The Waiting Time: Student Perceptions of Gender Bias in Middle School Mathematics

by

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BA, University of Victoria, 2006
BEd, University of Victoria, 2008

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Supervisory Committee

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Studies have shown that girls' attitudes toward math are not as positive as that of boys (Fennema, & Sherman, 1977; Eccles, & Blumenfeld, 1985; Guimond, & Roussel, 2001). Crucially, research has also shown that this gender imbalance is a learned trait, female students in high school are more likely to have negative perceptions of Mathematics, than female students in elementary school (Spears Brown, & Bigler, 2004; Maritnot, 2012). This mixed methods research study examined the perceptions of gender bias in Grade 8 mathematics at West Rock Middle School, surveying 45 participants, (20 male, 25 female). A *modified Fennema-Sherman Mathematics Attitude Scale*, in combination with a Forgasz and Leder *Who and Mathematics Scale*, was used to uncover a slight variability in achievement and attitudinal scores between genders in a middle school mathematics class. A follow-up semi-structured interview with six students (two male, four female) determined that that variance seemed not to be due to a student perception of gender bias, but, rather, a multitude of attitudinal concerns.

Keywords: Gender bias, mathematics, attitudinal difference, middle school, student perception, mixed methods.

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Chapter 1: Introduction

In September 2011, I was teaching a grade 8 Math class, one of the first of many such classes, and starting out in a new teaching position, when a curious thing happened. I made a sexist remark. I didn't mean to, it just slipped out, and at the time I thought little of it. To engage the boys in the class, I read out a word problem that involved playing hockey, and I said, "Here's a question for the boys in the class".

Realizing my mistake, I blurted out something about girls also playing hockey and moved on, thinking I had covered myself. However, after class a girl named Jazminne, or Jazzy for short, stuck around to introduce herself. She told me that she had problems in math and wanted to know what she could do to stay on top of everything, and then she dropped a bomb. Without a pause she said, "Oh, by the way, I didn't like how you said that the hockey question was just for the guys".

I was amazed at the composure of this Grade 8 girl telling her new teacher that he is sexist. I felt about ten inches tall at that moment, but I told her that I was sorry, and that I wouldn't do that again, and I haven't since. However, that brief moment stuck with me. What do students actually take away from their Math classes? What are we teaching, and, more importantly, what are our students learning?

The issue of gender bias was again brought to my attention through an assigned article critique. Karen Zittleman and David Sadker's "Gender bias in teacher education texts: New (and Old) lessons", reported a staggering gender bias toward males in teacher education textbooks; "Although most texts include some coverage of gender issues and the role and contribution of women, that coverage is minimal and not always positive" (Zittleman and Sadker, 2002, p. 178). Zittleman and Sadker's article, was eye opening, but it did not address what goes on in an actual classroom, and did not examine any Canadian textbooks.

I thought that Canada, known for its progressivism, would have a much more balanced gender approach. This is not, however, what I actually found. Although much has been done in Canada since the issue was first addressed in the 1970s, government lead policy has stalled (Coulter, 1996). In fact, I performed a journal sweep of the *Canadian Journal of Education* for the past ten years and found very little on feminist issues, and even less on gender bias. Even more interesting than the absence of research in Canada, is that what little that is done is largely structural, proceeding, in most cases, at a governmental, and not a classroom, level (Coulter, 1996). The vast majority of articles on gender and perception of bias are written using quantitative methods, largely eliminating the very personal impact of that bias. The research is still being carried out in the same way it has for the past thirty years, and demonstrating the same results. I wanted to find a new approach; I wanted to know what, if any, were the students' perceptions of gender bias in Mathematics.

Purpose

The purpose of this research is to examine the attitudinal differences between genders in mathematics at the middle school level, using a mixed methods approach to triangulate the empirical and experiential data within an explanatory transformative framework. In essence, this research wishes to find the answer to two questions:

1. What, if any, are the attitudinal differences between genders at the Grade 8 level in mathematics at West Rock Middle School?

2. If there is a difference, is it due to a student perception of gender bias in mathematics?

Having identified the key questions of this research, the next step is to find the pertinent literature and methodology. The concept of attitude in math can be defined in a multitude of ways, in fact, a study by Fennema and Sherman in 1976, examined nine different sub-scales of attitude in mathematics: 1)Attitude toward success in mathematics, 2) Mathematics as a male domain, 3)The Mother scale, 4) The Father scale, and 5) The Teacher scale which measured the effect of the interest of the mother, father, and teacher on the student's own interest; 6) The Confidence in learning mathematics Scale, 7)

The Anxiety in math Scale, 8) The Perceived Usefulness of Mathematics Scale, and, finally, 9) The Student Motivation within Mathematics Scale. However, for the purpose of this study, I will examine four key concepts: Confidence, Anxiety, Attitude toward success, and Mathematics as a gendered domain; as this research focuses on the student, the mother, father, and teacher scales did not fall within the focus of this study.

The Confidence Scale, as defined by Elizabeth Fennema and Julia Sherman, “is intended to measure confidence in one's ability to learn and to perform well on mathematical tasks. The dimension ranges from distinct lack of confidence to definite confidence. The scale is not intended to measure anxiety or mental confusion, interest, enjoyment, or zest in problem solving” (1976, p.326). Fennema and Sherman’s definition of confidence is nearly identical to contemporary definitions of the much more popular self-efficacy, “the self-perception that one can perform in ways that allow some control over life events. More specifically, self-efficacy determines one's perception that he or she can produce desired results” (Arminio, 2010, p. 688). While several studies have used self-efficacy scales (Hackett, 1985; Pajares & Millar, 1995; Fast, et al., 2010), I chose the Fennema and Sherman scale because it specifically focuses on measuring student anxiety *and* confidence specifically in mathematics and has been previously validated (Split –half reliability α = .93, Fennema and Sherman, 1976).

Fennema and Sherman’s Anxiety scale (Split –half reliability α = .89, Fennema and Sherman, 1976), “is intended to measure feelings of anxiety, dread, nervousness, and associated bodily symptoms related to doing mathematics. The dimension ranges from feeling at ease to feeling distinct anxiety. The scale is not intended to measure confidence in, or enjoyment of, mathematics” (1976, p. 325). The anxiety scale is, essentially, the converse of the confidence scale. It would be assumed that if a student has low confidence, then he or she would have high anxiety. Ironically, due to the way the Fennema-Sherman Anxiety Scale is calculated, a numerically high score actually means the student has low anxiety, and a numerically low score means he or she is relatively anxious about mathematics. However, low confidence alone might not cause anxiety, and it is conceivable that a student may be both confident and anxious at the same time. Although anxiety can be the result of many factors, I selected the Fennema-Sherman anxiety scale because apprehension is a critical factor in my research.

The Attitude toward success in mathematics scale (Split –half reliability α = .87, Fennema and Sherman, 1976), like the confidence and anxiety scales, will be employed to gauge students' perception of their ability to succeed in mathematics. In Fennema and Sherman's initial study, the attitude scale was designed, **"**to measure the degree to which students anticipate positive or negative consequences as a result of success in mathematics" (1976, p. 326). Although the three scales have obvious inter-relations, breaking the attitudinal scale into three parts, attitude, confidence, and anxiety, versus one self-efficacy scale, can potentially reveal more granular relationships between and among the factors on these independent scales and the gendered domain scale.

I have chosen to not include Fennema and Sherman's original Mathematics as a Male Domain Scale for several reasons. Primarily, and described in greater detail in Chapter 2, the questions, written in 1976, no longer describe the social, and societal, mores of today's middle school students. Forgasz and Leder developed the Who and Mathematics (WAM) scale to update the original concept of gender issues in mathematics (WAM; Forgasz & Leder, 1999). The researchers went a step further than Fennema and Sherman by incorporating the possibility of mathematics not just being a male domain, but also the possibility of math as a female or gender-neutral domain as well by using a five point likert scale to gauge students' gender perceptions related to specific topical questions (1 = Boys Definitely, 2 = Boys Probably, 3 = Neutral, 4 = Girls Probably, 5 = Girls Definitely). The WAM scale is fundamental to answering my second general question of a student perception of gender bias.

Through the Confidence, Anxiety and Attitude scales, combined with a standardized achievement test, I examined the attitudinal differences between genders. The WAM scale helped me to gain a better understanding of student perception of gender bias. By completing my research with a semi-structured interview based on student answers to the WAM scale, I tried to understand individual student perceptions in greater depth.

Chapter 2: Literature Review

Definitions and Research Questions

One of the most difficult aspects of trying to find articles to include in my literature review was the overwhelming variety of vocabulary variance. As an example, I wanted to find research on student perception, but most of what has been done, especially relating to gender, uses different terminology; attitudes, awareness, motivation, and perception were used interchangeably in the research. It was also difficult to find gender articles with a focus on students in the middle school years. Most articles dealt with teenagers, generally, and many with high school students, that is, students ranging in age from around sixteen to eighteen years old specifically. Unfortunately, the term "bias" was also used in a vague manner in much of the research. In addition to bias, there are stereotypes, difference, and sex-typing, all of which are related and all of which do not exactly interconnect. In fact, the only clear textual link in any of the articles was the concept of Math itself; every other additional term needs further explanation:

> *Perception*: **"**The capacity to be affected by a physical object, phenomenon, etc., without direct contact with it; an instance of such influence" (Oxford English Dictionary, 2012).

Perception is linked to the hidden, or lived, curriculum. It is not explicitly taught in schools, although it may be implicitly done. This is different from awareness, because to be aware does not necessarily mean to be impacted, or influenced, by a phenomenon. For the purposes of this research, the term "perception" will be used because of its implied capacity to affect outcomes.

> *Gender*: To define gender one must first define sex as a biological distinction between males and females. Gender, then, is defined as, "the state of being male or female as expressed by social or cultural distinctions and differences, rather than

biological ones; the collective attributes or traits associated with a particular sex, or determined as a result of one's sex" (Oxford English Dictionary, 2012).

It is easy to get confused with the literature around gender as the primary usage of gender really means sex, as in, the biological distinction. The question is, is there a difference, when it comes to mathematical understanding, between sexes? This research uses the term gender, because the social, political, and cultural distinctions cannot be separated from the biological ones, just as the social, political, and cultural connotations of "school" cannot be separated from the physical presence of the building. I also am aware of trans-gendered persons; however, for the purposes of this study, I will only discuss the two traditional gender ideals of male and female.

Middle School: A term as simple as middle school still has some level of variance. Many school districts do not have a distinct middle school level. With others, the starting and ending grades are different. For the purposes of this study, I will set the age range for middle school from eleven to fifteen years old, or, in terms of grade level, from grades six through eight (Oxford English Dictionary, 2012).

Bias: "A swaying influence, impulse, or weight; 'any thing which turns a man to a particular course, or gives the direction to his measures' (Johnson)" (Oxford English Dictionary, 2012).

Bias, like gender, is a tricky term to define. It can be used to define a statistical anomaly as well as a societal influence. Just as "perception" is different from "awareness", so too must "bias be separated from "difference". With these few simple definitions in place, it was my hope to construct a literature review on the place of contemporary Canadian issues in gender in education. Specifically, I wanted to know what, if any, research had been done on the perceptions of gender bias in middle school mathematics. In other words, how do students perceive the current biases that exist? Do the students internalize these biases in a conscious way? I had read several articles on the role of student perception in mathematics, and how those perceptions vary by gender. However, these articles never described student perceptions of the gender bias itself.

Criteria for Literature Inclusion

A cursory investigation using the UVic library search revealed a surprising number of journal articles on the subjects of my research: student perception, gender, and math. In fact, title searching “gender” and “math” returned some 77, 676 hits. On the other hand, title searching “math”, “gender”, and “middle school” returned only eight hits, three of which linked to the same article and none of which were what I was looking for. Somewhere in the middle ground, between 77,000 and eight, were the articles that I needed. As I have mentioned before, the inconsistent definitions within the field also created some challenges. For example, “teenage” replaced “middle school”, and “bias” gave way to “difference”, or “stereotype”, until I managed to find approximately 150 articles on the topics of “gender”, “middle school”, “math”, and “student perception”. Unfortunately, while many of the articles dealt with gender issues in teenagers, they often lacked either a math or a perception focus. By scanning the titles of those 150 articles, I was able to select about forty for further investigation. Finally, by reading the abstracts, and in some cases the introduction and conclusions, I was able to find roughly twenty articles on student perceptions of math, and gender issues in math.

Through my investigation, I became interested by the study of gender difference, or, the study of the academic discrepancy between sexes. Is there even a difference? If there is a difference, is it the result of gender, or something else, like socio-economic status (SES). I had heard for years that there is, in fact, a difference, favouring boys, in both math achievement and attitude between genders and I wanted to understand the origins of this research. I looked at several articles from my initial search and found that many shared similar references.

Lastly, I looked at the Third International Mathematics and Science Study Repeat (TIMSS-R), and the Organization for Economic Co-operation and Development`s (OECD) book entitled, “Equally Prepared for Life? How 15 year-old Boys and Girls Perform in School” published in 2009. Both studies break the data into several different categories, one of which is gender.

Through various means and methods, I feel that I have gathered enough data to begin to ask questions about student perceptions of gender bias in middle school mathematics. However, in order to answer these questions, it was necessary to uncover the historical genesis of gender difference research. Why have women been seen as less intellectually capable than men, especially in subjects such as math? Where is the research to back this up and why is this perceived intellectual inferiority still prevalent in today’s socio-cultural view of the female sex?

Historical Connections

“History is the witness that testifies to the passing of time; it illumines reality, vitalizes memory, provides guidance in daily life and brings us tidings of antiquity” – Cicero

Much of the research is bound to social and political mores from the past. In fact, the argument could be made that the subjugation of women has been the norm in western civilization since the Ancient Greeks denied women the right to vote. However, even at the dawn of the 20th Century, over two thousand years after the fall of the Greek empire, the role of women had seen little change (Thompson, 2010). Women still did not have the right to vote, and were deemed to be less intelligent than men. This erroneous fact was bolstered by pseudo-scientific studies like the Variability Hypothesis, which stated, “While women were all very much the same, men showed a much greater range of both physical and mental abilities” (Milar, 2012, para. 1). The greater variability of intelligence in men showed, according to Johann Meckel, that they were, in fact, more intelligent. The Variability Hypothesis is one of many theories that existed in the early 1900s that was used to promote the superiority of men.

It was not until the 1960s and liberation of the feminist movement that western academia started to challenge the idea of the inherent, genetic, mental inferiority of women. Writing in 1966, Eleanor E. MacCoby suggests that female performance in school may have a societal, rather than genetic, component:

> The evidence is not clear whether boys or girls have a higher correlation between ability (as measured by I.Q. tests) and achievement…. [Girls] wish to conform to their parents' and teachers' expectations of good academic performance, but fear that high academic achievement will make them unpopular with boys" (1966, p. 31).

MacCoby is one of the first of a group of scholars to draw a connection between academic performance and something other than genetic differences. Prior to the 1960s, the only explanation for poor female performance when compared to males, was that girls, while getting an early intellectual head-start on the boys, would fall behind as boys matured, caught up, and then superseded their female counterparts. MacCoby also wrote that girls, especially in a subject like Math, did not do well because there was no need for the subject in their societally pre-determined role as housewife:

> Perhaps the explanation for the differences we have noted is very simple: members of each sex are encouraged in, and become interested in and proficient at, the kinds of tasks that are most relevant to the roles they fill currently or are expected to fill in the future. According to this view, boys forge ahead in math because they and their parents and teachers know they may become engineers or scientists; on the other hand, girls know that they are unlikely to need math in the occupations they will take up when they leave school (MacCoby, 1966, p. 40).

Eleven years later, in 1977, Fennema and Sherman still laboured to disprove the contemporary belief that women were not as intellectually capable as men, “It has been an accepted belief that males achieve better in mathematics than females. Sometimes this difference is attributed to underlying ability and other times it is attributed to a social climate that does not encourage girls to study mathematics” (1977, p. 51). Fennema and Sherman tried to explore the true sex difference under conditions where other variables, such as attitude, SES, and gender stereotypes were controlled. The authors used their own metric, the Fennema-Sherman Attitude Scales, which, subsequently, was used in several articles I found, to rate gender differences. Their results were definitive, “The data do not support either the expectations that males are invariably superior in mathematics achievement and spatial visualization or the idea that differences between the sexes increase with age and/or mathematics difficulty” (Fennema & Sherman, 1977, p. 69). The authors also concluded, like MacCoby, that it is attitudinal, not intellectual, difference that affects female performance (Fennema & Sherman, 1977, p. 69). Furthermore, the attitudinal difference is likely to be derived from social pressure against women, “Since the study of mathematics appears not to be sex-neutral, attitudes toward mathematics may reflect cultural proscriptions and prescriptions. Thus the attitudes measured probably reflect more of this socio-cultural influence on the student than any incorrigible personal characteristics” (Fennema & Sherman, 1977, p. 69).

Fennema and Sherman’s original attitudinal study is referred to frequently in the field of Educational Psychology. According to Google Scholar, this study has been cited on more than 750 occasions by various researchers. The Fennema-Sherman Mathematics Attitude Scale (MAS) is still used by researchers today; however, the scale does have some limitations in that it was designed over thirty years ago and, as a result; it may not reliably measure contemporary student attitudinal difference, especially gender difference. A construction validity test was conducted on the Fennema-Sherman scale in 1981, to independently test Fennema and Sherman’s results. Broadbooks, et al. found that the

Fennema-Sherman MAS demonstrated validity similar to the original study, “The major conclusion of the present study is that for a sample of 1541 junior high school students there is evidence to support the theoretical structure of the Fennema-Sherman Mathematics Attitudes Scales” (Broadbooks, et al., 1981, p.7). While some limitations may exist in the use of the Fennema-Sherman MAS, including their use of possibly antiquated language, its validity and reliability measures outweigh, in my opinion, its limitations.

The MAS is broken into nine different categories. One category, the Mathematics as a Male Domain Scale (MD), is used to:

> measure the degree to which students see mathematics as a male, neutral, or female domain in the following ways: (a) the relative ability of the sexes to perform in mathematics; (b) the masculinity/femininity of those who achieve well in mathematics; and (c) the appropriateness of this line of study for the two sexes” (Fennema, & Sherman, 1976, p. 324).

As mentioned earlier, the original MD is not consistent with our current understanding of gender. Likert-scale questions such as, “When a woman has to solve a math problem, she should ask a man for help”, and, “I would expect a woman mathematician to be a forceful type of person”, not only do not meet with current social mores, but also would be, quite simply, unethical to ask of contemporary student populations. Most damningly, the central philosophical construction of the mathematics as a Male domain precludes the possibility of mathematics as a Female domain:

> Consider the following negatively worded item "It's hard to believe a female could be a genius in mathematics." Agreement would result in a low score for the item (negatively worded items are reverse-scored) and would indicate that the respondent does believe that mathematics is a male domain. But what inference can be drawn from disagreement with the item (resulting in a high item-score)? On the

> basis of our data, we suggest that disagreement does not automatically indicate that a respondent believes mathematics to be a gender-neutral domain, the assumption underpinning the original MD scale (Forgasz, Leder, & Gardner, 1999, p. 346).

Forgasz, Leder, and Gardner suggested that a new gender bias scale, one that can determine a Male/Female/Neutral bias, must be developed. Consequently, a year later, Forgasz and Leder did develop the Who and Mathematics (WAM) scale, "The aim of [which] is to measure the extent to which mathematics is stereotyped as a gendered domain; that is, the extent to which it is believed that mathematics may be more suited to males, to females, or be regarded as a gender-neutral domain" (Forgasz, 2000, para. 5). While much of the original Fennema-Sherman Attitude Scale is still valid, the MD is woefully out of date, and should no longer be used to measure gender bias. Forgasz and Leder's current metric is a less biased tool that re-examines the gender issue in mathematics, "the new instruments more easily allow measurement of the possibility that mathematics is viewed as a female domain and measurement of specific aspects of gender-related issues in the mathematics classroom and society" (Forgasz, Leder, & Kloosterman, 2004, p. 416).

As previously mentioned, the original Fennema-Sherman MAS for Confidence, Attitude, and Anxiety, although old, are still relevant and widely cited. Indeed, in the time that it has taken to complete this research, their original study has been cited in a further 84 articles, increasing from 750 to 834 citations according to Google Scholar. As mentioned earlier, an updated version of the Male Domain Scale had to be used due to the changing mores of contemporary society. There was no substantial evidence of contemporarily inappropriate language in the Attitude, Anxiety, and Confidence scales and they are well validated and thoroughly reliable measures (Broadbooks, et al., 1981).

Philosophical Conventions

If gender difference in achievement is not intellectual, but rather, attitudinal, then how did girls come to inhabit this achievement morass? It was thought that their teachers somehow explicitly taught gender difference (MacCoby, 1966; Eccles & Blumenfeld, 1985). However, beginning in the 1980s, a growing body of research suggested that teachers did not, at least explicitly, teach gender bias. Eccles and Blumenfeld (1985) examined why girls displayed an attitudinal difference in mathematics when compared to boys, “Although teachers do not appear to be the major source of these beliefs, they also do very little to change them or provide boys and girls with the types of information that might lead them to re-evaluate their sex-stereotyped beliefs” (1985, p. 80). The authors found that teachers generally direct more of their attention, or teacher-talk, to boys (1985, p. 87). While teacher-talk is an obvious example of bias, it does not seem to be, as the researchers established, an especially meaningful one. Eccles and Blumenfeld found that the achievement gap is far more complicated than a lack of simple teacher attention time:

> Our data suggest that differential treatment may be one factor, although not a very powerful or ubiquitous factor. Girls have lower expectancies for themselves in those classrooms in which they are treated in a qualitatively different manner than the boys. And while this differential treatment was not characteristic of most of our classrooms, these results suggest that the brightest girls are not being nurtured to the same extent as are boys in some classrooms. The causal implications of this difference need to be established (Eccles, & Blumenfeld, 1985, p. 111).

Unfortunately, researchers are now no closer to understanding the causes behind these attitudinal differences. In 2006, Meece, Glienke, and Burg suggested, “To date, research on gender differences in causal attributions and learned helplessness is inconclusive and equivocal. Patterns of gender differences depend on methodology used, academic domain, academic abilities, type of achievement task, and research setting” (2006, p. 355). The researchers believe that the myriad of causal influences (parental, schooling, sociocultural, socioeconomic, and so on) make accurate research extremely difficult. Meece et al. feel that while the gender gap has declined in recent years, the knowledge that it still exists in any form proves, “There is still much that can be done to change the feminine image of reading and writing and the masculine image of science and school athletics” (Meece, et al., 2006, p. 367).

Bourdieu’s Cultural Capital theory could be used to, at least partially, explain the attitudinal difficulties women face in the education system. He believed that cultural capital, unlike an economic capital that is simply a value on goods and services, has three parts, which influence the individual within a given political state:

> Cultural capital can exist in three forms: in the *embodied* state, i.e., in the form of long-lasting dispositions of the mind and body; in the *objectified* state, in the form of cultural goods (pictures, books, dictionaries, instruments, machines, etc.), which are the trace or realization of theories or critiques of these theories, problematics, etc.; and in the *institutionalized* state, a form of objectification which must be set apart because, as will be seen in the case of educational qualifications, it confers entirely original properties on the cultural capital which it is presumed to guarantee (Bourdieu, 1986, para. 5).

Bourdieu wrote that individuals gained cultural capital by being exposed to cultural edifices like the library, museum, plays, and so on. Individuals then used this knowledge to their advantage in school and, by extension, society in general, “Cultural capital refers to symbolic goods existing in the mode of linguistic and cultural competence, and largely institutionalized in the form of educational credentials, that agents use to maintain their prestige” (Kebede, 2012, para. 4). If individuals have the cultural capital to achieve a high degree of success at school, then, generally, they will achieve a higher degree of wealth, and be able to afford to pursue further opportunities to increase his or her cultural capital; thus continuing a cycle of privilege. Strangely, people with lower SES seem to accept this cycle, something that Bourdieu calls habitus, "A set of norms and expectations unconsciously acquired by individuals through experience and socialization as embodied dispositions, internalized as second nature, predisposing us to act improvisationally in certain ways within the constraints of particular social fields" (OED, 2012).

Generally, Bourdieu's theory is used to explain why people of lower SES backgrounds achieve relatively low academic success compared to individuals who exist within higher SES. However, I believe that cultural capital can also work against the female gender.

If cultural capital is, "an accumulated labor," which can be appropriated in the form of "social energy that acts both as a force and as a principle permeating the social world" (Kebede, 2012, para. 2), then it could act as a force of culture to continue to deny individuals of a lower cultural class, i.e. women. Individuals choosing not to pursue an academic role demonstrate this lack of cultural capital, thereby re-enforcing the idea that academia is not for women. It is a cyclical denigration for the purpose of maintaining cultural standards:

> In its institutionalized mode, cultural capital exists in the form of mostly educational credentials. In addition to augmenting the added value of cultural capital and guaranteeing its worth, the institutionalization of cultural capital minimizes the problem of cultural capital being constantly questioned. By establishing a qualitative difference between those who are licensed and those who are not, even if they possess the talent, cultural capital is made to acquire an autonomous position, thereby guaranteeing the monetary value of credentials (Kebede, 2012, para. 10).

Acker and Dillabough argue that Bourdieu's theoretical framework can be extended to working women in their article, "Women 'learning to labour' in the 'male emporium': exploring gendered work in teacher education" (2007). The authors write that the Bourdieuian theoretical notion of symbolic domination can be logically extended to the feminist struggle against paternal social mores:

> We focus, in particular, upon Bourdieu's concept of symbolic domination… Symbolic domination, as we use it here, refers to active yet often invisible social processes which lead to the reproduction and recontextualization of historically coded elements of gender (e.g., woman as 'housewife', 'servant to the state') across space and time, in the university as elsewhere (Acker and Dillabough, 2007, p. 298).

I would contend that the concept of symbolic domination can not only be applied to working women, but also to school aged women as well. In fact, it could be said that girls in school are subject to a kind of intensification due to the particular constraints of school that may not be found elsewhere.

While university entrance rates for women have equalled and even surpassed that of men, women are not choosing mathematics as an occupational field, "Women have increased their share of university graduates such that in 2007, they accounted for more than 50% of graduates in all fields…. Only one category saw a decrease in the female share of graduates between 1992 and 2007– mathematics, computer sciences and information sciences" (Statistics Canada, 2013, para. 18). Another interesting observation is that while the female proportion of architecture, engineering, and related technologies has risen, proportions of females in fields that rely heavily on Mathematics, it is still shockingly low, even less than the number of female students in Mathematics.

Table 1: Female Share of University Graduates: 1992 to 2007

Female Share of University Graduates: 1992 to 2007	**1992**	**2007**
	percent	
Architecture, engineering and related technologies	**17.5**	**23.8**
Mathematics, computer and information sciences	**35.2**	**29.9**
Personal, protective and transportation services	**18.2**	**47.5**
Business, management and public administration	**51.4**	**52.9**
Agriculture, natural resources and conservation	**36.7**	**57.9**
Physical and life sciences, and technologies	**45.6**	**59.2**
Parks, recreation and fitness studies	**51.5**	**63.1**
Humanities	**63.7**	**64.7**
Visual and performing arts, and communications	**65.9**	**67.3**
Social and behavioural sciences, and law	**59.3**	**67.6**
Education	**72.6**	**76.4**
Health professions and related clinical sciences	**73.3**	**82.3**
Source: Statistics Canada, 2013		

Perhaps more frustrating is the knowledge that gender, as an area of research, has also stalled; (Coulter, 1996). Coulter believes that gender-equity policy is being removed from explicit guidelines of conduct in favor of an implicit, teacher driven approach, “The emphasis on “self-reliance” and rampant individualism threatens any systemic or structural interpretation of gender-equity policies” (Coulter, 1996, p. 447). Indeed, BC’s Diversity Framework gives only a cursory definition of gender diversity in reference to the School Act, and does not include any resources, suggestions, or adaptations to help teachers to address issues of gender bias (BC Ministry of Education, 2008). Coulter writes that the similarity of educational policy among Canada’s various Ministries of Education is due, in large part, to a narrow interpretation of the issue:

> Across Canada, the dominant approach to gender-equity policies in education, and even then implemented unevenly and inconsistently, remains the relatively shallow

> one of sex-role stereotyping first articulated in the 1970s…. Why sex-role socialization theory remains dominant in education can in part be explained by the fact that it is a form of critique easily accommodated within existing state arrangements and liberal notions of equality of opportunity (Coulter, 1996, p. 435).

Coulter seems to echo Bourdieu's idea of Cultural Capital, the idea that the feminist movement has remained stagnant is due to the nature of Western cultural mores. She believes that new research into the systems of education, rather than its curriculum, need to be examined.

The acceptance and reproduction of social constructs can even be seen in ministerial literature. In British Columbia, curriculum has stalled at the level of gender difference recognition wherein an acceptance of that gender difference could hide elements of what Acker and Dillabough term symbolic domination:

> Diversity is an overarching concept that relies on a philosophy of equitable participation and an appreciation of the contributions of all… Diversity refers to the ways in which we differ from each other. Some of these differences may be visible (e.g., race, ethnicity, gender, age, ability), while others are less visible (BC Ministry of Education, 2008, p. 7).

Present Conditions

In 1999, several thousand Canadian Grade 8 students took part in the Third International Mathematics and Science Study Repeat (TIMSS–R), which tested students' knowledge of general mathematic and scientific principles. Five provinces drew large enough school and student samples to generate representative, generalizable provincial statistics: British Columbia, Alberta, Ontario, Quebec and Newfoundland; "in mathematics, there was no significant difference in the achievement scores of Canadian boys and girls. (This was the same result as in 1995.) The same trend was evident for all of the provinces that over-sampled (including Ontario) and almost all of the participating countries" (Education Quality and Accountability Office, 2000, p. 12).

The Organization for Economic Co-operation and Development (OECD), together with thirty-four separate countries, launched the Programme for International Student Assessment (PISA) in 2000 to evaluate educational systems worldwide. In 2009, the OECD-PISA published their findings specifically related to gender in a book entitled, *Equally prepared for life? How 15 year-old boys and girls perform in school*. Their findings were disappointing at best:

> The broader gender patterns in later career and occupational choices are already apparent in the mathematics performance of 15-year-old males and females as observed by PISA. Gender patterns in mathematics performance are fairly consistent across OECD countries (*Learning for Tomorrow's World – First Results from PISA 2003*). In most countries, male students outperformed female students in the combined mathematics scale and every subscale. In terms of attitudes, the study found even greater gender differences. Female students consistently reported lower levels of enjoyment, interest and motivation than their male peers, as well as higher levels of anxiety, helplessness and stress in class (OECD, 2009, p. 18).

The seemingly conflicting results from the TIMSS-R and the OECD's PISA assessment only serve to underscore the complex nature of gender issues in education. Although Canada was observed in the PISA assessment to have a statistically significant gender difference, with boys achieving a higher score than girls in mathematics (OECD, 2009, p. 136), the TIMSS-R results indicate no relevant gender difference.

MacCoby first suggested that girls and boys were intellectually equivalent in 1966, and Fennema and Sherman provided evidence to support an equivalent attitudinal capacity empirically in 1977 using their MAS scale. Does a gender gap even exist around the world? Is there bias? A systemic manipulation of the oppressed? What can the research tell us? What do the students say?

Dentith (2008) addresses the need for a systemic educational review by demonstrating, similar to the OECD review, the disparity between sexes. The author takes an interesting approach however, interviewing girls from high SES backgrounds to negate the influence of affluence, “Focus group interviews with 45 of the highest achieving students in this affluent suburb revealed salient inequities and lingering impediments in the struggle for women’s equality” (Dentith, 2008, p. 145). I would maintain that a different kind of cultural capital is at work here. Girls are culturally indoctrinated to maintain positive peer relationships. Truly, even in the group follow up the female test subjects often agreed with each other, “Sarah explained… Katie concurred… Magenta told us… Other participants echoed this sentiment” (Dentith, 2008, p. 155), thus reinforcing societal mores.

Although British Columbia’s Ministry of Education does not hold specific attitudinal data for their students, it does assess student mathematics achievement yearly through the much-maligned Foundations Skills Assessment (FSA). Held on an electronic database, these scores show, down to individual schools, if students, separated into many categories including gender, are meeting the required grade-level criteria. The results yield a surprising difference in achievement between genders. Even more surprising is that the difference favors girls, not boys, opposing the worldwide trend examined by the OECD.

Table 2: Foundations Skills Assessment Numeracy Results for all Grade 4 Students in British Columbia

	Performance Level Unknown		Not Yet Meeting		Meeting		Exceeding	
	#	%	#	%	#	%	#	%
All Students	6443	15	7282	17	24796	57	4657	11
Male	3642	16	3688	17	12362	55	2590	12
Female	2801	13	3594	17	12434	60	2067	10

At the provincial level, in Grade 4, sixty percent of females are meeting expectations compared to fifty-five percent of boys on the numeracy portion of the FSA (BC Ministry of Education, 2012). An even smaller advantage toward males exists at the "Exceeding" level. However, slightly more males (three percent) than females have an unknown performance level. The unknown quantity could legitimately close the gap between genders, but this cannot be definitively determined.

Table 3: Foundations Skills Assessment Numeracy Results for all Grade 7 Students in British Columbia

	Performance Level Unknown		Not Yet Meeting		Meeting		Exceeding	
	#	%	#	%	#	%	#	%
All Students	7910	17	10319	23	23357	51	4026	9
Male	4297	18	5163	22	11632	50	2245	10
Female	3613	16	5156	23	11725	53	1781	8

By Grade 7, only fifty-three percent of females are meeting expectations and fifty percent of males are still achieving at the meeting expectations level in math (BC Ministry of Education, 2012). The achievement scores have declined slightly, the achievement gap between genders has also slightly diminished. Although this decrease between genders is slight at only two percent, it does seem to follow the traditional stereotype of mathematics as a male domain, and the literature that students become more aware of this stereotype as they age. With such slightly altered percentages, the "Unknown" level of achievement may account for the difference, increasing by two percent for males, and three percent for females, but this cannot be determined.

Table 4: Foundations Skills Assessment Numeracy Results for Grade 4 Students in a Small District in Southwest British Columbia

	Performance Level Unknown		Not Yet Meeting		Meeting		Exceeding	
	#	%	#	%	#	%	#	%
All Students	43	10	55	12	306	69	39	9
Male	25	11	28	12	157	67	26	11
Female	18	9	27	13	149	72	12	6

However, at the Grade 4 level in a small school district in Southwest BC, the district in which I conducted my research, the percentage of females meeting expectations exceeds the percentage of males meeting expectations by 5%. At the "Exceeding" expectations level, the trend is reversed, with the percentage of males exceeding expectations 5% higher than the percentage of females exceeding expectations. The number of students at the "Unknown" performance level is also less than at the provincial level, which may give a more accurate result (BC Ministry of Education, 2012).

Table 5: Foundations Skills Assessment Numeracy Results for Grade 7 Students in a Small District in Southwest British Columbia

	Performance Level Unknown		Not Yet Meeting		Meeting		Exceeding	
	#	%	#	%	#	%	#	%
All Students	50	9	131	24	316	59	42	8
Male	27	10	66	25	143	55	25	10
Female	23	8	65	23	173	62	17	6

At the Grade 7 level, the difference between genders is similar to the Grade 4 level, with two exceptions: the percentage of females at the "Meeting" level in math is now seven percent higher than that of the males. The percentage of students at the "Not Yet Meeting" level has dramatically increased to 25 percent for males and 23 percent for females.

Oceanview and Fredrick Douglass Middle Schools, the two other middle schools in the district, seemed to display a similar female advantage in mathematics achievement to that at the district level. Oceanview Middle School's female population outperformed the male population at the "Meeting" level by seven percent (Females = 67%, Males = 60%), but were outperformed by the boys at the "Exceeding" level (Females = 4%, Males = 9%).

Table 6: Foundations Skills Assessment Numeracy Results for Grade 7 Students at Oceanview Middle School

	Performance Level Unknown		Not Yet Meeting		Meeting		Exceeding	
	#	%	#	%	#	%	#	%
All Students	7	4	48	26	119	64	12	6
Male	2	2	26	29	55	60	8	9
Female	5	5	22	23	64	67	4	4

At Fredrick Douglass Middle School, a slightly wider achievement gap in math exists at the "Meeting" level, eight percent; however, both the "Not Yet Meeting" and the "Exceeding" levels are closer between the genders.

Table 7: Foundations Skills Assessment Numeracy Results for Grade 7 Students at Fredrick Douglass Middle School

	Performance Level Unknown		Not Yet Meeting		Meeting		Exceeding	
	#	%	#	%	#	%	#	%
All Students	11	6	31	17	124	69	15	8
Male	5	6	15	19	50	64	8	10
Female	6	6	16	16	74	72	7	7

Finally, at West Rock Middle School, where students completed my survey, 62 percent of females meet expectations compared to only 44 percent of males on the 2012 BC FSA (See Appendix 8). There are also significantly fewer females than males at the "Not Yet Meeting" level, (23 percent for females and 49 percent for males). Finally, the percentage of female students at the "exceeding level" is higher than males, (12 percent to 3 percent, respectively). In their totality, the numbers show a male population at West Rock Middle School that is achieving at a significantly lower rate than the female population.

While the 2011 – 2012 school year seems to show an exceptionally large achievement gap in math between the genders for West Rock (See Appendix 8), more female students have performed at the "Meeting and Exceeding" level than their male counterparts for the past three years. In the 2009 – 2010 and 2010 – 2011 school years, there were also a larger percentage of male students at the "Unknown" level (See Appendix 8). Although it cannot be proven that these "Unknown" students would increase the achievement gap between genders, it seems significant that the decrease in “Unknown” level students in 2011 – 2012 compared to the previous year also corresponds to a much greater percentage of students at the “Not Yet Meeting” level.

At the school level, there is a much greater probability of observing what I will call cohort bias; there may happen to be an exceptionally gifted cohort of females, or an exceptionally low cohort of males at West Rock Middle School. As a result, the numbers become biased toward one group and away from another. Additionally, the actual numbers of students (as opposed to percentage) vary from year to year. The trend could be very different in any given cohort. For instance, the numbers in the Exceeding expectations category are quite low; some volatility could be expected from year to year for this category.

Although cohort biases may occur at West Rock Middle School, the existence of such radically different achievement scores between genders could be due to a possible gender bias. This makes West Rock Middle School an interesting school to research. Will a male superiority in mathematics stereotype still exist?

Much of the research in gender and math seems to revolve around the question of self-awareness, or, perception, in Mathematics. (Guimond & Roussel, 2001; Leedy, LaLonde & Runk, 2003; Kloosternman, et al., 2008). However, a study from the United States by Brown and Bigler (2004) showed that student awareness of gender bias was less clear in younger children than in adults. The authors went on to suggest that girls more often viewed girls as victims of bias, while boys were less likely to be viewed, by girls, to be victims of bias, “Results indicated that older children were more likely than younger children to make attributions to discrimination when contextual information suggested that it was likely. Girls (but not boys) were more likely to view girls than boys as victims of discrimination” (Brown, & Bigler, 2004, p. 714).

Paradoxically, another study, set in France, had very different results. Martinot and Désert

(2007) explored whether children in two age groups, fourth and seventh graders, were aware of male superiority stereotype in math. Children's mathematical ability, and the link between the stereotype and the student's own self-perceptions were also examined. The authors were more than slightly perplexed by their results:

> As expected, there was not a clear-cut awareness of a math-ability gender stereotype favorable to boys. More surprising, girls in both age groups and seventh grade boys believed that girls do better than boys. Moreover, when their gender identity was made salient, the boys who believed in girl superiority perceived their own performance in mathematics as lower. The girls, on the other hand, regardless of their age and stereotype awareness or personal beliefs, perceived their performance in math as higher when their gender identity was made salient than when it was not (Martinot and Désert, 2007, p. 455).

Despite Martinot and Désert's findings on students' lack of awareness of a male favored math ability stereotype, such a stereotype still exists within the adult population. This gender imbalance seems to be re-enforced by empirical testing of achievement as well:

> For example, 63% [of teachers] believed that boys were naturally better at math than girls…. Parents similarly believed mathematics to be more difficult for their daughters than for their sons. With such parental and instructional support for stereotypes of gender differences in math abilities, it is no wonder that young women are typically less confident in their math abilities, take fewer math courses, and generally have more negative attitudes toward math. According to statistics provided by the National Education Association, parents' and teachers' stereotypes about female deficiencies in math are, on the surface, supported by sex differences in scores on

> the math subtest of the Scholastic Achievement Test, favoring boys by about 50 points (Brown and Josephs, 1999, p. 246).

However, Brown and Josephs (1999) contend that that empirical evidence is, once again, not as definitive as believed initially. Brown and Josephs investigated gender-specific test anxiety and found that adult males and females react differently to external handicaps: "women who believed a math test would indicate whether they were especially weak in math performed worse on the test than did women who believed it would indicate whether they were exceptionally strong. Men, however, demonstrated the opposite pattern, performing worse on the ostensible test of exceptional abilities" (Brown and Josephs, 1999, p. 246). The authors conclude that the stereotype of poor female performance may be the reason for poor female performance, while at the same time, counter-intuitively, also lead to poor male performance:

> Although it is possible, as some have argued, that biological factors may account for part of the variance underlying gender differences in performance in certain domains, it is clear that within-group differences are much larger than between-group differences in most domains…. Whether or not biological differences underlie gender differences in mathematics, the mere suggestion of between-group differences may lead to a self-fulfilling prophecy in which the threat of failure promotes poor performance among the stigmatized (Brown and Josephs, 1999, p. 257).

One of the greatest difficulties in gender bias research is the staggering amount of seemingly contradictory research. A true study comparison is nearly impossible because each is measuring a different aspect of the same problem, using different methods, within vastly different countries and cultures. Brown and Bigler (2004) report that girls feel that they are more often victims of bias, while Martinot and Désert (2007) report that girls are less affected than boys. In fact, Martinot and Désert conclude that boys' affirmation of female superiority in mathematics may result in boys falling behind their counterparts. "Such a finding is consistent with the problem of boys' underachievement, which has been raising more and more questions in industrialized countries" (Martinot and Désert, 2007, p. 467). However, Brown and Josephs (1999) conclude that achievement testing can negatively impact women in a different way than men.

Finally, another study by Martinot, Bagès, and Désert (2012) offered a positive glimpse into the future:

> Three hundred ninety-eight French fifth graders from a medium-sized provincial town answered a questionnaire designed to examine, both with direct and indirect measures, if they hold different gender stereotypes concerning mathematics and reading depending on target's age (children vs. adults). As expected, results showed that participants, regardless of their gender, were aware of a math-ability stereotype favorable to men when the stereo-typed targets were adults. When the stereotyped targets were children and young adolescents, the math-ability stereotype was less clear. Participants believed that people think that girls succeed as well as boys in math (Martinot, Bagès, and Désert 2012, p. 210).

If nothing else, Martinot, Bagès, and Désert give us hope for younger students. Perhaps only older people, adults, hold the male superiority in mathematics stereotype. If we can stop the transmission between young and old, then, perhaps, we can stop the propagation of this two thousand year-old myth; "knowing the content of these stereotypes and whether, and when, children are aware of them, are indispensible steps for minimizing their potential harmful effects and reducing the gap between boys and girls in school" (Martinot, Bagès, and Désert 2012, p. 217).

The current research is, unfortunately, stuck describing the problems of gender bias, rather than researching how those problems affect individual students. Other research shows the perceptions of different genders, but crucially misses the effect on individuals by that perceived gender bias. Studies are empirical, statistical, and entirely scientific. There were no phenomenological studies on the subject of gender bias. No one had asked the students, apart from within quantitative questionnaires, how they felt about the opposite gender; whether students thought math catered to one gender or the other. Researchers seem to be aware of the problem, but cannot fix it.

Need for Further Research

The Canadian Journal of Education publishes the most research on gender issues in Canada. However, there needs to be an increased awareness of the ramifications of gender bias to the education of Canadian children. The nomenclature of gendered discussions is also woefully out of date, and, in general, utterly fragmented. Some articles write of gender equity when they really mean bias, and others of stereotype, when they mean attitude. Most studies use surveys whose methodology was created over thirty years ago, and wonder why they get the same results year after year.

There is a need for a more personal approach. We know that there is a worldwide achievement gap, favoring boys, in math and it is probable that it is, at least partially, due to gender bias. We also know that younger students are less aware, and thereby less affected, by this bias than older students. We must find out where, and how, the students are learning gender bias. Understanding of the students must come from the students themselves.

Chapter 3: Methodology

Mixed Methods Research

Since there is very little research on student perceptions of gender bias in middle school mathematics, and what little that has been documented comes from the largely quantitative fields of psychology and educational psychology, I felt that my research was best examined through a mixed methods lens to gain a potentially fresh perspective. Creswell and Clark provide a definition of mixed methods research that will direct this research:

> Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis and the mixture of qualitative and quantitative approaches in many phases of the research process. As a method, it focuses on collecting, analyzing, and mixing both the quantitative and qualitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches, in combination, provides a better understanding of research problems than either approach alone (Creswell & Clark, 2011, p. 5).

While I have already given a definition of perception in the second chapter, it is its root word, “perceive”, which elucidates the need for a mixed methods approach, “To apprehend with the mind; to become aware or conscious of; to realize; to discern, observe” (OED, 2012). The action of perceive, perception, is a personal, and highly subjective, experience. If quantitative data alone is used, it will miss the very personal ramifications to individual students. If I am to research student perception of gender bias, then I will need to gather those student perceptions in a qualitative way.

Although the action of perception is highly individualistic and, as a result, subjective, qualitative data alone cannot tell the whole story; quantitative data must also be used to gauge the general student understanding of bias, and attitudinal difference. Neither qualitative, nor quantitative research alone is able to give the most accurate understanding; however, using a mixed methods approach can provide a more thorough analysis.

Theoretical Perspective

I once attended a dinner party wherein the host, Dave, got into a heady philosophical debate with a friend of mine; Dave argued that he did not consider himself a feminist, while my friend argued that he was in everything but name. Eventually, over the course of the evening, Dave begrudgingly had to admit that, although he had never thought of himself in that way, he was, in fact, a feminist.

I think that Dave was rebelling against the misplaced stereotype of the feminist as someone who hates men. While feminism, be it radical or conservative, is many things to many people; it is certainly not anti-male. The definition of feminism could be a thesis all its own, but, simplistically, it can be defined as follows:

> Western feminism, in addressing the unequal status of women, has necessarily aligned itself with the emancipatory discourse of Western liberalism, which has proved to be a powerful tool for feminists seeking to establish gender parity. It has also required, however, acquiescence with the principle of the sameness of individuals, and this has often been at the expense of the specificity of a more plural understanding of women and the differences between them…. Consequently, Western feminism invokes a complex history of both complicity and resistance, and if it has any definitional utility it is with regard to embodying and clarifying this tension (Gwendolyn, 2007, p. 539).

With the existence of that dynamic tension, not between men and women, but between acceptance and its inevitable backlash, I must admit that I approach this research within a feminist emancipatory framework. The questions that are examined here necessitate such a stance. If an attitudinal difference between genders exists, then, by the definition above, the acknowledgement of that disparity, and the pursuit of its solution, must be viewed through a feminist lens:

> An emancipatory theory in mixed methods involves taking a theoretical stance in favor of underrepresented or marginalized groups, such as a feminist theory… and calling for change. With one goal of qualitative research to address issues of social justice and the human condition, this emphasis has come to be expected from some scholars in mixed methods research" (Creswell & Clark, 2011, p. 49).

Research Design – Overall Construction

I produced an explanatory sequential design to generate a fresh viewpoint into the research, that of mixed methods. The explanatory sequential design follows a framework determined in Creswell and Clark's *Designing and Conducting Mixed Methods Research*:

> The explanatory sequential design occurs in two distinct interactive phases. This design starts with the collection and analysis of quantitative data, which has the priority for addressing the study's questions. This first phase is followed by the subsequent collection and analysis of quantitative data. The second, qualitative phase of the study is designed so that it follows from the results of the first, quantitative phase (Creswell & Clark, 2011, p. 71).

Ultimately, the nature of my research questions has led me to the explanatory sequential model. While my research is still weighted toward quantitative data, I feel a qualitative follow-up of the quantitative data can only benefit our understanding of the impacts of gender bias.

After sending a formal request for research to the School District (See Appendix 1), and receiving permission to conduct my research at West Rock Middle School (See Appendix 2), I sent an email to the three Grade 8 math teachers (See Appendix 3) asking permission to have their students participate in my study. Two of the teachers, who teach three classes in total, confirmed that they were willing to give up the class time necessary for the study. The other teacher could not spare the time, and as a result, was not part of the study. Students in the participating classes were given a participant consent form (see Appendix 4) and made aware of the possible risks and inconveniences a week before the quantitative survey was scheduled to allow for student questions and to make sure participants were fully informed and completely voluntary subjects. A letter was also sent home to the students' guardians to inform them of the study (See Appendix 5). Participants were asked to complete a self-reflective survey on their level of engagement with mathematics (see Appendix 6) with the possibility of a one on one follow-up interview (See Appendix 7). Several of the key concepts within British Columbia's Integrated Resource Package are related to self reflection; for example, communications, and problem-solving. It can therefore be logically assumed that the participants who complete this study will be expected "to regard the probability and magnitude of possible harms implied by participation in the research to be no greater than those encountered by the participant in those aspects of his or her everyday life" (TCPS, 2010). Students should be engaged in self-reflection within a classroom setting on a regular basis, this research is merely a more critical extension of that self-reflection. As a result, I feel that participants will be within the Tri-Council Policy Statement definition of minimal ethical risk and be completely safe to participate in this study.

Quantitative phase

The purpose of the quantitative phase of my research is, "to explain quantitative significant (or nonsignificant) results, positive-performing exemplars, outlier results, or surprising results" (Creswell, 2011). While the literature shows that student perception of gender bias is a factor in some cases, I want to know if it is a factor for my participants. I selected three Grade 8 math classes based on teacher permissions from West Rock Middle School. Participant Consent forms were sent to 84 students, which yielded a sample of 69 students, or, approximately 23 out of 28 students on average per class. Students not completing the quantitative survey were asked to work on IXL.com, a web-based mathematics practice program. 45 students actually completed the survey; however, more female students completed the survey than males (20 males and, 25 females). Each group of students had one 67 minute class block to complete the survey using an online tool, Lime Survey. An adapted version of the standardized achievement indicator test from the BC Ministry of Education's Foundation Skills Assessment (FSA) Numeracy test was the first section in the survey. The number of questions was reduced from 45 multiple choice questions to 30 multiple choice questions designed for Grade 7 mathematics achievement (See Appendix 6). Although this test is specifically designed for a group that is one year behind my test subjects, it is a well documented, valid, and reliable measure of student achievement in mathematics, which I feel is still relevant for Grade 8 students early in their academic year (BC Ministry of Education, 2008). If I were to use a Grade 8 metric, I would have validity and reliability issues between classes as individual teachers would be working on different chapters, and, as a result, I would be unable to consistently apply a standardized test for all three classes. It was important to start the overall survey with the achievement test because students may answer math-related survey questions more readily after completing a mathematics exercise.

Once students had completed the adapted FSA numeracy test, they were asked to complete the Fennema-Sherman Mathematics aptitude scales identified earlier: the Confidence in Learning

Mathematics Scale, the Attitude toward Success in Mathematics Scale, and the Mathematics Anxiety Scale. Finally, students completed the Forgasz and Leder WAM Scale (See Appendix 6). Participants were required to state their agreement with a series of items using a five point Likert scale from *1 = strongly disagree* to *5 = strongly agree*. The students were then asked to provide additional anecdotal comments at the end of the survey. I had debated whether to include a comments section, but I am glad that I did because while some comments were predictably silly, others were quite insightful.

Although the quantitative survey seems excessively large, the 96 item questionnaire is less than the original Fennema-Sherman test, which included 108 items. As mentioned previously, of the 69 students that started the survey, 45 completed. While burnout may have been a factor, the survey was achievable within the allotted time. In fact, only three students required additional time to complete the survey.

After the three student sets completed the survey, I used SPSS to find correlational values among the variables determined in the five attitudinal tests, mean scores, and MANOVA values. It is only after analysing the quantitative data that I was able to determine suitable qualitative questions for the individual student interviews. The results from the WAM scale were especially helpful; it was determined that several key questions from this scale showed what seemed to be an attitudinal differences between boys and girls. For example, students thought that boys were more likely to become distracted than girls, and girls were more likely to get on with their work than boys. I used this information to create questions for the qualitative interviews to, hopefully, provide some more information from the students on these, and other, specific attitudinal differences.

Qualitative phase

One of the disadvantages of the explanatory sequential design is the difficulty in planning the qualitative phase of the research:

> The researcher develops or refines the qualitative research questions, purposeful sampling procedures, and data collection protocols so they follow from the quantitative results…. It can be difficult to secure institutional review board (IRB) approval for this design, because the researcher cannot specify how participants will be selected for the second phase until initial findings are obtained (Creswell & Clark, 2011, p.83).

The qualitative section of my mixed-methods research was the piece that I was most excited to conduct with the students. Having found that an attitudinal difference existed, I wanted to know what the students thought of that difference. Were they surprised that a difference existed? What did they think, or know, or feel, about it, “many of these elements are directly observable and as such may be viewed as objectively measureable data. Nonetheless, certain elements of symbolism, meaning, or understanding usually require consideration of the individual’s own perceptions and subjective apprehensions. This is qualitative data” (Berg & Lune, 2012, p. 44).

I used a semi-structured interview framework, primarily based on the quantitative results of the WAM scale, to allow myself a little flexibility to follow students natural thought processes. The interview itself was composed of sixteen main questions that were asked of each student, and several follow-up type questions that may or may not have been asked depending on the students’ answer. I started with the student`s name, age, and a few general school-related questions to set them at ease, i.e. tell me about your typical school day. Berg and Lune write that it is imperative to start with a few introductory questions, “this allows informants to become comfortable with the interview process before deciding how much they are really willing to share” (2012, p. 47). Originally, I had scheduled a full 67 minute class block for each interview. While students did not respond monosyllabically, the interviewees also did not give overly long-winded answers. The longest interview was under fifteen minutes in total, which, given the age group, seemed to be at the upper limit of concentration for discussions of mathematics.

Six students were contacted for qualitative interviews, and all accepted, initialing their consent forms. Student selection for an interview was administered through a stratified random sample. Two students who scored highly, on the achievement test, over 80 percent; two students who represented an average score, between 60 and 80 percent; and two students who received a low achievement score, under 50 percent; were selected for interviews. Although a goal of gender neutrality was not met, (four girls and two boys were interviewed), the genders were still represented across the achievement spectrum; one boy scored highly on the achievement test, while the other represented a low degree of achievement. Two average achieving girls were interviewed as well as one highly achieving, and one poorly achieving.

The qualitative interviews actually took place roughly three months after the initial survey was completed. There are several reasons for this delay. Firstly, the earliest I was able to conduct the quantitative surveys was just before Christmas holidays, so there was a natural break for the analysis of the results. In addition, the SPSS calculations took longer than originally anticipated and were not completed until late January 2013. Unfortunately, the interviews were delayed a further three weeks because the school had started the Foundation Skills Assessments with its Grade 7 students, and all meeting areas and times were booked.

To analyze the qualitative data, I re-read the transcripts, looking for major themes across all the interviews. A summative content analysis was performed openly coding for both individual words and their synonyms, and for generalizable, latent meanings. The feminist emancipatory framework with which I write requires me to extrapolate interviewees' answers to a broader theoretical perspective. Any larger understanding from a researcher must come from a personal place, but can still be grounded in theory:

> Interpretive analysis of the data, once organized according to certain content elements, should involve consideration of the literal words in the text being analyzed, including the manner in which these words are offered…. In turn, this analysis should be related to the literature and broader concerns and to the original research questions. In this manner, the analysis provides the researcher a means by which to learn about how subjects or the authors of texual materials view their social worlds and how these views fit into the larger frame of how the social sciences view these issues and interpretations (Berg and Lune, 2012, p. 237).

I will acknowledge that my own theoretical perspective may, inherently, introduce bias to the interviewees responses. Knowing this, I recorded all interviews on an Apple iPhone using its voice memo software to prevent any egregious copying on the part of the researcher. I then used an independent transcription service to change that audio into a textual format, once again in an effort to prevent my own interpretation of the audio at that point.

After the intial open coding, "the central purpose of which is to open inquiry widely" (Berg and Lune, 2012, p. 229), another round of coding was completed to group these open codes into more manageable, thematic, chunks. A final round was then administered to connect the findings to the literature.

Chapter 4: Results

Quantitative Results

Three classes of Grade 8 mathematics students were asked to participate in a survey adapted from three separate instruments, the Foundation Skills Assessment (FSA), the Fennema-Sherman Mathematics Attitude Scale, and the Who and Mathematics Gender scale (See Appendix 6). 84 students were contacted, however, only 45 (N = 45; 20 male, 25 female) completed the survey. Although this represents a seemingly high attrition rate of 47 percent, it is still a large enough sample size to extrapolate these findings to the entire population of the three classes at West Rock Middle School.

The analysis was completed using SPSS for Windows version 19.0. The significance level for all analyses was 0.05 or below. One of the primary concerns for the quantitative analysis was the reliability and validity of the adapted survey instrument. Reliability was not run on the adapted FSA test. However, the original FSA is a highly regarded, well used instrument, with a reliability of 0.90 (BC Ministry of Education, 2008), so I felt that the adapted version would be suitable as well. While the Fennema-Sherman attitude test has been used in social psychology for the past thirty years, the WAM scale is less widely used; the blended adaption of these scales necessitated a further test for reliability. A Cronbach's alpha test was run on the combined 66 item scale resulting in a highly acceptable internal consistency of 0.924

Table 8: Cronbach`s Alpha of combined three instruments totalling 66 items

Cronbach's Alpha	N of items
0.924	66

Students' achievement tests were then graded and coded in SPSS as a percentage achieved. Scores ranged from 7 / 30, or, 23% to 29 / 30, or, 97%. A mean score of 57% was observed; however, the broad range of scores was not isolated to one gender. Comparative means show virtually identical standard deviations, although females scored slightly higher than their male counterparts.

Table 9: FSA Achievement Score Means and Standard Deviation Compared Between Male and Female Genders

Comparative Means	Gender	M^a	SD
Achievement Score	Female	59.76	22.4
	Male	54.15	22.4

Curiously, the achievement scale resulted in a much smaller achievement gap than the 2012 FSA, which was performed on the same test group a year earlier, (see Appendix 8). Several variables could explain this discrepancy. The BC 2012 FSA test had a “performance level unknown” rate of only four percent compared to roughly 47% in this survey (See Appendix 9). In addition, due to the voluntary nature of the survey, several students dropped out, eight males and nine females, citing a difficulty level on the mathematics achievement section with which they were uncomfortable. The total number of females participating in this survey was also higher than that of males, and not representative of the student population as a whole. This may have biased the achievement results. Finally, West Rock Middle School has 21 designated students in Grade 8 (two students with chronic health issues, three with autism, one gifted, one with intense behaviour issues, four with moderate behaviour issues, and ten with a learning disability). However, only two designated students, (both male, one with moderate behaviour issues, and one with a learning disability), completed the survey. Although the two male designated students may have increased the achievement gap, the two students scored 23% and 37%, I believe that the survey results were not greatly impacted by the students with designations.

Further comparative analysis of the confidence, attitude, and anxiety scales resulted in a similar, slight, advantage to female students.

Table 10: Comparative Means and Standard Deviations between genders for the Confidence, Attitude, and Anxiety Scales

Comparative Means	Gender	M[a]	SD
Confidence Score	Female	4.08	0.98
	Male	3.58	0.98
Attitude Score	Female	4.09	0.63
	Male	3.65	0.79
Anxiety Score	Female	3.81	0.83
	Male	3.63	0.79

Descriptive statistics were performed on the responses to the 66-items of the Confidence, Attitude, Anxiety, and WAM scores (See Appendix 10). While an average of 3.005 was achieved on the WAM scale, meaning participants find Mathematics to be a gender neutral subject, a closer look at those items 0.5 points above or below the average score generate an interesting result:

Table 11: Who and Mathematics Scale (WAM) Item responses averaging + / - 0.5 from total mean score of 3.00.

WAM + / - 0.5		
Who and Mathematics items	M[a]	SD
WAM. 4: **Boys more likely** Give up when they find a mathematics problem is too difficult.	2.4	0.94
WAM. 7: **Girls more likely** Care about doing well in mathematics.	3.67	0.85
WAM. 16: **Boys more likely** Distract other students from their mathematics work.	2	0.88
WAM. 18: **Girls more likely** Find mathematics easy.	3.64	0.83
WAM. 20: **Boys more likely** Need more help in mathematics.	2.4	0.81
WAM. 22: **Girls more likely** Worry if they do not do well in mathematics.	3.5	0.89
WAM. 23: **Boys more likely** Are not good at mathematics.	2.47	0.72
WAM. 26: **Boys more likely** Consider mathematics to be boring.	2.47	0.98
WAM. 27: **Boys more likely** Find mathematics difficult.	2.42	0.84
WAM. 28: **Girls more likely** Get on with their work in class.	3.6	0.78

The above averages yield a much clearer picture of an attitudinal gender difference in mathematics at West Rock Middle School. A lower item score on the WAM scale means that students perceive that boys are more likely to be linked to that item (e.g. WAM 26: Boys were more likely to consider math boring). A higher item score meant that students perceived girls more likely to be associated to that particular item (e.g. WAM 28: Girls were more likely to get on with their work in class). Boys were perceived to be more likely to give up when they found math difficult, distract others from their work, need more help, consider math boring, and feel that they are not good at math. Girls were perceived more likely to find math easy, get on with their work, care about doing well, and worry when they are not doing well. The values also seemed to be further validated by anecdotal evidence of my experience administering the survey. A male student in the second class set, who chose not to partake in the survey, had to be sent to the principal's office because he also chose not to participate in the alternative activity, IXL.com, instead choosing to play computer games and distract other students. A further three boys, in the same group, decided to drop out of the survey when they were reminded that participation was voluntary. Interestingly, there were more female students with incomplete surveys than males,(9 females, 8 males). While males were more noticeable in general, the data suggests a more neutral gender distribution of non-completion.

A test of correlational values seemed to determine that confidence, attitude and anxiety had a much greater impact on achievement than that of gender:

Table 12: Correlational Values for Achievement Scale, Confidence Scale, Attitude Scale, and Gender of Participant

	Achieve. Score	Con. Score	Attitude Score	Anxiety Score	Gender
Achieve. Score	1	0.42**	0.37**	0.40**	-0.13
Con. Score		1	0.74**	0.72**	-0.25
Attitude Score			1	0.66**	-0.30
Anxiety Score				1	-0.12
Gender					1

Achieve. Score = Achievement score; Con. Score = Confidence Score; ** significant for p < 0.01

Overall, the greatest correlation was between attitude and confidence; if a person has high confidence, he or she will generally have a good attitude. The correlation between Confidence and Anxiety was also high; if a person has high confidence, then she or he will generally have low anxiety. As was previously mentioned, due to the way the Fennema-Sherman Anxiety Scale is calculated, a numerically high score actually means the student has low anxiety, and a numerically low score means he or she is relatively anxious about mathematics. Although one would expect a negative correlation between anxiety and confidence, in the case of the Fennema-Sherman scale, a positive correlation is to be expected. The negative gender correlation, meaning that being male had a slight inverse relation to Achievement, Confidence, or Anxiety, is not large enough, nor significant enough, to determine conclusively that gender does not play a role in the difference in overall attitude scores between males and females. Further testing was required to determine the significance of variables and the interrelationships of each to the other.

A MANOVA test was conducted to determine if attitude had a significant effect on the following group of variables: achievement, anxiety, confidence. A set of univariate tests was also performed to calculate individual variable significance.

Table 13: Multivariate Test for Effects of Attitude on Achievement, Anxiety, and Confidence Scores

Effect	Value	F	Hypothesis df	Error df	Sig.	Observed Power
Pillai's Trace	1.790	1.774	60	72	0.010	0.998
Wilks' Lambda	0.048	1.952	60	66.470	0.004	0.999
Hotelling's Trace	6.229	2.146	60	62.00	0.002	1.000
Roy's Largest Root	4.120	4.944	20	24	0.000	1.000

In this case, Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root are all significant ($p < .05$), to a highly acceptable, ($\pi > 0.80$) Observed Power. It can be determined that

Attitude did have a significant effect on the three different scales, as a whole. The univariate tests indicated that anxiety and confidence had a high degree of significance toward attitude, while achievement did not. Apparently, you do not have to be good at math to feel good about math:

Table 14: Univariate Test of Between-Subjects Effects of Confidence, Anxiety, and Achievement for Attitude

Dependant Variable	Type III Sum of Square	Mean Square	F	Sig.	Observed Power
Confidence	35.185	1.759	4.592	0.000	0.999
Anxiety	20.561	1.028	3.011	0.006	0.976
Achievement	12087.100	604.355	1.475	0.181	0.703

Another MANOVA test was administered to explore the effect of gender on the same group of variables, with the addition of attitude. Similar to the correlational values results, gender did not have a significant effect on attitude, achievement, confidence, or anxiety as a group of dependant variables; however, the low observed power increases the chance of a type II error, which could increase the odds finding no relationship, difference, or gain, when in fact there is one of these effects. The results are, once again, frustratingly inconclusive. In the future, a larger sample size could increase the observed power such that there is less chance of type II errors and more definitive results.

Table 15: Multivariate Test for Effects of Gender on Achievement, Attitude, Anxiety, and Confidence Scores

Effect	Value	F	Hypothesis df	Error df	Sig.	Observed Power
Pillai's Trace	0.114	1.288	4	40	0.291	0.365
Wilks' Lambda	0.886	1.288	4	40	0.291	0.365
Hotelling's Trace	0.129	1.288	4	40	0.291	0.365
Roy's Largest Root	0.129	1.288	4	40	0.291	0.365

Finally, an additional univariate test was run to determine the between subjects effects for gender. Unfortunately, only Attitude gave a significance level that could be acceptable, however, its F values, and Observed Power are not acceptable, and, as a result, cannot be conclusively determined as significant.

Table 16: Univariate Test of Between-Subjects Effects of Confidence, Anxiety, Attitude, and Achievement for Gender

Dependant Variable	Type III Sum of Square	Mean Square	F	Sig.	Observed Power
Confidence	2.750	2.750	2.841	0.099	0.378
Attitude	2.119	2.119	4.290	0.044	0.526
Anxiety	0.380	0.380	0.576	0.452	0.115
Achievement	349.69	349.69	0.697	0.408	0.129

Ultimately, the results of the quantitative survey were both useful and, unfortunately, inconclusive. The results of the survey did show an attitudinal difference between genders, and the math as a gendered domain scale, the WAM scale, did illustrate several ways in which boys and girls acted differently in their math classes. However, the same WAM results seemed to oppose the current findings in curriculum literature. The correlational tables and multivariate analysis also were not able to determine definitively if gender actually played a part in the observed gender difference in achievement and attitudes. It seemed much more likely that the achievement difference between genders was a result of slightly higher attitude, confidence, and anxiety score for girls when compared with boys, rather than resulting from the effects of gender alone. Why girls scored slightly higher in the aforementioned scales, and in the achievement scale, could not be determined.

Qualitative Results

Written Comments

The qualitative results of this study include several student names and identifying characteristics in an effort to show the impact of perceptions of gender bias on individual students. All names are, in fact, pseudonyms, and identifying characteristics have been altered to protect the identity of the participants. Having established a slight attitudinal difference between boys and girls, the purpose of the qualitative interviews was to establish if this difference was due to a student perception of gender bias. The additional comment section of the quantitative survey was first analyzed and coded to gauge an overall student perception of mathematics to help guide the one-on-one student interviews. Several student answers had to be removed from initial coding due to silly answers. For example, Jerry Harrop wrote, “MATH IS STUPID”, followed by one hundred thirty-eight exclamation marks. Although his answer is representational of a low attitudinal score, it does not explain why he thinks math is stupid, and was something of a fully capitalized outlier in terms of comments. Curiously, Jerry earned a score of 57% on the adapted FSA Achievement test, which would place his score within the average range. His negative attitude, therefore, might not come from a lack of understanding, but rather a lack of interest, or a bad experience, in the subject. Unfortunately, Jerry was not selected for a follow-up interview because he did not consent to an interview in his consent form.

While all students understood the English language, two responses were completed in languages other than English, one boy wrote in Spanish, “Yo no tengo ningún comentario que hacer sobre el tema de matemáticas que no sea el hecho de que nadie que conozco le gusta mucho las clases de matemáticas”. Roughly translated, “I don't have any comment what to do on the subject of mathematics other than the fact that nobody I know likes the math classes”. Once again, this is representative of the slightly lower attitudinal scores of boys in mathematics at West Rock Middle School when compared to girls.

Other answers dealt not with general comments regarding Math, but with the survey itself, “...i guessed for most of the question because they were annoying and i didnt want to answer them, sorry, i am actually very good at math but in this i didnt really try my hardest, im never scared to do a challenging question because i usually get them right”. As mentioned earlier, when designing this survey to include not just attitudinal scales, but also an achievement test, student burnout was a concern. The importance of the test was stressed to the students, and that they should try their best. However, as the comments above show, not every student answered every question to the best of their abilities. The student, a female, received 47% on the achievement test. It is interesting to note that although girls had both higher achievement, and higher attitudinal scores than boys, and were perceived to be harder working and boys, individual students varied widely in their perceptions of mathematics, and, by extension, the overall student survey.

Initial coding revealed four main themes within the survey's additional comment section: students who like math; students who find math boring, uninteresting, or confusing; students who think that math is important for the future; and those who seem to be concerned with various peer pressures.

Three students wrote that although math was difficult, they knew it was important for the future. Tommy M, a thirteen-year-old hockey player who lived in the town wherein West Rock Middle School is located, wrote, "I Honestly Dont Like Math One Little Bit But I Learn It So I Can Get A Good Career". Santos T., another boy in Tommy's class, echoed his cohort's opinion, "I think Mathematics is a good subject because you will need it in the future/Adult life". However, Carol, an outspoken volleyballer, also believed in the importance of mathematics, "I don't really like math, but I know that I will need it in the futre [sic]".

There were quite a few students that wrote that they did not enjoy mathematics, including the sillier responses mentioned earlier. Fortunately, several students not only voiced their disapproval of mathematics, but also why they felt that math was not meaningful for them. Sandra H wrote that math was boring, and too complicated, "not many people like math because it isnt the hardest, but its just the most complicated and time consuming subject allowing your mind to wander and you to get distracted". Many thought it was too complicated, or questions needed too many steps to solve, and also, paradoxically, not engaging enough, or too boring. The disengagement of students seems to lead to an attitudinal rift between boys and girls who deal with that perceived boredom in different ways. Lucy B wrote, "girls probably don't care too much for maths because they find it boring and uninteresting. kind of". Chris T, a sublimely eloquent boy who scored 90% on the achievement scale provided the one of the most interesting survey comments:

> In my class, I find that boys get more help, although those specific ones need help with everything. Girls really don't get help I find. The girls in our class are amazing at every other subject but usually mess up on math questions (when there learning). I personally find math boring because we are to do repeated questions that are too simple but take up a lot of time. I feel im not learning ANYTHING from this work.

If girls are not engaged with the subject, then they seem to show their disengagement differently than boys, not misbehaving, but not asking for help either. It also seems that a few boys monopolize the teacher’s time, which leads to the perception that boys need more help; however, statistically, this may not be the case.

One of the students who wrote that she enjoyed mathematics, Emily D, barely passed the achievement test further justifying the lack of statistical significance, and lower correlation, between attitude and achievement. Emily wrote about a program at West Rock Middle School, called Cranial Club, which allows high achieving students to leave class and work at their own pace, “Math is my favourite subject. There are more girls in the cranial club (smart people group) than boys! GIRLS RULE BOYS DROLE! [sic]”. Opinions regarding the club are mixed among the student population, some do not like it due to its apparent lack of integration, while others enjoy leaving class, or, if the students stay, enjoy getting extra help.

One boy who enjoys math, Jason K, reports a disturbing trend of negative peer pressure, “I personally love mathematics, I'm not a girl so I don't really know how they feel about math, but I know that a lot of people tease me about being a nerd though. I don't care”. It seems that Jason is teased because he is good at math. Even more worrying is the implied understanding that the problem is not only that he is good at math, but also that he is a boy that is good at math. The stereotype, similar to Martinot and Désert’s (2007) study wherein grade 7 girls and boys perceived girls as being superior to boys, West Rock students seem to feel that not only should girls be better at mathematics, but also that boys should be worse. This stereotype leads to marginalizations in both genders. Cassie K., a girl, believed, “girls in general (not me) are more driven to do better in math. I said not me because I feel like I am not as capable as other girls”. Katherine B. also reiterates this feeling of inadequacy in a different way, “I find some stuff easy, other stuff not so much. I don't tend to get help because I don't want to admit I need it”.

Individual Interviews

Student individual interviews were conducted in the last week of February 2013, using voice memo software on an iPhone. The recordings were then transcribed using an online transcription service, rev.com, to eliminate researcher bias. Unfortunately, many of the students’ answers were little more than monosyllabic. According to a word frequency analysis completed by NVivo 10 software, some of the most common words were: “like”, spoken 349 times; “yeah”, spoken 192 times; “um” and “uh” for 250 instances; and, “ok”, at 169. Despite the prevalence of non-lexical vocalizations, primary content analysis revealed several key constructs; Boredom, attitude, confusion, struggle, trouble, not exciting, a bit lame, repetition, friends, work, distracted, easy, enjoys, have to do it, and just get through it. These words, or their synonyms, appear repeatedly throughout the six student interviews.

Four major themes emerge from the earlier constructs: boredom, effort, distraction, and negative peer pressure. While many students enjoy math, even those who do enjoy it can find it boring or confusing. Students either get confused by mathematics problems that are too difficult, tune out and become bored or frustrated; or, find the math too easy and repetitious and become bored or frustrated. Peter, whose last name is Bond and actually introduced himself as “Peter, Peter Bond”, described his favorite part of class as the waiting time:

> Interviewer: So tell me about your favorite part of math class.
>
> Peter: Um, probably the waiting part
>
> Interviewer: The, the waiting?
>
> Peter: The waiting, just waiting, not doing math. Just waiting on everyone to settle or stuff like that…. Like math isn't my favorite subject and I'm not very good at it, well, I mean, I am, but it just doesn't always makes sense, but it does eventually, so… I don't know, it's just not my favorite.

Ava Dennis, along with three other interviewees mentioned boredom. For Ava, however, this malaise derives from a perception that math was too easy:

> Interviewer: Why do you think it's [math is] boring then?
>
> Ava: I don't know. It might be that it's too easy, but most of the time I'm – I, like, ask questions about it, so I don't know…. I just like to do something that I like – I don't know. I just, like, do it and then like to do a test, and then go on to something else because it just gets boring.

When pressed, some interviewees said that they disliked worksheets, what one student called "paperwork", and textbook work that seemed to be monotonous or overly repetitious. Many students' favorite math memories involve some sort of hands on activity, such as constructing paper cut out cubes or working with money.

Interviewees seemed to believe that achievement was based on students either simply trying, or not. Adam D, who was one of the lowest scoring students on the achievement test, believed that if a student would try hard, then he or she would do well in math. Paradoxically, he also believes that he tries hard, but does not achieve as well as he would hope:

> Interviewer: Do you think that boys or girls are more likely to find math easy?
>
> Adam: Well, I guess the truth is it depends – well, some girls yes, some girls no. It depends on if you really care, like there's a lot of girls in the school who just don't care about Math, there's others that succeed very well, and the same with guys…. And that's because if they study. A lot of guys I know that just don't study. I tried, the truth is I really try, and I tried to study, I tried doing my best, and sometimes that just does not work.

Adam seems to be demonstrating the "self-fulfilling prophecy" (Brown and Josephs, 1999) phenomenon that was mentioned earlier in Chapter two. He believes that girls generally do better in math than boys, and is consequently frustrated by his poor performance despite his willingness to try his best. This seemed to happen to both the boys and girls that were interviewed.

A general level of frustration seemed to manifest itself in different ways for the girls interviewed than it had for the boys. The girls were quieter about their disillusionment, whereas boys were very evidently distracted. Several students spoke about this seemingly major attitudinal difference. Ava Dennis, once again, offers an interesting glimpse at the perceived difference between boys and girls:

> Interviewer: So one of the things that I'm trying to find out, right, is the difference in between how girls think about math and how boys think about Math.
>
> Ava: I mean, like, most of the people [boys] in my class definitely, like, struggle more than the girls. I don't know why but they ask more questions and stuff. Some of the girls in our class are also like that, they need more help too.
>
> Interviewer: Okay. So then why did you think it was more – like, your first thought went to the boys right?
>
> Ava: because the guys get distracted a lot, I don't know why. They just start talking to

> each other and throwing stuff across the room and stuff…. Yeah, they, they, like, speak out, they're like, "Ahh, I don't get this", but the girls just go and ask Mr Darcy [the teacher] and stuff.

Ava's personal experiences connect to the earlier WAM scale findings. The overall perception is that boys are louder, more distracted, and, in general, struggle more in math. However, the actual achievement and attitudinal differences between genders does not represent the perceived differences. The stereotype of lower attitudes for boys at West Rock Middle School is partially explained by another of the interviewees, Jane Campbell, who believes that boys fall victim to negative peer pressure and act out because they believe that is what their peers expect. She also admitted that girls are not as focussed as they seem:

> Interviewer: Why do you think the survey found that boys were more likely to give up on a math problem than girls?
>
> Jane: Um, I don't know. I don't really think that it has to do with boys or girls. I guess maybe it would be more likely, but I don't see why it would have to be more likely.
>
> Interviewer: Ok.
>
> Jane: Um, I don't know why. It could be the person. Maybe they [boys] think in their head that, oh, people think that boys are going to do it, so if that's what they think then, I'll just do it anyway because why should I care…. They're [boys] a lot more opinionated, I guess, well maybe we have the same opinions, but they speak their opinion very loudly. (laughs)
>
> Interviewer: Right, right.
>
> Jane: Like with us we just, like, talk to our friends about it quietly, like, just side

comments, um, during the class, like, but then just, um, keep working, but the guys would just completely go off task and talk.

Frustratingly, even those girls who seem to do well in math, do not necessarily believe that that will translate to a future career in the mathematics field. Once again, Jane presents a haunting disclosure:

Interviewer: Why do you think that would be, then, that they would, girls would become less interested in math?

Jane: Um, I don't know. Maybe because like I said, some of my friends just deal with math and even though their, it's not their favorite subject, they still get really good grades.

Interviewer: Mmhmm… (affirmative)

Jane: … Um, but because they're not enjoying it, but even though they might be enjoying it a little bit, that little bit of enjoyment is not going to persuade them to become a mathematician when they're older.

Interviewer: Ok, so why do you think that, that they don't enjoy it more?

Jane: I don't know. I, I enjoy math, but that doesn't mean I'm going to be a mathematician when I grow up.

Interviewer: Right…

Jane: … (laughs) Cause I know for a fact I'm not going to be a Mathematician…

Finally, the purpose of the interviews, discovering if attitudinal differences were the result of a student perception of gender bias, was resolved. The answer was an unequivocal no. Only one student, Adam, felt that math was biased toward girls (all other interviewees thought that math was not biased toward either gender); however, he also later recanted and said that it sometimes favored boys as well.

Adam also did not know *why* he felt, initially, that math favored girls; ergo, he was not aware of a gender bias. Returning to the initial definition of bias as, "A swaying influence, impulse, or weight" (OED, 2012), it becomes clear that bias is not just an acknowledgement of difference, but an understanding of where that difference is coming from. It is a form of meta-cognition that none of the interviewees vocalized.

Chapter 5: Conclusion

I had the remarkably serendipitous opportunity to work with Jazzy's, the student who first gave me the idea for my thesis, mother this year. A year later, and at a different school, I worked with Jazzy's mother, Shannon, at West Rock Middle School, I had the good fortune to let Shannon know the impact he daughter had made. She was positively glowing when I informed her that it was because Jazzy had told me off that I decided to investigate gender issues in education. Understandably, she went home that night and repeated my tale to her daughter. Jazzy didn't remember. The precocious teenager had no memory of that fateful conversation, but has twice provided inspiration for my research. Although the first event, her refusal to be marginalized, drove my initial research, it is the second, her ignorance of what became my eureka moment, that, in part, provides insight into a very conflicting set of data.

This research set out to explore two questions: Firstly, what, if any, are the attitudinal differences between genders at the Grade 8 level in mathematics at West Rock Middle School? Secondly, if there is a difference, is it due to a student perception of gender bias in mathematics?

There was a slight achievement and attitudinal advantage for girls; however, students did not perceive that this was the result of a gender bias. Although some students initially felt that math favored one gender or another, only to recant later, none could identify why, or, to put it another way, while some interviewees thought there might be a difference, none identified an influence for that difference. The lack of student perception of bias does not preclude the existence of bias. Students do not have a conscious understanding of any bias, but this lack of conceptualization of gender bias consociates with Bourdieu's (1986) cultural theory. A conscious understanding of social bias, i.e. patriarchal subjugation of women, would not be acceptable to today's societal mores. Indeed, two interviewees initially said that mathematics favored one gender over another, only to withdraw their views. Paradoxically, the current social model safeguards the existent norm by teaching political correctness while simultaneously maintaining cultural standards of gender imbalance. Students may be aware of this difference subconsciously; however, that was not determined, and, perhaps, cannot be determined at this developmental stage and age.

I believe that it is exceptionally difficult to compare any findings on gender bias because the research comes from many different countries, which will have vastly different cultures. Martinot and Désert's (2007) research comes from France, Brown and Bigler's (2004) from the United States, Coultier's (1996) from Canada, and Leder and Forgasz's (1999) from Australia. Each will have different societal mores, which could explain the different gender stereotypes and the baffling contradictions within the research.

During the course of my interviews, it seemed that students did perceive an attitudinal difference between genders. Boys were perceived as more distracted, for example. However, when this idea was explored further, the interviewees added more complexity rather than providing a simple solution. It seems that it is a loud minority of boys, perhaps subject to negative peer pressures, or, perhaps, manifesting their own insecurities, not wanting to appear stupid and, as a result, not willing to try, that causes this perception. Girls, the interviewees said, were just as bad in a different way. While female students did not throw eraser bits, and storm around the classroom, they were still quietly distracted, talking to their friends, doodling, waiting.

<u>The Waiting</u>

The Waiting Place...
...for people just waiting.
Waiting for a train to go
or waiting around for a Yes or No
Everyone is just waiting. – Dr. Seuss

Peter's startling revelation, regarding the waiting time, was more than an admission of boredom. It touched on a many of the issues students seemed to face in math class. For Peter, whose math class is the first block after lunch, the waiting time is the last moment of happiness before resuming his class work.

The kind of joyous inactivity that Peter described seemed to be coloured with a kind of passive-aggressive frustration as well. Five of the six students interviewed mentioned feeling some level of frustration with math. Even those students that did well still felt a certain level of frustration, either from being pestered by other students for answers, or from the repetitious nature of the worksheets that had to be done. Interviewees who were not as good at math, those who scored poorly on the achievement test, also simmered with frustration, or even boiled over into anger. Students, both highly achieving and poorly achieving know that they must be in class. However, they also know that they cannot be forced to learn, or even to love what they are learning. This creates a condition whereby many students are disengaged, and for many, math represents the height of this disengagement. Peter's delay seems to be a manifestation of this disengagement. The waiting time is his favorite part of math. In other words, his favorite part of math is not doing any math.

In an ideal situation, every student would be working on his or her own individual learning plan that caters to his or her current interest. However, even the most liberal educational philosopher would have to admit that this enthusiasm must be tempered to some degree. Unfortunately, this incremental omission sets the student down a different path of understanding and educational pedagogy, one wherein the teacher knows the way, and the students do not.

Practically, students must learn what the teacher, and by extension the Ministry of Education, provides. This takes the form of generally set lesson plans, classes, and standardized tests. Students can, and do, learn at different rates, and may pass through the material quicker or slower in relation to one another, but each student learns more or less the same thing. It is simply a matter of time management. A ministry in charge of roughly 400,000 students cannot assess all of them if they are all doing something different. A problem of power exists, not power in the Marxist sense, but in the sense of a social contract subconsciously signed by all members. Michel Foucault writes:

> "Basically power is less a confrontation between two adversaries or the linking of one to the other than a question of government. This word must be allowed the very broad meaning which it had in the sixteenth century. "Government" did not refer only to political structures or to the management of states; rather it designated the way in which the conduct of individuals or of groups might be directed: the government of children, of souls, of communities, of families, of the sick. It did not only cover the legitimately constituted forms of political or economic subjection, but also modes of action, more or less considered and calculated, which were destined to act upon the possibilities of action of other people. To govern, in this sense, is to structure the possible field of action of others. The relationship proper to power would not therefore be sought on the side of violence or of struggle, nor on that of voluntary linking (all of which can, at best, only be the instruments of power), but rather in the area of the singular mode of action, neither warlike nor juridical, which is government" (Foucault, 1982, p. 221).

In a classroom, both the teacher and the students are linked by power, students are *the other* to a teacher, but a teacher is also *the other* to his or her students. In an ideal situation, students would learn concepts based within their own interests. However, as a teacher, a group process is needed to maintain a smooth transition from one subject, and grade, to another. Unfortunately, that group process is a social contract bound within the curious rules of power. This is both a good and bad thing. A teacher does not, and cannot, govern because he or she cannot "structure the possible field of action of others" (221). Government is a hidden curriculum. The students listen to the teacher, for the most part, because society has deemed that it should be so.

Once again, a problem occurs for individuals. If an individual accepts to be governed, then she relinquishes her rights to complete freedom of action. One cannot be a part of a society, or, by extension, a classroom if one were to lash out, speak out, or otherwise, "act upon the possibilities of action of other people" (Foucault, 1982, p. 221). In addition, the power of government can never be altered by the individual, as it does not exist individually.

For students, the result is disengagement. They are bound by government to accept the rules and abide by them, but they do not have to be happy about it. Ironically, this disengagement is a kind of self-fulfilling prophecy. As students become increasingly disengaged, their academic progress may slow. If their academic progress slows, they may fail to achieve what they once believed to be possible for themselves. If they fail, they justify their initial disengagement.

Through reasons yet unknown, research has shown (MacCoby, 1966; Fennema & Sherman, 1977; Coulter, 1996) that girls` attitudes towards Math have been perceived, or measured, to be lower than that of boys. Could it be that they do not want to be in math class, that they are bored, or confused, or disengaged, due to societal pressures? Or simply waiting. Or that there is a decline in female students university enrollment in mathematics due to an amalgamation of Foucault`s conceptualization of government and power, and Bourdieu's notion of cultural capital and habitus? Do girls, still believe as children, or come to believe as adults, that mathematics is a male domain? What can be done?

Future Considerations

Ultimately, change must come through governmental, both in the political and Foucauldian sense, change. In a political sense, gender issues have been relegated to addendums and attachments to other documents such as the BC Ministry of Education Diversity Framework. Coulter wrote in 1996 that political discussions of gender have focussed on shallow interpretations of the issues. I would say that even less is discussed now. Politically, the fundamental view of gender is that everyone is now treated equally, and that any mention of difference between genders, other than a simple recognition of physical difference, is unacceptable. Too much of the research occurs outside of Canada. Such research is undertaken in vastly different social structures, and, as a result, will not transcribe directly to Canadian society. Policy should be altered, and a deeper understanding of the issues should be established, to correctly address the continued low numbers of women in university-level mathematics. And it must start at the middle school level.

Foucauldian government is much more difficult to change; no one individual, policy, or paper will alter this government or disrupt its power structures. I imagine that women, as a group, at the school, district, or provincial level, would have to change the direction of action. This change, in turn, would then have to be accepted, and integrated, into the larger societal group. Such a shift would not come quickly, and cannot be implemented by a single event, but necessarily through continuous, focussed, and considered action, by women, and men, who have the will to push into those areas that government (in a Foucauldian sense) tells them they are not allowed.

The district in which I conducted my research has a gender policy that comes directly from the BC Human Rights Code, “discrimination means the subordination of groups or individuals resulting from a distinction, preference or exclusion based on the grounds of race, religion, colour, ethnicity, place or origin, language, age, disability, socio-economic status, gender, gender identity, gender expression, sexual orientation, or any other difference or perceived difference” (School Board Policy, 2007). The District, and the BC Human Rights Code, take a very negative view of discrimination. Indeed, in popular vernacular, discrimination is a dirty word. It is not, in actuality, a definition that is entirely accurate. The Oxford English Dictionary defines discrimination as, “The action of discriminating; the perceiving, noting, or making a distinction or difference between things; a distinction (made with the mind, or in action).

Also with *against*" (OED, 2012). Discrimination is merely an acceptance of difference. A district cannot effectively make a difference in gender policy without first accepting that there is, in fact, a difference, even one that is only perceived, between genders. A clear, and complete, understanding of the issues regarding gender must inform a change in gender policy. A new policy, understood at the school and classroom level, by all users, teachers, educational assistants, and the students themselves, should be enacted, and accepted, to move gender issues forward.

Research Limitations

I have divided the limitations of this study into two categories, methodological and theoretical. The methodological limitations include the relatively small sample size, a lack of prior research, the aforementioned cohort bias, and the necessity of using self-reported data.

Although I had initially canvassed a large portion of the Grade 8 student population at West Rock Middle School, three out of seven classes of students, the study's attrition rate was quite high. A participant list of 84 students dwindled to 45 that actually completed the quantitative survey. When broken into their respective genders, these numbers were only marginally enough to run a statistical analysis. While I still feel that the quantitative data was valid, future research could investigate greater numbers of students.

Martinot and Desert, and Forgasz and Leder have produced several studies on the role of gender in mathematics; however, there was little research on the student perception of gender issues. Furthermore, the research comes from two distinctly different cultures that are, in turn, different from our own Canadian culture. This made comparative analysis difficult.

The cohort bias, and the use of self-reported data were, in my opinion, unavoidable given the nature of this study. Cohort biases could be limited with additional research in this field, especially by focussing on one school for several subsequent years to better gauge the trends in attitudinal and achievement differences between genders. Self-reporting was, perhaps, the greatest limitation of the qualitative interviews. I feel that students may have been filtering what they said, and felt about the different genders, sub-consciously denying any gender differences, or biases. Future research could use focus groups instead of individual interviews, or, a more skilled interviewer could be brought in to coax information for the participants.

Finally, theoretically, my own biases as a feminist researcher could have affected the qualitative interviews, and there subsequent analysis. Once again, an additional interviewer could mitigate this bias, and an additional researcher for coding of those interviews would help alleviate any personal research bias.

Future Research

Future research could focus on longitudinal studies of the same participants. Could a similar, age appropriate, study be conducted with the same students in high school once, as the research suggests, an attitudinal shift occurs? Would an awareness of gender bias exist in the students at this later age? The research would suggest that it would, but it would be interesting to hear from individual students through an interview. I imagine that students would be able to give more complete, richer, answers to questions similar to the ones posed in this survey. All too often interviewees gave simple, one-word answers, or simply said that they did not have an answer.

I would also like to conduct an identical study in subsequent years at West Rock Middle School to eliminate any cohort bias. Given the large drop in boys' Foundation Skills Assessment (FSA) results at West Rock Middle School, even from five years ago when they were within four percent of the girls, it could be beneficial to examine multiple years at the same level.

The same study could also be run in different schools within the School district. The achievement difference between girls and boys was largest at West Rock Middle School, so different schools may yield different results. Female students at Oceanview Middle School, and Fredrick Douglass

Middle School achieved a similar achievement score advantage to West Rock students on the numeracy portion of the 2013 Foundation Skills Assessment. Would their attitudinal scores also be similar to what was achieved at West Rock, or would they be more in line with the literature and demonstrate the more traditional stereotype that boys are better at math than girls. I might hypothesize that a traditional stereotype would exist. The boys at West Rock Middle School achieved significantly lower than the girls, so it is not inconceivable to imagine, given a closer achievement score between genders at Ocenview Middle School and Fredrick Douglass Middle School, a male superiority perception. However, if boys were higher achieving, then a different, and interesting, stereotype could occur.

Bibliography

Acker S. & Dillabough, J. (2007). Women learning to labour in the male emporium: exploring gendered work in teacher education. *Gender and Education*. Vol. 19, (No. 3), 297 – 316.

Arminio, J. "Self-Efficacy." *Encyclopedia of Identity.* Ed. Ronald L. Jackson II and Michael A. Hogg. Thousand Oaks, CA: SAGE, 2010. 687-91.

BC Ministry of Education. (2008). Diversity in Schools: A Framework. Victoria: BC Ministry of Education

BC Ministry of Education. (2008). FSA Technical Manual. Retrieved from: http://www.bced.gov.bc.ca/assessment/fsa/pdfs/08_fsa_technotes.pdf

BC Ministry of Education. (2012). Foundation Skills Assessment. Retrieved from: www.bced.gov.bc.ca/reports/pdfs/fsa/prov.pdf.

Berg, B. & Lune, H. (2012). *Qualitative Research Methods for the Social Sciences*. (8th ed). Boston: Pearson Education, Inc.

Broadbooks, et al. (1981). A Construct Validation Study of the Fennema-Sherman Mathematics Attitudes Scales. *Educational and Psychological Measurement*. Vol. 41, (No. 2), 551 – 557.

Brown, C., & Bigler, S. (2004). Children's Perceptions of Gender Discrimination. *Developmental Psychology*. Vol. 40, (No. 5), 714 – 726.

Brown, R. & Josephs, R. (1999). A Burden of Proof: Stereotype Relevance and Gender Differences in Math Performance. *Journal of Personality and Social Psychology*. Vol. 76, (No. 2), 246 – 257.

Bourdieu, P. (1986). The forms of capital. J. Richardson (Ed.) *Handbook of Theory and Research for the Sociology of Education*. New York: Greenwood, 241-258. Retrieved from: http://www.marxists.org/reference/subject/philosophy/works/fr/bourdieu-forms-capital.htm

Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, and Social Sciences and Humanities Research Council of Canada. (2010). Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans. Retrieved from: http://www.pre.ethics.gc.ca/pdf/eng/tcps2/TCPS_2_FINAL_Web.pdf.

Cicero, M. T. (1889). *Pro Publio Sestio* (3rd ed). Hubert A. Holden, (Ed.). London: MacMillan.

Coulter, R. (1996). Gender Equity and Schooling: Linking Research and Policy. *Canadian Journal of Education*, Vol. 21, (No. 4), 433 – 452.

Creswell, J. & Plano-Clark, V. (2011). *Designing and Conducting Mixed Methods Research*. (2nd ed). Thousand Oaks, CA: SAGE Publications.

Dentith, A. (2008). Smart Girls, Hard-working Girls but not yet self-assured girls: The limits of Gender Equity Politics. *Canadian Journal of Education*, Vol. 31, (No. 1), 145 – 166.

Eccles, J. S., & Blumenfeld, P. (1985). Classroom experiences and student gender: Are there differences and do they matter?. *Gender influences in classroom interaction*. L. C. Wilkinson, & C. B. Marrett (Eds.) Orlando, FL: Academic Press.

Education Quality and Accountability Office. (2000). Third International Mathemaics and Science Study Repeat Project (TIMSS-R) Ontario Report: Grade 8 Students. Ontario Ministry of Education, Toronto.

Fast, L.; Lewis, J.; Bryant, M.; Bocian, K.; Cardullo, R.; Rettig, M.; & Hammond, K. (2010). Does math self-efficacy mediate the effect of the perceived classroom environment on standardized math test performance? *Journal of Educational Psychology*, Vol 102(3), 729 - 740.

Fennema, E. & Sherman, J. (1976). Fennema-Sherman Mathematics Attitude Scales: Instruments designed to Measure Attitudes Toward the Learning of Mathematics by Females and Males. *Journal for Research in Mathematics Education*. Vol. 7, (No. 5), 324 – 326.

Fennema, E. & Sherman, J. (1977). Sex-Related Differences in Mathematics Achievement, Spatial Visualization and Affective Factors. *American Educational Research Journal* , Vol. 14, (No. 1), 51 – 71.

Forgasz, H. J. Leder, G., Gardner, P. (1999). The Fennema-Sherman Mathematics as a Male Domain Scale Re-Examined. *Journal For the Research in Mathematics Education*. Vol. 30, (No. 3), 342 – 348.

Forgasz, H. J. (2000). The gender-stereotyping of mathematics: Pre-service teachers' views. Retrieved from http://www.aare.edu.au/00pap/for00168.htm

Forgasz, H. J., Leder, G., & Kloostermen, P. (2004). New Perspectives on the Gender Stereotyping of Mathematics. *Mathematical Thinking and Learning*. Vol. 6, (No. 4), 389 – 420.

Foucault, Michel. (1982). "The Subject and Power." *Michel Foucault: Beyond Structuralism and Hermeneutics*. 2nd edition. Ed. Hubert L. Dreyfus and Paul Rabinow. Chicago: U of Chicago Press.

Guimond, S. & Roussel, L. (2001). Bragging about one’s school grades: gender stereotyping and students’ perception of their abilities in science, mathematics, and language. *Social Psychology of Education*. Vol. 4, 275 – 293.

Gwendolyn, M., et al. (2007). *Feminism*. Encyclopedia of Sex and Gender. Ed. Fedwa Malti Douglas. Vol. 2. Detroit: Macmillan Reference USA.

Hackett, G. (1985). Role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis. *Journal of Counseling Psychology*, Vol 32(1), Jan 1985, 47-56.

Kebede, A. (2012). Cultural Capital. *Encyclopedia of Identity.* Ed. Ronald L. Jackson II and Michael A. Hogg. Thousand Oaks, CA: SAGE, 2010. 162-65. Retrieved from: http://knowledge.sagepub.com.ezproxy.library.uvic.ca/view/identity/n58.xml?rskey=xL3cg5&row=4.

Kloosterman, P. Tassell, J. Panniah, A. & Essex, N. Perceptions of Mathematics and Gender. *School Science and Mathematics*. Vol. 108, (No. 4), 149 – 162.

Leedy, M. LaLonde, D. & Runk, K. (2003). Gender Equity in Mathematics: Beliefs of Students, Parents, and Teachers. *School Science and Mathematics*. Vol. 103, (No. 6), 285 – 292.

MacCoby, E. (1966). Sex Differences in Intellectual functioning. *The Development of Sex Differences*. Eleanor MacCoby (Ed). Stanford, California: Stanford University Press.

Martinot, D. & Désert, M. (2007). Awareness of a gender stereotype, personal beliefs and self perceptions regarding math ability: when boys do not surpass girls. *Social Psychology Education*. Vol. 10, 455 – 471.

Martinot, D. Bagès, C., Désert, M. (2012). French Children's Awareness of Gender Stereotypes about Mathematics and Reading: When Girls Improve their Reputation in Math. *Sex Roles*. Vol. 66, 210 – 219.

Meece, J. L., Glienke, B. B., & Burg, S. (2006). Gender and Motivation. *Journal of School Psychology*. Vol. 44, 351 – 373.

Milar, K. (2012). An Historical View of Some Early Women Psychologists and the Psychology of Women. In *Classics in the History of Psychology Special Collections.* Christopher D. Green (Ed.), Retrieved from http://psychclassics.yorku.ca/Special/Women/variability.htm

Organization for Economic Co-operation and Development. (2009). Equally prepared for life? How 15 year-old boys and girls perform in school. Retrieved from: http://www.oecd.org/pisa/pisaproducts/pisa2006/42843625.pdf

Oxford English Dictionary. (2012). *Bias*. Oxford University Press. Oxford.

Oxford English Dictionary. (2012). *Discrimination*. Oxford University Press. Oxford.

Oxford English Dictionary. (2012). *Gender*. Oxford University Press. Oxford.

Oxford English Dictionary. (2012). *Habitus*. Oxford University Press. Oxford.

Oxford English Dictionary. (2012). *Perceive*. Oxford University Press. Oxford.

Oxford English Dictionary. (2012). *Perception*. Oxford University Press. Oxford.

Pajares, F. & Millar, D. (1995). Mathematics self-efficacy and mathematics performances: The need for specificity of assessment. *Journal of Counseling Psychology*, Vol 42(2), Apr 1995, 190-198.

School Board Policy. (2007). Human Rights and Discrimination. Retrieved from http://www.sd63.bc.ca/ourboard/board-policies/governance-and communication/miscellaneous/human-rights-and-discrimination

Statistics Canada. (2013). Trends in University Graduation, 1992 to 2007. Retrieved from http://www.statcan.gc.ca/pub/81-004-x/2009005/article/11050-eng.htm

Seuss, D. (1990). *Oh, the places you'll go!*. New York: Random House.

Thompson, James. (2010). Women in the Ancient World. Retrieved from http://www.womenintheancientworld.com/greece.htm

Zittleman, K. & Sadker, D. (2002). Gender Bias in Teacher Education Texts: New (and Old) Lessons. *Journal of Teacher Education*, Vol. 53, (No. 2), 168 – 180.

Appendix 1: Request for Research Approval District-level

1. Title of Research Project: Student Perception of Gender Bias in Middle School Mathematics

Brief description of research project: This study will examine perceptions of gender bias in grade 8 mathematics. A modified Attitude Scale, in combination with a gendered Mathematics Scale, will be used to uncover any variability between genders in Math using five key constructs, while a semi-structured interview will determine if that variance is due to a student perception of gender bias.

3. Your project involves (check one or more boxes):

X	Students – Grade levels 8	☐	Principal
X	Teachers	☐	Trustees
☐	School District Staff	☐	Parents

4. Involvement in your project by School District 63 employees, students and parents is optional:

X Yes ☐ No

Please indicate level of involvement required:
Teachers may be asked to help their students complete surveys.

5. The timeline of your actual involvement in our School District:
From: October 15th to January 30th

6. Approximate date that SD #63 may look forward to receiving the results of your project:
April 30th

7. University Human Subjects Approval Form attached:

X Yes ☐ No. Expected date of completion: ____________________________

8. Please submit a copy of the entire package (including this cover sheet as the first page) to:

Heather Gross
District Executive Assistant
Office of the Assistant Superintendent of Schools
School District 63 (Saanich)
2125 Keating Cross Road
Saanichton, BC V8M 2A5 (phone: 652-7330)

Ian Cooper	Ian Cooper
Name (PLEASE PRINT)	Signature

Appendix 2: District-level Letter of Approval

Dear Ian:

I am pleased to inform you that your request for research proposal entitled "Student Perception of Gender Bias in Middle School Mathematics" has been approved, subject to the following conditions:

1. Benefit to professional staff related to their practice;
2. Benefit to students further to the outcomes of the research study;
3. Positive or neutral effect on the learning environment, with minimal impact on instructional time;
4. The participation be on a voluntary basis as previously requested;
5. That the identity of all participants be kept confidential;
6. That the results of the research project be shared with School District 63;
7. Completion of all research protocols from the sponsoring university, including ethics review approval.

Best of luck with your research.

Sincerely,

Appendix 3: Permission Letter to Teachers

Hello,

I am a starting the research portion of my Master's in Education with the University of Victoria and I am looking for Grade 8 math teachers who would be willing to let me use their classes for my research.

This would entail collecting consent forms, and allowing me to take willing participants from your class to your school's computer lab for one block to complete a survey assessing aptitude and four key attitudinal characteristics: Confidence, Anxiety, Attitudes toward Success, and Perceptions of Gendered Issues in Mathematics. Some students may need more than one block to complete this survey, in which case the researcher will stay with those students to help them complete the survey. Additionally, some students may be selected for an individual follow up interview, which will take a maximum of one block per student. I have attached the participate consent form to this email, and would request that you review if you have any concerns, or, to gain a better understanding of the study requirements and the risks and inconveniences.

If it is possible to use your students for my research, or if you have any additional questions or concerns, please e-mail me as soon as is convenient.

Thanking you in advance,

Ian Cooper
Graduate Student
University of Victoria
Department of Curriculum and Instruction

Appendix 4: Participant Consent Form

University of Victoria Department of Curriculum and Instruction

Participant Consent Form

You are invited to participate in a study entitled Student perception of gender bias in middle school math students that is being conducted by Ian Cooper.

Ian Cooper is a Graduate sudent in the department of Curriculum and Instruction at the University of Victoria and you may contact him if you have further questions by email at icooper@uvic.ca.

As a graduate student, I am required to conduct research as part of the requirements for a master's degree in Education. It is being conducted under the supervision of Leslee Francis-Pelton. You may contact my supervisor at lfrancis@uvic.ca or via phone at 250-721-7886.

Purpose and Objectives

The goal of this research is to understand why girls dislike math. In general, studies have shown that girls' attitudes toward math are not as positive as that of boys. Crucially, Research has also shown that this gender imbalance is a learned trait, female students in high school are more likely to have negative perceptions of Mathematics, than female students in elementary school. This study will examine perceptions of gender bias in grade 8 mathematics. This proposal wishes to find the answer to two questions:

1. What, if any, are the differences in attitudes between genders at the Grade 8 level in mathematics?

2. If there is a difference, is it due to a student feeling of gender bias in mathematics?

Importance of this Research

If current research could find a reason for girls' poor attitude toward math in their beginning school years, then perhaps, changes could be made to bridge the mathematical divide, and bring equality to the work force.

Participants Selection

You are being asked to participate in this study because you are a student in grade 8 enrolled in a math class in the Saanich school district.

What is involved

If you consent to voluntarily participate in this research, your participation will include an online copy of the FSA numeracy test and sixty-seven survey questions that will test your confidence, anxiety, and success in math, and a scale to get your opinion on which gender is best at certain skills in math. You will have one class block to complete this survey, but may be awarded more time if you need it. Your answers will be held on a secure online data base.
You may be asked to complete a follow up interview at a later date to get a better understanding of your opinion. This interview will last for no more than one class block. If you are contacted for an interview it will be audio recorded, and a paper copy will be made for research purposes.
None of your responses will be shared with your teacher or anyone else from your school.

Inconvenience

Participation in this study may cause some inconvenience to you, including loss of class time which could amount to up to two blocks, or 134 minutes of instructional time. Missing up to two (plus) blocks of instructional time in math, which you would need to make up, as well as completing math tests that will not be used for your academic requirements, may be additional inconveniences. It is possible that students will feel stress or other emotional discomfort if they feel they cannot make up the missed time; however, the researcher will discuss this possibility with the participants' teacher to make sure any stress is minimized by allowing catch up time, study sessions, or possibly partially reduced homework.

Risks

There are some potential risks to you by participating in this research and they include the potential of stress or fatigue from answering challenging and potentially frustrating questions. To prevent or to deal with these risks the following steps will be taken if you feel at all uncomfortable, or are getting frustrated, you will be able to take a break, you may be asked to complete fewer questions, or in extreme cases, not have to complete the survey or interview.

Benefits

Not a lot is known about certain gender issues in BC, by completing this research you would have the potential to benefit society by increasing its awareness of potential gender imbalances.

Voluntary Participation

Your participation in this research must be **completely voluntary**. If you do decide to participate, you **may withdraw at any time** without any consequences or any explanation. If you do withdraw from the study, your data will only be used if you give further permission to the researcher.

On-going Consent

By signing this consent document you will also consent to the possibility of a follow up interview that will be set at a later date. However, if you are selected for an interview you will be reminded of the risks involved and asked to initial a copy of your original consent form as proof of consent before the interview may begin.

Anonymity

Your name and identifying characteristics will only be used for possible selection for an interview. In all other cases a different name and characteristics will be used so that you cannot be identified.

Confidentiality

Your confidentiality and the confidentiality of the data will be protected by storing all material related to this research in either a locked filing cabinet or in password protected files and databases. There are limits due to context, and limits due to selection (students will be recruited from specific classes, interview students will presumably leave class to participate in the interviews). Therefore, it appears that teachers and other students will know or guess who is participating in this study and who is not. However students, and teachers, will not be made aware of participants answers in any way, and, as a result, participants can feel safe in the knowledge that their responces to both survey and interview will remain anonymous.

Dissemination of Results

It is anticipated that the results of this study will be shared with others in the following ways: In a thesis, and possibly in an academic article.

Disposal of Data

Data from this study will be disposed of in approximately five years by shredding paper documents and deleting of all electronic files.

Contacts

Individuals that may be contacted regarding this study include:

Ian Cooper – researcher –
email: icooper@uvic.ca

Leslee Francis-Pelton – Graduate advisor –

Email: lfrancis@uvic.ca

Phone: (250)721-7886

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Your signature below indicates that you understand the above conditions of participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project, and for the future use of data for the purposes of this research study.

______________________	______________________	____________
Name of Participant	*Signature*	*Date*

A copy of this consent will be left with you, and a copy will be taken by the researcher.

Appendix 5: Informational Letter to Parents

University of Victoria: Department of Curriculum and Instruction

Saanich School District #63 Parental information Letter

Dear Parent or Guardian,

I am a starting the research portion of my Master's in Education with the University of Victoria and I would like to request permission to use Saanich School district student for that research.

The goal of this research is to understand why girls dislike math. In general, studies have shown that girls' attitudes toward math are not as positive as that of boys. Crucially, Research has also shown that this gender imbalance is a learned trait; female students in high school are more likely to have negative perceptions of Mathematics than female students in elementary school. This proposal wishes to find the answer to two questions:

1. What, if any, are the differences in attitudes between genders at the Grade 8 level in mathematics?
2. If there is a difference, is it due to a student feeling of gender bias in mathematics?

PARTICIPATION IS VOLUNTARY AND STUDENTS ARE UNDER NO OBLIGATION TO PARTICIPATE. THOSE STUDENTS WHO WOULD LIKE TO PARTICIPATE WILL SIGN AN INFORMED CONSENT FORM. THOSE WHO CHOOSE NOT TO PARTICIPATE WILL CONTINUE WITH THEIR REGULAR CLASS TIME.

Participation in this study may cause some inconvenience to the selected students, including loss of class time, which could amount to over two blocks, or 134 minutes of instructional time.

Students' participation will include the completion of an online copy of the FSA numeracy test and sixty-seven survey questions that will test their confidence, anxiety, and success in math and a scale to get students' on which gender is best at certain skills in math.

Additionally, Students may be asked to complete a follow up interview at a later date to get a better understanding of their opinion. This interview will last for no more than one class block.

There are some potential risks to those students participating in this research and they include the potential of stress or fatigue from answering challenging and potentially frustrating questions.

I will be following the University of Victoria's Human Research Ethics Board standard of ethical conduct, which is an institutional protocol based on the Tri-Council Policy Statement on the Ethical Conduct for Research Involving Humans.

If you have any questions regarding the nature of my research, please see the attached information document, or contact myself, or UVic Human Ethics, using the following information.

Thanking you in advance,

Ian Cooper
Graduate Student
University of Victoria
Department of Curriculum and Instruction
icooper@uvic.ca
(778)426-1464

Leslee Francis-Pelton
Graduate Supervisor
University of Victoria
Department of Curriculum and Instruction
lfrancis@uvic.ca
250-721-7886

Human Research Ethics
University of Victoria
ethics@uvic.ca
250-472-4545

Appendix 6: Quantitative Survey

Student Perceptions in Mathematics

This study will examine perceptions of gender bias in grade 8 mathematics. You will be asked to complete a few math questions, You ARE allowed to use a calculator for the math section. Then, you will be asked a series of questions based on your experiences with math. These questions should be YOUR opinions, so please don't share your answers with the person next to you.

Hello,

Please complete this voluntary survey to the best of your abilities. You will be able to save your progress and complete it at a later date if you need more time.

Good Luck!

There are 41 questions in this survey

Personal Information

1 [1]Please enter your full name (first and last) PLEASE NOTE If you do not want to be a part of the follow up interview, you do not have to include your name: *

Please write your answer here:

2 [2]Please enter your grade and division (i.e. 8-4, 8-1, etc.) *

Please write your answer here:

3 [3]Please enter the name of your school: *

Please write your answer here:

4 [4]Please enter the current date: *

Please enter a date:

5 [5]Please enter your gender PLEASE NOTE If you do not want to be a part of the follow up interview, you do not have to include your gender: *

Please choose **only one** of the following:

- ○Female
- ○Male

Math Acheivement Test

This group of questions is a test of your general Mathematical Ability. This test will in no way affect your grades in your class, it is only for the purposes of this survey

6 [1]

Students were surveyed to find out on which day they should hold a Fun Fair

Wednesday: 3
Thursday: 21
Friday: 6

What percentage of students chose Wednesday?

*****

Please select one answer

Please choose **all** that apply:

- ☐30%
- ☐11%
- ☐10%
- ☐3%

7 [2]

Students want to make cookies for the fun fair

To make two dozen cookies, they need 350g of chocolate chips.

What mass of chocolate chips is needed for 15 dozen cookies?

*****

Please select one answer

Please choose **all** that apply:

- ☐1.875 kg
- ☐2.45 kg
- ☐2.625 kg
- ☐5.25 kg

8 [3]

Stephanie has 24 square pieces of carpet for her booth at the fair, each piece measures 1m by 1m.

What arrangement will give her the greatest perimeter

*****

Please select one answer

Please choose **all** that apply:

- ☐6m by 4m
- ☐8m by 3m
- ☐12m by 2m
- ☐24m by 1 m

9 [4]

When asked about donating a prize to the fun fair, 4 out of 50 students surveyed said they would. If there are 600 students in the school, how many prizes can be expected?

*****

Please select one answer

Please choose **all** that apply:

- ☐48
- ☐75
- ☐150
- ☐200

10 [5]

Javier inflated balloons for a pop-a-balloon booth. The following balloons were in the bag:

8 blue

3 green

5 orange

7 yellow

2 red

If he randomy picked one balloon, what is the probability that he picked either a red or green balloon?

*****

Please select one answer

Please choose **all** that apply:

- ☐2/5
- ☐1/3
- ☐1/4
- ☐1/5

11 [6]

Several other students helped to fill up the balloons.

Time spent	**Total number of balloons**
5 min	**5**
10 min	**11**

15 min **19**

20 min **29**

If the pattern continued, how many balloons would be inflated by 40 minutes?

*****

Please select one answer

Please choose **all** that apply:

- ☐64
- ☐71
- ☐89
- ☐109

12 [7]

The parent group paid $675.00 to purchase a bike for a raffle. Raffle tickets were sold at 4 for $3.00.

What is the least number of tickets the students needed to sell to pay for the bike?

*****

Please select one answer

Please choose **all** that apply:

- ☐225 tickets
- ☐900 tickets
- ☐2025 tickets
- ☐2700 tickets

13 [8]

The Lucky Number Game uses a regular 6-sided die.

In order to win, a player must roll an EVEN number greater than 3. What is the probability of winning on the first roll?

*****

Please select one answer

Please choose **all** that apply:

- ☐1/6
- ☐1/4
- ☐1/3
- ☐1/2

14 [9]

There was a problem at the popsicle booth.

- **The popsicles all melted because the freezer was unplugged**
- **the freezer temperature should have been -10 Celsius**
- **The freezer temperature rose by 12 degrees**

What was the new freezer temperature?

*****

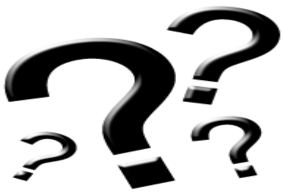
Please select one answer

Please choose **all** that apply:

- ☐-2 Celsius
- ☐2 Celsius
- ☐12 Celsius
- ☐22 Celsius

15 [10]

A Guess the Answer booth asked students to figure out a Math problem. This was the question:



Determine the solution to the equation 4a – 3 = 29

Can you figure out the answer?

*****

Please select one answer

Please choose **all** that apply:

- ☐2
- ☐5
- ☐8
- ☐11

16 [11]

At the Pop-a-balloon booth, each balloon popped earns double the points of the previous balloon.

1st balloon 1 point

2nd balloon 2 points

3rd balloon 4 points

Ralph earned 128 points on the last balloon popped.

How many balloons did he pop?

*

Please select one answer

Please choose **all** that apply:

- ☐8
- ☐7
- ☐6
- ☐5

17 [12]

The students sell cheeseburgers at the Fun Fair. Each cheeseburger needs one slice of cheese, one patty, and one bun.

A box of 48 hamburger patties costs $36.00/box

A package of 8 hamburger buns costs $1.59/package

A package of 16 cheese slices costs $7.99/package

What is the approximate cost to make a single cheeseburger?

*

Please select one answer

Please choose **all** that apply:

- ☐$1.00
- ☐$1.25
- ☐$1.50
- ☐$1.75

18 [13]

These are the costs to running the popcorn booth:

Supplies	**Cost**

Popcorn machine rental	**$75.00**
Popcorn kernals	**$30.00**
Butter	**$15.00**
Salt	**$2.00**
Bags	**$20.00**

How much money will the students need to earn in order to make a 50% profit?

*****

Please select one answer

Please choose **all** that apply:

- ☐$71
- ☐$142
- ☐$192
- ☐$213

19 [14]

Jan bought the following items for lunch, but she did not notice the price of the popcorn

Popcorn	**?**
Salad	**$4.85**
Chocolate Milk	**$1.25**

She paid with a $20.00 bill and received $11.35 in change. What was the cost of the popcorn?

*****

Please select one answer

Please choose **all** that apply:

- ☐$2.55

- ☐$3.60
- ☐$6.10
- ☐$8.65

20 [15]

At the Fun Fair, 60 students volunteered.

There were three Grade 8 volunteers for every two Grade 7 volunteers.

How many of the volunteers were Grade 8 students?

*****

Please select one answer

Please choose **all** that apply:

- ☐20
- ☐30
- ☐36
- ☐40

21 [16]

The Smith family spent these amounts at the Fun Fair

Concession: $12.00

Bake Sale: $5.00

Pony Rides: $4.50

Raffle Tickets: $3.50

The amounts spent on the bake sale and the pony ride was ABOUT what percentage of their total spending?

*****

Please select one answer

Please choose **all** that apply:

- ☐10%
- ☐20%
- ☐30%
- ☐40%

22 [17]

Students recorded the drinks that were sold at the fun fair in this circle

What drink accounts for 1/4 of the the total drinks sold?

*****

Please select one answer

Please choose **all** that apply:

- ☐Juice
- ☐Iced Tea
- ☐Bottled Water
- ☐Lemonade

23 [18]

The Grade 8 class plans on going on a ski trip

The costs for a class of 28 students while at the ski hill are:

Lessons: $1200

Meals: $480

Lift tickets: $1050

What is the total cost for one Student?

*****

Please select one answer

Please choose **all** that apply:

- ☐$58.93
- ☐$97.50
- ☐$113.57
- ☐$151.79

24 [19]

The cost of renting a bus to drive to the ski hill is $180 for the bus and $15 for each student. So far student have raised $540.

How many student fares are they able to pay for so far?

*****

Please choose **all** that apply:

- ☐36

- ☐24
- ☐12
- ☐3

25 [20]

Taylor wants to buy 500g of trail mix for the Ski Trip.

Supermart: $0.69 for 100g

Valumarket: $1.65 for 250g

U-Shop: $6.20 for 1 kg

ShopandSave: $0.75 for 125g

Which is the best buy?

*****

Please select one answer

Please choose **all** that apply:

- ☐Supermart
- ☐Valumarket
- ☐U-Shop
- ☐ShopandSave

26 [21]

Helga agrees to pay her parents for new ski boots. She has five and one-half payments left. Each payment is $18.00.

About how much is left to pay?

*****

Please select one answer

Please choose **all** that apply:

- ☐Between $61 to $70
- ☐Between $71 to $80
- ☐Between $81 to $90
- ☐Between $91 to $100

27 [22]

Four students made necklaces while riding the bus to the ski hill

Student	**Necklace Pattern**
Lee	**Every 2nd bead is blue**
Amy	**Every 3rd bead is blue**
Taylor	**Every 4th bead is blue**
Nita	**Every 5th bead is blue**

Which bead was blue on all of the necklaces?

*****

Please select one answer

Please choose **all** that apply:

- ☐60th
- ☐40th
- ☐30th
- ☐15th

28 [23]

The students recorded the number of skiers at the equipment rental store.

1st hour: 48

2nd hour: 35

3rd hour: 24

4th hour: 15

5th hour: ?

If this pattern continued, how many customers would they have seen during the fifth hour?

*

Please select one answer

Please choose **all** that apply:

- ☐6
- ☐7
- ☐8
- ☐9

29 [24]

Jagjit wants to buy one pair of gloves and a hat.

The gloves are brown, white, or green.

The hats are yellow, red, or brown.

Jagjit doesn't want the same color gloves and hat.

How many choices does he have?

*

Please select one answer

Please choose **all** that apply:

- ☐2
- ☐6
- ☐8
- ☐9

30 [25]

Some students began cross country skiing at 9:20am

- **They skied the 15km trial at an average rate of 2.5km/h**
- **During the trip they stopped for 45 minutes to eat lunch**

At what time did they finish the trail?

*

Please select one answer

Please choose **all** that apply:

- ☐4:05pm
- ☐3:20pm
- ☐11:50am
- ☐11:05am

31 [26]

On the Ski Trip, the ratio of girls to boys was 5 to 6. There were 54 boys.

How many girls were there?

*

Please select one answer

Please choose **all** that apply:

- ☐30
- ☐43
- ☐45
- ☐60

32 [27]

Kevin, Remy and Gabriel worked part-time at the ski hill.

- **The ski hill was open seven days a week**
- **Kevin worked every second day**
- **Remy worked every third day**
- **Gabriel worked every fourth day**

On Friday they all worked together.

Which was the next day they all worked together?

*****

Please select one answer

Please choose **all** that apply:

- ☐Monday
- ☐Wednesday
- ☐Thursday
- ☐Friday

33 [28]

Emily noticed this pattern on the Ski lift chairs.

4, 7, 10, 13, 16, 19, 22, ...

If the pattern continued , what number would be on the 25th chair?

*****

Please select one answer

Please choose **all** that apply:

- ☐61
- ☐76
- ☐91
- ☐106

34 [29]

Kayla measured her heart rate before and after cross-country skiing.

- **Before skiing: 6 beats for every five seconds**
- **After skiiing: 9 beats for every five seconds**

By how many beats did her heart rate increase in one minute

*****

Please select one answer

Please choose **all** that apply:

- ☐15
- ☐30
- ☐36
- ☐45

35 [30]

At the ski hill, Alain drank 650mL of water and Remy drank 750mL of water.

ABOUT how many liters of water did they drink in total?

*

Please select one answer

Please choose **all** that apply:

- ☐1 L
- ☐1.5 L
- ☐2 L
- ☐2.5 L

Confidence in learning Mathematics Scale

36 [1]

Confidence in Learning Math Scale

On this page is a series of statements. There are no "correct" answers for these statements. They have been set up in a way that permits you to indicate the extent to which you agree, or disagree, with the ideas expressed.
As you read the statement, you will know whether you agree or disagree; it is simply your personal opinion.

If you strongly agree, select "5";
if you agree but with reservations, select "4"
if you have no opinion one way or the other, select "3"
if you disagree select "2"
if you strongly disagree, select "1".

*****

Please choose the appropriate response for each item:

	1	2	3	4	5
Generally, I have felt secure about attempting Mathematics	○	○	○	○	○
I am sure I could do advanced work in Mathematics	○	○	○	○	○
I am sure that I can learn Mathematics	○	○	○	○	○
I think I could handle more difficult Mathematics	○	○	○	○	○
I can get good grades in Mathematics	○	○	○	○	○
I have a lot of self-confidence when it comes to Mathematics	○	○	○	○	○
I'm no good at Math	○	○	○	○	○
I don't think that I could do advanced Mathematics	○	○	○	○	○
I'm not the type to do well in Math	○	○	○	○	○
For some reason, even though I study, Math seems unusually hard for me	○	○	○	○	○
most subjects I can handle OK, but I have a knack for messy up in Math	○	○	○	○	○
Math has been my worst subject	○	○	○	○	○

Attitude toward Success in Mathematics Scale

37 [1]

Attitudes toward Success in Mathematics Scale

On this page is a series of statements. There are no “correct” answers for these statements. They have been set up in a way that permits you to indicate the extent to which you agree, or disagree, with the ideas expressed.
As you read the statement, you will know whether you agree or disagree; it is simply your personal opinion.

If you strongly agree, select “5”
If you agree but with reservations, select “4”
If you have no opinion one way or the other, select “3”
If you disagree select “2"
If you strongly disagree, select “1”.

*****

Please choose the appropriate response for each item:

	1	2	3	4	5
It would make me happy to be recognized as an excellent student in mathematics.	○	○	○	○	○
I’d be proud to be the outstanding student in math.	○	○	○	○	○
I’d be happy to get top grades in mathematics.	○	○	○	○	○
It would be really great to win a prize in math.	○	○	○	○	○
Being first in a math competition would make me pleased.	○	○	○	○	○
Being regarded as smart in mathematics would be a great thing.	○	○	○	○	○
Winning a prize in math would make me feel unpleasantly noticeable.	○	○	○	○	○
People would think I was some kind of nerd if I got straight A’s in Math.	○	○	○	○	○
If I had good grades in math, I would try to hide it.	○	○	○	○	○
If I got the highest grade in math, I’d prefer if no one knew.	○	○	○	○	○
It would make people like me less if I were a really good math student.	○	○	○	○	○
I don’t like people to think I’m smart in math.	○	○	○	○	○

Mathematics Anxiety Scale

38 [1]

Mathematics Anxiety Scale

On this page is a series of statements. There are no "correct" answers for these statements. They have been set up in a way that permits you to indicate the extent to which you agree, or disagree, with the ideas expressed.
As you read the statement, you will know whether you agree or disagree; it is simply your personal opinion.

If you strongly agree, select "5"
If you agree but with reservations, select "4"
If you have no opinion one way or the other, select "3"
If you disagree select "2"
If you strongly disagree, select "1"

*****

Please choose the appropriate response for each item:

	1	2	3	4	5
Math doesn't scare me at all	◯	◯	◯	◯	◯
It wouldn't bother me at all to take more Math courses	◯	◯	◯	◯	◯
I haven't usually worried about be able to solve math problems.	◯	◯	◯	◯	◯
I almost never have gotten shook up during a math test.	◯	◯	◯	◯	◯
I usually have been at ease during math tests.	◯	◯	◯	◯	◯
I usually have been at ease during math classes.	◯	◯	◯	◯	◯
Mathematics usually makes me feel uncomfortable, and nervous.	◯	◯	◯	◯	◯
Mathematics makes me feel uncomfortable, restless, irritable, and impatient.	◯	◯	◯	◯	◯
I get a sinking feeling when I think of trying hard math problems.	◯	◯	◯	◯	◯
My mind goes blank and I am unable to think clearly when working on mathematics.	◯	◯	◯	◯	◯
A math test would scare me.	◯	◯	◯	◯	◯
Mathematics makes me feel uneasy and confused.	◯	◯	◯	◯	◯

Who and Mathematics Scale

39 [1]

Who and Mathematics Scale

On this page is a series of statements. There are no “correct” answers for these statements. You will be asked to respond by selecting one of the following:

BD - boys definitely more likely than girls
BP - boys probably more likely than girls
ND - no difference between boys and girls
GP - girls probably more likely than boys
GD - girls definitely more likely than boys

*****

Please choose the appropriate response for each item:

	BD	BP	ND	GP	GD
Mathematics is their favourite subject.	○	○	○	○	○
Think it is important to understand the work in mathematics.	○	○	○	○	○
Are asked more questions by the mathematics teacher.	○	○	○	○	○
Give up when they find a mathematics problem is too difficult.	○	○	○	○	○
Have to work hard in mathematics to do well.	○	○	○	○	○
Enjoy mathematics.	○	○	○	○	○

	BD	BP	ND	GP	GD
Care about doing well in mathematics.	○	○	○	○	○
Think they did not work hard enough if they don't do well in mathematics.	○	○	○	○	○
Parents would be disappointed if they do not do well in mathematics.	○	○	○	○	○
Need mathematics to maximise future employment opportunities.	○	○	○	○	○
Like challenging mathematics problems.	○	○	○	○	○
Are encouraged to do well by the mathematics teacher.	○	○	○	○	○
Mathematics teachers think they will do well.	○	○	○	○	○
Think mathematics will be important in their adult life.	○	○	○	○	○
Expect to do well in mathematics.	○	○	○	○	○

Who and Mathematics Continued

40 [2]

Who and Mathematics Scale Continued.

On this page is a series of statements. There are no “correct” answers for these statements. You will be asked to respond by selecting one of the following:

BD - boys definitely more likely than girls
BP - boys probably more likely than girls
ND - no difference between boys and girls
GP - girls probably more likely than boys
GD - girls definitely more likely than boys *

Please choose the appropriate response for each item:

	BD	BP	ND	GP	GD
Distract other students from their mathematics work.	○	○	○	○	○
Get the wrong answers in mathematics.	○	○	○	○	○
Find mathematics easy.	○	○	○	○	○
Parents think it is important for them to study mathematics.	○	○	○	○	○
Need more help in mathematics.	○	○	○	○	○
Tease boys if they are good at mathematics.	○	○	○	○	○
Worry if they do not do well in mathematics.	○	○	○	○	○
Are not good at mathematics.	○	○	○	○	○

	BD	BP	ND	GP	GD
Like using computers to work on mathematics problems.	○	○	○	○	○
Mathematics teachers spend more time with them	○	○	○	○	○
Consider mathematics to be boring.	○	○	○	○	○
Find mathematics difficult.	○	○	○	○	○
Get on with their work in class.	○	○	○	○	○
Think mathematics is interesting.	○	○	○	○	○
Tease girls if they are good at mathematics.	○	○	○	○	○

Additional Information

41 [1]Please include any additonal information that you wish to share about your experiences, thoughts, or feelings regarding your mathematics courses

Please write your answer here:

Thank you for completing this survey!

Submit your survey.
Thank you for completing this survey.

Appendix 7: Data Collection Methods Cont: Qualitative Methods

Q.1: Name: ___________________________________

Q.2: Age:____________________________________

Q.3: Please describe your school life / typical day at school
Teachers?
Friends?

Q.4: When I say "attitude" what does that mean to you?

Q.5: Please tell me about your favorite part of Math class. What about your best experience with Math (Why?)

Q.6: Please explain your least favorite part of Math class What about your worst experience with Math in general (Go on… Why is that?)

Q.7: What do your friends think of math? (tell me more…, Can you elaborate on that?)

Q.8: When you are in math class, how do you feel?
Why?

Q.9: When you get stuck on a math question, what do you do?
Why?

Q. 10: The survey determined that boys were more likely to give up when they find a math problem too difficult than girls, why do you think that is?

Q. 11: Does North Saanich Middle school have any academic help programs just for boys or just for girls? Do you think it would help? Would students go?

Q. 12: Do you think that boys or girls are more likely to find math easy?

Q. 13: Does your teacher seem to spend more time with the boys or the girls, or is it about equal? Why?

Q. 14: What do you think about the textbook for Math?

Q. 15: The survey found that girls were more likely to get on with their work in class, what do you think? Why?

Q.16: Do you consider Math to favor boys, girls, or neither?
Please explain the reason behind your response in the previous question

Appendix 8: West Rock Middle School FSA Results Table

West Rock Middle School BC FSA test results 2007 - 2012												
SCHOOL YEAR	POPULATION	NUMBER WRITERS	NUMBER UNKNOWN	PERCENT UNKNOWN	NUMBER NOT YET MEETING	PERCENT NOT YET MEETING	NUMBER MEETING	PERCENT MEETING	NUMBER EXCEEDING	PERCENT EXCEEDING	NUMBER MEETING AND EXCEEDING	PERCENT MEETING AND EXCEEDING
2007/2008	All Students	150	3	2	34	22	105	69	11	7	116	76
2007/2008	Female	68	1	1	18	26	44	64	6	9	50	72
2007/2008	Male	82	2	2	16	19	61	73	5	6	66	79
2008/2009	All Students	152	8	5	51	32	96	60	5	3	101	63
2008/2009	Female	73	2	3	26	35	43	57	4	5	47	63
2008/2009	Male	79	6	7	25	29	53	62	1	1	54	64
2009/2010	All Students	108	28	21	28	21	76	56	4	3	80	59
2009/2010	Female	61	11	15	16	22	43	60	2	3	45	63
2009/2010	Male	47	17	27	12	19	33	52	2	3	35	55
2010/2011	All Students	100	28	22	34	27	60	47	6	5	66	52
2010/2011	Female	44	6	12	17	34	26	52	1	2	27	54
2010/2011	Male	56	22	28	17	22	34	44	5	6	39	50
2011/2012	All Students	132	5	4	50	36	72	53	10	7	82	60
2011/2012	Female	64	2	3	15	23	41	62	8	12	49	74
2011/2012	Male	68	3	4	35	49	31	44	2	3	33	46

Appendix 9: West Rock Middle School BC FSA Comparison to Adapted FSA

West Rock Middle School BC FSA test results 2012

SCHOOL YEAR	POPULATION	NUMBER WRITERS	NUMBER UNKNOWN	PERCENT UNKNOWN	NUMBER NOT YET MEETING	PERCENT NOT YET MEETING	NUMBER MEETING	PERCENT MEETING	NUMBER EXCEEDING	PERCENT EXCEEDING	NUMBER MEETING AND EXCEEDING	PERCENT MEETING AND EXCEEDING
2011/2012	All Students	132	5	4	50	36	72	53	10	7	82	60
2011/2012	Female	64	2	3	15	23	41	62	8	12	49	74
2011/2012	Male	68	3	4	35	49	31	44	2	3	33	46

West Rock Middle School Adapted Achievement results 2012

SCHOOL YEAR	POPULATION	NUMBER WRITERS	NUMBER UNKNOWN	PERCENT UNKNOWN	NUMBER NOT YET MEETING	PERCENT NOT YET MEETING	NUMBER MEETING	PERCENT MEETING	NUMBER EXCEEDING	PERCENT EXCEEDING	NUMBER MEETING AND EXCEEDING	PERCENT MEETING AND EXCEEDING
2011/2012	All Students	69	24	35	20	29	18	26	7	10	25	36
2011/2012	Female	36	11	31	9	24	11	31	5	14	16	44
2011/2012	Male	33	13	39	11	34	7	21	2	6	9	27

Appendix 10: Quantitative Data Results Table

			Response Category				
Item	M^a	SD	1	2	3	4	5
Conf. 1	3.91	1.02	1 2.10%	3 6.40%	10 21.30%	16 34.00%	15 31.90%
Conf. 2	3.44	1.24	3 6.40%	8 17.00%	11 23.40%	12 25.50%	11 23.40%
Conf. 3	4.4	0.91	1 2.10%	0 0%	7 14.90%	9 19.10%	28 59.60%
Conf. 4	3.56	1.25	3 6.40%	7 14.90%	10 21.30%	12 25.50%	13 27.70%
Conf. 5	4.18	1.05	1 2.10%	3 6.40%	6 12.80%	12 25.50%	23 48.90%
Conf. 6	3.87	1.03	1 2.10%	4 8.50%	9 19.10%	17 36.20%	14 29.80%
Conf. 7	4	1.17	2 4.30%	3 6.40%	9 19.10%	10 21.30%	21 44.70%
Conf. 8	3.64	1.35	5 10.60%	4 8.50%	9 19.10%	11 23.40%	16 34.00%
Conf. 9	3.76	1.23	2 4.30%	6 12.80%	10 21.30%	10 21.30%	17 36.20%
Conf. 10	3.76	1.25	3 6.40%	4 8.50%	11 23.40%	10 21.30%	17 36.20%
Conf. 11	3.84	1.24	2 4.30%	6 12.80%	8 17%	10 21.30%	19 40.40%
Conf. 12	3.91	1.38	5 10.60%	3 6.40%	5 10.60%	10 21.30%	22 46.80%
Att. 1	3.87	1.04	1	2	12	14	15

			2.10%	6.40%	25.50%	29.80%	31.90%
Att. 2	3.8	1.06	0 0%	5 10.60%	15 31.90%	9 19.10%	16 34.00%
Att. 3	4.27	0.97	1 2.10%	2 4.30%	5 10.60%	13 27.70%	24 51.10%
Att. 4	3.69	1.06	2 4.30%	2 4.30%	16 34.00%	13 27.70%	12 25.50%
Att. 5	3.56	1.2	3 6.40%	5 10.60%	13 27.70%	12 25.50%	12 25.50%
Att. 6	3.8	0.97	1 2.10%	2 4.30%	14 29.80%	16 34.00%	12 25.50%
Att. 7	3.49	1.04	1 2.10%	6 12.80%	17 36.20%	12 25.50%	9 19.10%
Att. 8	3.47	1.36	5 10.60%	7 14.90%	8 17.00%	12 25.50%	13 27.70%
Att. 9	4.18	0.96	1 2.10%	2 4.30%	5 10.60%	17 36.20%	20 42.60%
Att. 10	4.13	0.99	1 2.10%	2 4.30%	7 14.90%	15 31.90%	20 42.60%
Att. 11	4.24	0.98	1 2.10%	1 2.10%	8 17%	11 23.40%	24 51.10%
Att. 12	4.22	0.9	1 2.10%	0 0%	8 17%	15 31.90%	21 44.70%
Anx. 1	3.89	1.15	2 4.30%	4 8.50%	8 17.00%	14 29.80%	17 36.20%
Anx. 2	3.42	1.22	4 8.50%	6 12.80%	11 23.40%	15 31.90%	9 19.10%
Anx. 3	3.6	1.14	3	3	14	14	11

			6.40%	6.40%	29.80%	29.80%	23.40%
Anx. 4	3.24	1.32	6 12.80%	7 14.90%	11 23.40%	12 25.50%	9 19.10%
Anx. 5	3.36	1.26	3 6.40%	10 21.30%	11 23.40%	10 21.30%	11 23.40%
Anx. 6	3.49	1.2	2 4.30%	10 21.30%	7 14.90%	16 34.00%	10 21.30%
Anx. 7	3.91	1.12	1 2.10%	5 10.60%	9 19.10%	12 25.50%	18 38.30%
Anx. 8	4.02	1.06	0 0.00%	6 12.80%	6 12.80%	14 29.80%	19 40.40%
Anx. 9	3.89	1.09	0 0.00%	8 17.00%	5 10.60%	16 34.00%	16 34.00%
Anx. 10	3.78	1.24	3 6.40%	4 8.50%	10 21.30%	11 23.40%	17 36.20%
Anx. 11	4.04	1.13	1 2.10%	5 10.60%	6 12.80%	12 25.50%	21 44.70%
Anx. 12	4.09	1.1	2 4.30%	2 4.3%	7 14.90%	13 27.70%	21 44.70%
Who. 1	3.33	0.78	1 2.10%	3 6.40%	24 51.10%	14 29.80%	3 6.40%
Who. 2	3.27	0.69	0 0.00%	4 8.50%	27 57.40%	12 25.50%	2 4.30%
Who. 3	3.16	1.04	3 6.40%	6 12.80%	23 48.90%	7 14.90%	6 12.80%
Who. 4	2.4	0.94	8 17.00%	16 34.00%	17 36.20%	3 6.40%	1 2.10%
Who. 5	2.91	0.67	2	6	31	6	0

			4.30%	12.80%	66.00%	12.80%	0.00%
Who. 6	3.31	0.76	1 2.10%	2 4.30%	27 57.40%	12 25.50%	3 6.40%
Who. 7	3.67	0.85	1 2.10%	2 4.30%	14 29.80%	22 46.80%	6 12.80%
Who. 8	3.2	0.59	1 2.10%	1 2.10%	31 66.00%	12 25.50%	0 0.00%
Who. 9	3.4	1.01	3 6.40%	1 2.10%	23 48.90%	11 23.40%	7 14.90%
Who. 10	3	0.77	2 4.30%	6 12.80%	28 59.60%	8 17.00%	1 2.10%
Who. 11	3.2	0.79	0 0.00%	8 17.00%	22 46.80%	13 27.70%	2 4.30%
Who. 12	3.16	0.8	0 0.00%	6 12.80%	31 66.00%	3 6.40%	5 10.60%
Who. 13	3.44	0.81	1 2.10%	1 2.10%	25 53.20%	13 27.70%	5 10.60%
Who. 14	3.07	0.89	2 4.30%	7 14.90%	25 53.20%	8 17.00%	3 6.40%
Who. 15	3.42	0.78	1 2.10%	2 4.30%	22 46.80%	17 36.20%	3 6.40%
Who. 16	2	0.88	13 27.70%	22 46.80%	8 17%	1 2.10%	1 2.10%
Who. 17	2.51	0.94	7 14.90%	13 27.70%	22 46.80%	1 2.10%	2 4.30%
Who. 18	3.64	0.83	0 0.00%	2 4.30%	20 42.6%	15 31.90%	8 17.00%
Who. 19	3.12	0.78	2	2	29	10	2

			4.30%	4.30%	61.7%	21.30%	4.30%
Who. 20	2.4	0.81	7 14.90%	15 31.90%	21 44.7	2 4.30%	0 0.00%
Who. 21	2.56	0.99	8 17%	11 23.40%	20 42.60%	5 10.60%	1 2.10%
Who. 22	3.5	0.89	2 4.3	0 0.00%	21 44.70%	16 34.00%	6 12.80%
Who. 23	2.47	0.72	6 12.80%	12 25.50%	27 57.40%	0 0.00%	0 0.00%
Who. 24	2.56	0.62	3 6.40%	14 29.80%	28 59.60%	0 0.00%	0 0.00%
Who. 25	2.71	0.92	4 8.50%	14 29.80%	19 40.40%	7 14.90%	1 2.10%
Who. 26	2.47	0.98	9 19.10%	11 23.40%	21 44.70%	3 6.40%	1 2.10%
Who. 27	2.42	0.84	8 17.00%	12 25.50%	23 48.90%	2 4.30%	0 0.00%
Who. 28	3.6	0.78	0 0.00%	5 10.60%	10 21.30%	27 57.40%	3 6.40%
Who. 29	3.36	0.71	0	3 4.30%	26 55.30%	13 27.70%	3 6.40%
Who. 30	2.89	0.75	2 4.30%	8 17.00%	29 61.70%	5 10.60%	1 2.10%