3
METHODOLOGY

Data Source

The data for this study are from the 1990 British Columbia Mathematics Assessment.

In the spring of 1990, the Ministry of Education of British Columbia conducted the fourth British Columbia Mathematics Assessment. Approximately 120 000 students and 4 500 teachers in B.C. participated in the assessment. For grade 7, every teacher who taught grade 7 mathematics completed one of three forms of a teacher questionnaire. This questionnaire contained, among other things, questions designed to gather information about teachers’ beliefs about topics in school mathematics. Students were also asked to respond to 12 items distributed among the four booklets regarding topics in school mathematics. Both teachers and students indicated how important they felt each topic was, how easy they found each topic, and how much they like each topic. The responses were made on one of the following five-point scales:
The lower scores are indicative of negative attitude and higher scores are indicative of positive attitude. Students were instructed to omit responses if they did not know what a topic meant. The majority of students in grade 7 were either 12 or 13 years old at the time the assessment was conducted: 50 percent and 45 percent respectively. Less than 1 percent of the students reported ages under 12 years and less than 5 percent reported ages over 13 years. The numbers of male students and female students were almost equal. The reliability and validity of the British Columbia mathematics assessment are very high, with the reliability ranging from 85 percent to 87 percent (Robitaille, 1991).
Design of the Study

The current study employs the techniques of survey research, but because the data used were from the 1990 British Columbia Assessment database, it is an ex post facto descriptive study. The independent variables are gender and status. Here “status” refers to being a teacher or a student. The dependent variables are ratings of importance and difficulty, on the questionnaire about selected topics in mathematics. This will be explained in more detail in the discussion on instrumentation.

Subjects and Selection

The target population is grade 7 mathematics teachers and the grade 7 students who were enrolled in public and independent schools in British Columbia in 1990. Considering the extremely unequal population size between students and teachers in the database, a random sampling technique is used for this research. The sample for this study is randomly taken from the whole population and is designed to ensure equal representation of the four groups (female teachers, female students, male teachers, and male students). Sample sizes ranged from 167-174. This procedure ensures the randomness of the sample and sufficient numbers in each group so that appropriate comparisons can be made.
Instrumentation

The main purpose of this study is to investigate gender differences in teachers’ and students’ beliefs about mathematics. The questionnaire contained 12 items regarding school mathematics topics. The six items dealing with importance and difficulty of three mathematics topics were included in this analysis. The topics of geometry, problem solving, and numbers and operations were chosen as they constitute major strands studied in schools and are of particular interest to the researcher. The following topics were omitted: memorizing, using calculators, and data and graphs. Compared to the main strands studied in schools, they are considered secondary.

Data Analyses

The study examined gender differences within and across two status groups (teachers and students). The statistical procedure for analyzing the variables involved in this study is univariate factorial analysis of variance (ANOVA) using the SPSS univariate MANOVA program.

To explore the effects of gender, planned comparisons (t-test) were used to compare male/female teachers as well as male/female students. These provided the answers to questions 1a (Do male and female mathematics teachers differ in beliefs about the importance of the selected
mathematics topics?) and 2a (Do male and female students differ in beliefs about the importance of the selected mathematics topics?). To investigate the research questions 1b (Do male and female mathematics teachers differ in beliefs about the difficulty of teaching the selected mathematics topics?) and 2b (Do male and female students differ in beliefs about the difficulty of the selected mathematics topics?), again t-tests are employed. The gender by status interaction effect from a 2-way ANOVA answered research question 3 (Are gender differences in teachers different from gender differences in students with respect to beliefs about the importance of selected mathematics topics?), while the gender main effect gave the answer to the research question 4 [Do males and females (regardless of their status) differ in their beliefs about the importance of the selected mathematics topics?].

**Appropriateness and Significance of Statistical Analysis**

According to Cohen (1965):

Statistical analysis is a tool, not a ritualistic religion. It is for use not reverence, and it should be approached in the spirit that it was made for psychologists rather than vice versa. (p. 95).

Therefore, the statistical tools are powerful when the use of statistical techniques to analyze and interpret research questions is appropriate.
Although the instrument used was an ordinal scale, it is important to note that all data analyzed in this study were treated as interval data in accordance to current thinking of this issue. According to Glass and Hopkins (1984):

In the past, some text books have exaggerated the importance of the level of measurement, claiming that the mean, variance and many other statistical measures and methods require an interval scale. Since many educational and psychological variables do not achieve this level of measurement, considerable emphasis was devoted to non-parametric statistics... It is now been shown that the disenchantment with the classical methods was premature. Heermann and Braskamp (1970, pp.30-110) give the principal papers and studies on this issue.

ANOVA

The univariate analysis of variance (ANOVA) is selected to answer the research questions in this study. Tabachnick and Fidell (1989) contend that univariate/multivariate techniques are mainly developed for use in non-experimental research, the most common form being the survey. Bray and Maxwell (1985) and Tabachnick and Fidell (1989) point out that the response variables are usually interrelated in highly complex ways, and univariate statistics are not misled by this complexity. Therefore univariate statistics have been chosen since they detect the relationships this research focuses on and would not be affected by other interrelations among variables.
In addition, the utilization of univariate statistical procedures reduces what Schutza and Gessaroli (1993) called “probability pyramiding”. Type 1 error (rejecting the null hypothesis when it is true) is controlled by such a method.
CHAPTER 4

RESULTS AND DISCUSSION

This chapter reports the results of the statistical analyses conducted; however, a check of violations of statistical assumptions is briefly addressed at the outset. Summary of results of data analyses are presented by means of tables and figures. Interpretations of the tables and figures are also provided.

Statistical Assumptions

In order to answer the research questions, SPSS FREQUENCIES was run with SORT & SPLIT FILE to divide cases into groups. Data and distributions for each group were inspected for missing values and variance.

Fig. 4.1 Mean ratings of importance
As a preliminary check for violations, sample variances for each of the dependent variables in the four independent variable groups were examined. For all dependent variables the difference between male and female is not large (See Fig. 4.1 and Fig. 4.2).

For the within-group variances, tests for heterogeneity with the Brown-Forsythe test were taken in each of the mathematics topics: geometry, problem solving, and numbers and operations.

For geometry, the F-ratios were non-significant. However, significant F-ratios were found in problem solving and in numbers and operations which indicate the actual significance level may be higher than the nominal significance level 0.05. Simply lowering the significance level from 0.05 to 0.025 can correct the inflation. (Keppel, 1991). Therefore, an alpha = 0.025 was used in the 2-way ANOVA in problem solving and in numbers and operations.
ANOVA Randomized Groups Design

One primary goal of this analysis is to compare, by gender, teachers and students beliefs about importance of geometry, problem solving, and numbers and operations. The descriptive statistics for the importance of the three mathematical topics are presented in Table 4.1.

Table 4.1

Mean Ratings of Perceived Importance for the Three Mathematics Areas

<table>
<thead>
<tr>
<th>Topic</th>
<th>Teacher</th>
<th>Student</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
</tr>
<tr>
<td>Geom</td>
<td>174*</td>
<td>174</td>
<td>348</td>
</tr>
<tr>
<td></td>
<td>3.98</td>
<td>3.98</td>
<td>3.98</td>
</tr>
<tr>
<td></td>
<td>0.77</td>
<td>0.73</td>
<td>0.77</td>
</tr>
<tr>
<td>Prob</td>
<td>167</td>
<td>167</td>
<td>334</td>
</tr>
<tr>
<td></td>
<td>4.51</td>
<td>4.58</td>
<td>4.54</td>
</tr>
<tr>
<td></td>
<td>0.66</td>
<td>0.62</td>
<td>0.83</td>
</tr>
<tr>
<td>Numb</td>
<td>173</td>
<td>173</td>
<td>346</td>
</tr>
<tr>
<td></td>
<td>4.36</td>
<td>4.25</td>
<td>4.30</td>
</tr>
<tr>
<td></td>
<td>0.39</td>
<td>0.48</td>
<td>0.57</td>
</tr>
</tbody>
</table>

* For each topic the first row of numbers is the number of students in the specified group; the second row of numbers is the mean for the specified group, and the third row of numbers is the standard deviation of the specified group.

Research Question 1a

Do male and female mathematics teachers differ in beliefs about the importance for selected mathematics topics?
The results of the ANOVA test produced by SPSS Univariate MANOVA are presented in Table 4.2.

Table 4.2
ANOVA Table for Beliefs about Importance by Gender (Teacher)

<table>
<thead>
<tr>
<th>Topics</th>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gem</td>
<td>Between</td>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>346</td>
<td>0.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob</td>
<td>Between</td>
<td>1</td>
<td>0.43</td>
<td>1.05</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>332</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numb</td>
<td>Between</td>
<td>1</td>
<td>1.13</td>
<td>5.86</td>
<td>0.016*</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>344</td>
<td>0.19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*alpha is set at 0.05 level for all F’s

Analyses of teachers’ beliefs about importance by gender of Geometry and Problem Solving show no statistically significant differences (see Table 4.2). When the female teachers are compared to the male teachers in their beliefs about importance of Numbers and Operations, however, male teachers rated the topic significantly more important, P=0.016 (see Table 4.2). The mean ratings of importance for this topic for male teachers was 4.36 and for the female teachers 4.25 (see Table 4.1).

Table 4.3 provides the descriptive statistics regarding the perceived difficulty of the three mathematics topics.
Table 4.3

Mean Difficulty Ratings for the Three Mathematics Topics

<table>
<thead>
<tr>
<th>Topics</th>
<th>Teacher</th>
<th></th>
<th></th>
<th>Student</th>
<th></th>
<th></th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
<td>Male</td>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geom</td>
<td>174*</td>
<td>174</td>
<td>348</td>
<td>174</td>
<td>174</td>
<td>348</td>
<td>348</td>
<td>348</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.32</td>
<td>3.39</td>
<td>3.35</td>
<td>3.59</td>
<td>3.33</td>
<td>3.46</td>
<td>3.46</td>
<td>3.34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.98</td>
<td>1.06</td>
<td></td>
<td>0.99</td>
<td></td>
<td>0.96</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob</td>
<td>167</td>
<td>167</td>
<td>334</td>
<td>167</td>
<td>167</td>
<td>334</td>
<td>334</td>
<td>334</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.63</td>
<td>2.54</td>
<td>2.58</td>
<td>3.19</td>
<td>3.05</td>
<td>3.12</td>
<td>2.91</td>
<td>2.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.05</td>
<td>1.07</td>
<td></td>
<td>1.03</td>
<td></td>
<td>0.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numb</td>
<td>173</td>
<td>173</td>
<td>346</td>
<td>173</td>
<td>173</td>
<td>346</td>
<td>346</td>
<td>346</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.31</td>
<td>3.18</td>
<td>3.24</td>
<td>3.84</td>
<td>3.69</td>
<td>3.76</td>
<td>3.58</td>
<td>3.44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.69</td>
<td>0.67</td>
<td></td>
<td>0.59</td>
<td></td>
<td>0.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* For each topic the first row of numbers is the number of students in the specified group; the second row of numbers is the mean for the specified group, and the third row of numbers is the standard deviation of the specified group.

Research Question 1b

Do male and female teachers differ in beliefs about the difficulty of teaching selected mathematics topics?

Table 4.4 shows that there were no significant differences between female and male teachers in beliefs about the difficulty of all three mathematics topics.
Table 4.4

ANOVA Table for Beliefs about Difficulty by Gender (Teacher)

<table>
<thead>
<tr>
<th>Topics</th>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geom</td>
<td>Between</td>
<td>1</td>
<td>0.49</td>
<td>0.47</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>346</td>
<td>1.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob</td>
<td>Between</td>
<td>1</td>
<td>0.67</td>
<td>0.60</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>332</td>
<td>1.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numb</td>
<td>Between</td>
<td>1</td>
<td>1.50</td>
<td>3.24</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>344</td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*alpha is set at 0.05 level for all F's.

Research Question 2a

Do male and female students differ in beliefs about the importance of selected mathematics topics?

The results of the ANOVA test produced by SPSS Univariate MONOVA are presented in Table 4.5. There were no significant differences between female and male students in beliefs about the importance of each of the three topics.
Table 4.5

ANOVA Table for Beliefs About Importance by Gender (Student)

<table>
<thead>
<tr>
<th>Topics</th>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geom</td>
<td>Between</td>
<td>1</td>
<td>0.65</td>
<td>1.04</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>346</td>
<td>0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob</td>
<td>Between</td>
<td>1</td>
<td>0.87</td>
<td>1.10</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>332</td>
<td>0.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numb</td>
<td>Between</td>
<td>1</td>
<td>0.61</td>
<td>1.89</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>344</td>
<td>0.32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*alpha is set at 0.05 level for all F’s

Research Question 2b

Do male and female students differ in beliefs about the difficulty of selected mathematics topics?

The t-test results regarding the gender differences in students beliefs about the difficulty of selected topics are provided in the Table 4.6.
Table 4.6

ANOVA Table for Beliefs about Difficulty by Gender (Student)

<table>
<thead>
<tr>
<th>Topics</th>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geom</td>
<td>Between</td>
<td>1</td>
<td>6.08</td>
<td>6.41</td>
<td>0.01*</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>346</td>
<td>0.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prob</td>
<td>Between</td>
<td>1</td>
<td>1.73</td>
<td>1.68</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>332</td>
<td>1.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numb</td>
<td>Between</td>
<td>1</td>
<td>1.92</td>
<td>5.21</td>
<td>0.02*</td>
</tr>
<tr>
<td></td>
<td>Within</td>
<td>344</td>
<td>0.37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*alpha is set at 0.05 level for all F’s.

The analysis of students’ perceived difficulty in Problem Solving by gender shows no significant differences. Nevertheless, when female students are compared to male students, female students rated Geometry and Numbers and Operations significantly more difficult than male students. [P=0.01 for Geometry and P=0.02 for Numbers and Operations (see Table 4.6)]. The mean ratings for the female students were 3.33 (Geometry) and 3.69 (Numbers and Operations) and male students 3.59 (Geometry) and 3.84 (Numbers and Operations) (see Table 4.3).
Research Question 3

Are gender differences in teachers reflected in their beliefs about the importance of selected mathematics topics different from gender differences in students regarding the importance of these topics?

Table 4.7

ANOVA Results for Perceived Importance of Geometry

<table>
<thead>
<tr>
<th>Effects</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (G)</td>
<td>1</td>
<td>0.54</td>
<td>0.461</td>
</tr>
<tr>
<td>Status (S)</td>
<td>1</td>
<td>18.29</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>GxS</td>
<td>1</td>
<td>0.54</td>
<td>0.461</td>
</tr>
</tbody>
</table>

* alpha was set at 0.05 level for all F’s.

Table 4.8

ANOVA Results for Perceived Importance of Problem Solving

<table>
<thead>
<tr>
<th>Effect</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender(G)</td>
<td>1</td>
<td>0.06</td>
<td>0.80</td>
</tr>
<tr>
<td>Status(S)</td>
<td>1</td>
<td>73.00</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>GxS</td>
<td>1</td>
<td>2.10</td>
<td>0.15</td>
</tr>
</tbody>
</table>

*alpha was set at 0.025 level for all F’s.
Table 4.9

ANOVA Results for Perceived Importance of Number and Operation

<table>
<thead>
<tr>
<th>Effects</th>
<th>df</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender(G)</td>
<td>1</td>
<td>6.59</td>
<td>0.01*</td>
</tr>
<tr>
<td>Status(S)</td>
<td>1</td>
<td>32.24</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>GxS</td>
<td>1</td>
<td>0.15</td>
<td>0.69</td>
</tr>
</tbody>
</table>

* alpha was set at 0.025 level for all F's

To answer the research question 3, the ANOVA Tables (Table 4.7, Table 4.8, Table 4.9) show that there were no significant Gender by Status interaction effects in each of the three mathematics topics [F(1,692)=0.54, P=0.46 for Geometry; F(1,664)=2.1, P=0.15 for Problem Solving; and F(1,688)=0.15, P=0.69 for Numbers and Operations respectively]. These indicate that the differences in importance ratings of each of the three mathematics topics between females and males for teachers were similar to that for students, in other words, the differences between females and males were constant for each status (See Fig.4.1). The ANOVA Tables (Table 4.7, Table 4.8, Table 4.9) of all three mathematics topics shows that there were significant univariate F ratios for the status main effect [F(1, 692)=18.29, P<0.001 for Geometry; F(1,664)=73.00, P<0.001 for Problem
Solving; and F(1,688)=32.24, P<0.001 for Numbers and Operations respectively] suggesting that teachers and students differ significantly in their importance ratings of all three mathematics topics. Data in Table 4.1 show that teachers' mean ratings were higher than students' mean ratings of every mathematics topic.

Research Question 4
Do males and females (regardless of their status) differ in beliefs about the importance of selected mathematics topics?

The univariate analyses show that there were no significant differences between females and males (including teachers and students) in beliefs about the importance of Geometry and Problem Solving (see Table 4.7 and Table 4.8). Nevertheless, Table 4.9 indicates that male ratings are significantly different from female ratings in beliefs about the importance of Numbers and Operations. Females rated the importance of Numbers and Operations significantly lower than males. In other words, females perceived the Numbers and Operations significantly less important than males. The mean score for females is 4.15 and males 4.25 (see Table 4.1).
CHAPTER 5

DISCUSSION

The goal of the present study was to investigate, by analyzing 1990 British Columbia Mathematics Assessment data, at the grade 7 level, possible gender differences in teachers’ beliefs and students’ beliefs about the importance and difficulty of a range of mathematics topics. This chapter presents conclusions which were drawn from the findings and a discussion of them in light of available literature on the subject. Suggestions for further research are also provided.

Conclusions

Several conclusions are highlighted by the results of the present study. The main purpose of this study was to compare differences by gender of teachers’ beliefs about certain mathematics topics. The conclusion was that male and female teachers are more similar than different with respect to their beliefs regarding the importance and difficulty of certain mathematics topics. Numbers and Operations was the only topic under study in which male and female teachers differed significantly. Male teachers rated Numbers and Operations more important than female teachers.
Further, comparisons of male and female students' beliefs about the importance and difficulty of three mathematics topics were made. Gender differences existed only in students' beliefs about the difficulty of Geometry, and Numbers and Operations. Female students, compared to male students, believe Geometry and Numbers and Operations are more difficult. This is consistent with the research done by Eccles-Parsons, Alder, Futterman, Goff, Kaczala, Meece, and Midgleg (1983). Their research also indicated that females tend to rate mathematics as more difficult than males.

Another question asked in this study was whether gender differences in beliefs about the importance of certain mathematics topics depended on the status of respondents. The findings of this study show that the gender differences within each status group are similar.

Similar to the finding of teachers' beliefs, significant gender difference was found only in overall males' and females' (regardless of their status) beliefs about the importance of Numbers and Operations. Males rated Numbers and Operations as significantly more important than females. Considering there were no gender differences in students' beliefs about the importance of Numbers and Operations, this suggests that the gender
differences in teachers’ beliefs about the importance of Numbers and Operations causes this overall gender difference.

Even though it is not the focus of this study, it is worthwhile to notice that the results of ANOVA analysis of all three mathematics topics illustrated that there were significant F ratios for the status main effect, suggesting that teachers and students differ significantly in their importance ratings for all three mathematics topics. Teachers, regardless of their gender, rated all three mathematics topics as significantly more important than their students. This is not surprising, since teachers are adults who are trained to teach mathematics, and therefore, would more likely have a more global perspective from which to rate the topics as more important.

Previous research has shown that gender differences were found in students’ beliefs at high school and college level (Kwiatkowski, 1993; Mcleod, 1994). Moreover, gender differences in students’ beliefs toward mathematics favoring males appear to increase with increasing age (Hyde, 1990). However, this study is unable to point to clear reasons why differences were not found in this sample. Further research into this phenomenon is needed.

No gender difference was found in grade 7 students’ beliefs about the importance of all three mathematics topics, nor in their beliefs regarding the
difficulty of Problem Solving. Nevertheless, female students rated Geometry and Numbers and Operations significantly more difficult than male students. This conclusion concurs with research by Kwiatkowsk (1993) and Mcleod (1994), and points to a trend where, although gender differences of students’ beliefs in mathematics learning are small (if it exists) at early grades, some gender differences start to occur in these later elementary years.

**Suggestions for Further Research**

The results of this study have provided some information regarding gender differences in teachers’ and students’ beliefs about mathematics topics. In addition, the study has provided information about the relationship between gender differences in beliefs about importance of mathematics topics and the status of respondents. This work, however, also suggests a variety of additional questions which require further research.

At first glance, the conclusions of this study seem to negate the hypothesis that one would find gender differences in teachers’ beliefs about mathematics. However, in hindsight, the limited gender differences found seem due, in part at least, to the instrument. Since the questions being asked regarding the teachers’ beliefs about selected mathematics topics in
this Assessment document were general, it seems reasonable that teacher responses were similarly general. Therefore, this researcher speculates that if more specific questions were used, differences in teachers' beliefs might be found to exist. Hence, a more "sensitive instrument" which examines the decision making process that each group used to come to their conclusions may allow for more fruitful results. On the other hand, since the parameters of the data are limited, a study dealing with a broader range of mathematics is recommended. This may result in significantly different conclusions. As discussed in Chapter 1, concerning the Modified CGI research model, this researcher still hypothesizes that the gender of teachers may be an important variable with respect to their beliefs. More research is needed in this area.

The focus of this research was specifically on gender differences of teachers' beliefs toward mathematics. Constrained by the database, the study was unable to connect gender differences in teachers' beliefs with gender differences in students' beliefs. Research which relates gender differences in teachers' beliefs and students' beliefs may broaden the framework of knowledge regarding affective factors and the learning of mathematics. Likewise, research which encompasses teachers' and students' beliefs other than those involved in this study would allow for
information regarding the relationship of teachers’ beliefs and students’ beliefs.

Another issue that may prove to be important is to investigate the relationship of teachers’ beliefs, students’ beliefs and students’ achievement: that is, linking teachers’ beliefs to students’ beliefs, further to students’ achievement. Moreover, future research is needed to ascertain whether the findings of the present study can be replicated in other samples.
REFERENCES


at the Sixth International Congress on Mathematical Education, Budapest, Hungary.


Kaschak, E. (1981). Another look at sex bias in students’ evaluations of professors: Do winners get the recognition that they have been given? *Psychology of Women Quarterly, 5*, 767-772.


Appendix A

Part of the Teacher Questionnaire of the 1990 British Columbia Mathematics Assessment Used in This Study
For each of the next items in this scale, two answers are needed.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all important</td>
<td>very difficult</td>
</tr>
<tr>
<td>not important</td>
<td>difficult</td>
</tr>
<tr>
<td>undecided</td>
<td>undecided</td>
</tr>
<tr>
<td>important</td>
<td>easy</td>
</tr>
<tr>
<td>very important</td>
<td>very easy</td>
</tr>
</tbody>
</table>

1. Adding, subtracting, and multiplying fractions.

2. Adding, subtracting, multiplying and dividing decimals.

3. Working with percent.

4. Working with perimeter, area, and volume.

5. Learning geometry.

Appendix B

Part of the Student Questionnaire of the 1990 British Columbia Mathematics Assessment Used in This Study
For each of the next items, two answers are needed.

A) Tell how important you think the topic.
B) Tell how easy you think the topic is.

If you are not sure what a topic means, leave its two answers blank.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>not at all important</td>
<td>very difficult</td>
</tr>
<tr>
<td>not important</td>
<td>difficult</td>
</tr>
<tr>
<td>undecided</td>
<td>undecided</td>
</tr>
<tr>
<td>important</td>
<td>easy</td>
</tr>
<tr>
<td>very important</td>
<td>very easy</td>
</tr>
</tbody>
</table>

1. Adding, subtracting, and multiplying fractions.

2. Adding, subtracting, and multiplying decimals.

3. Working with percents.

4. Working with perimeter, area, and volume.

5. Learning geometry.