Senior-Level Math Teachers’ Perceptions on Student and Teacher Math Anxiety in the Classroom

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Abstract

This research paper investigated two secondary mathematics teachers’ perceptions of mathematics anxiety in the classroom. The research findings added to the current body of research on the topic of mathematics anxiety by outlining what the teachers believed mathematics anxiety to be and by determining how they address mathematics anxiety in their classrooms. An extensive literature review and two face-to-face interviews were done to collect the data. The findings of the paper were highlighted through three main themes: 1) how mathematics anxiety and inquiry-based learning is defined by two secondary math teachers; 2) how secondary math teachers perceive math anxiety in their students and colleagues; 3) what strategies two secondary math teachers implemented to address math anxiety and promote student success in mathematics courses. This research paper will not only demonstrate the current perceptions of mathematics anxiety in the secondary school classroom, but also provide educators and researchers a foundation to start building knowledge on pedagogy that effectively promotes student success in mathematics classrooms from kindergarten to grade 12.

Key Words: Mathematics Anxiety, Strategies, Mathematics, Inquiry-based learning, Intermediate/Senior
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Chapter 1: INTRODUCTION

When asked whether they enjoy mathematics, most people will say “I’m horrible at math!” or “I hate math!” I feel like disliking mathematics is becoming increasingly part of the status quo in Ontario. This trend is concerning since mathematics is integrated into many aspects of everyday life, particularly that of intermediate and senior students who are required by the curriculum to complete mathematics up to grade 11. Learning is a multi-faceted process that is influenced by one’s interests, learning style, and attitude toward learning. Negative attitudes toward mathematics can result in decreased motivation to learn and lead to performance anxiety. The Ontario mathematics curriculum recognizes the importance of attitudes for math learning by outlining that teachers can help develop students’ confidence by demonstrating a positive disposition towards math (The Ontario Curriculum: Secondary Mathematics Grade 9 and 10, 2007). Mathematics anxiety peaks during adolescence – a time when most students are in grades 9 and 10 (Ashcraft & Moore, 2009; Bekdemir, 2010). Teachers who have experienced math anxiety are most likely to understand their students' attitudes. However, they may not have the tools or means to help their students overcome negative attitudes towards math. Teaching mathematics is difficult due to the challenging nature of the material and the increasing occurrence of math anxiety. Therefore, it is necessary that teacher education programs prepare teachers for the rising prevalence of math anxiety by addressing the teachers’ needs and providing tools to address the students’ attitudes. Additionally, it is important to examine how teachers perceive mathematics anxiety in the classroom. The topic of math anxiety will be explored in depth in Chapter 2: LITERATURE REVIEW.
Purpose of the Study

The purpose of this case study is to address the following question:

What are the perceptions of two senior-level mathematics teachers on the impact of teacher and student math anxiety on student success in mathematics?

Other questions to support the central research question include:

1. How do senior teachers define and perceive mathematics anxiety?
2. What resources/strategies do teachers perceive to be the best to address mathematics anxiety of their students?

For the purpose of this study mathematics anxiety is defined as the anxiety related to performance in mathematics which includes: learning new mathematical concepts, taking of tests and evaluations, and explaining learned concepts (discussed further in Chapter 2: LITERATURE REVIEW).

Teachers are in a position to influence the attitudes of the students they teach. This case study explores how senior teachers of mathematics perceive the impact of math anxiety on their students’ academic performance in mathematics. This study will also examine teacher perceptions of the possible impact of strategies in addressing mathematics anxiety. This study aims to shed light on methods of reducing overall mathematics anxiety in classrooms.

Additionally, it is useful to determine if the literature supports or contrasts the current teachers’ perceptions of mathematics anxiety. In summary, it might be helpful to know how teachers perceive the impact of mathematics anxiety on student success.
Research Questions

The central question to be addressed in my research is: What are the perceptions of two senior-level mathematics teachers on the impact of teacher and student mathematics anxiety on student success in mathematics?

Other questions to support the central research question include:

1. How do teachers define and perceive mathematics anxiety?
2. What resources/strategies do teachers perceive to be the best to address mathematics anxiety of their students?

Background of the Researcher

My first interest in mathematics anxiety arose from my unique experiences in elementary and high school. My life changed dramatically at the age of 9 and the catalyst for my research interest was the “big move” to Portugal. I completed grade 4 at Collegio Luso International du Porto (C.L.I.P.), an English-speaking private school. I recall adjusting well to the difficult curriculum but watched my sister, then in grade 11, struggle to adjust since the material was significantly more challenging. At the time, her teachers shared with my parents that my sister was a bright student but lacked the necessary foundation to keep up with the curriculum. Returning to Ontario a year later, my sister and I needed to re-adjust to the curriculum and instructors. My sister continued to struggle through her final years of mathematics in high school, coping with some mathematics anxiety. I adjusted well since I was always successful in my coursework and self-identified as being good at math. When we moved yet again and I transitioned to secondary school, my confidence in social situations was shaken but my success in mathematics was not. Further success in
first year university mathematics helped me solidify my confidence and I self-identified as a “math person”. I truly came to appreciate mathematics during my undergraduate degree and further developed my interest in sharing a love for mathematics and science through teaching by completing my Masters of Teaching degree.

My experiences in tutoring mathematics brought me to the topic of mathematics anxiety and a profound curiosity in why math anxiety occurs in some but not in others. Was it the curriculum, the teachers, or the students? Could there be another variable? I tutored many students in mathematics and felt that their attitudes towards the subject aligned. Having never experienced mathematics anxiety myself, I struggled to understand my students’ attitudes towards mathematics and felt it played an important role in their efforts towards success. Thus, this research project was a means to explore a topic that I felt was important to student success in mathematics and would educate me on an issue I did not experience.

As a teacher candidate in the Masters of Teaching program at the Ontario Institute for Studies in Education, I have reflected on the role of the teacher in the classroom. As a result, I felt it was important to examine what roles, if any, the teacher played in fostering mathematics anxiety and what strategies could be used successfully to address mathematics anxiety. In addition, my graduate courses raised my awareness of the role of teachers’ perceptions and biases in shaping the classroom and the impact of hidden or null curriculum (Finnessey, 2006). My experiences motivated me to ask what were the perceptions of educators of mathematics who have had experiences with mathematics
anxiety (either their own or of their students) and how did they address mathematics anxiety when they perceived it.

Through discussions with colleagues and students during my teaching experiences I became aware that my love for mathematics was not widely shared. Through this research project I hoped to gain an understanding of the role of mathematics anxiety in the classroom and possible strategies to address it so that I can help my students experience the joy that I do in mathematics.

**Overview**

I have introduced my topic and outlined the purpose of the study in Chapter 1: INTRODUCTION and included the research questions, as well as how I came to be involved in this topic and study. Chapter 2: LITERATURE REVIEW reviews the literature, placing the research question in the broad scope of the field studying mathematics anxiety. I provide the methodology and procedures used in this study in Chapter 3: METHODOLOGY, including information about the participants and data collection instruments. Chapter 4: FINDINGS describes the data and analysis and Chapter 5: DISCUSSION describes the implications the data has on the study, recommendations for practice, and further reading and study. Following the five chapters are the References and Appendices.
Chapter 2: LITERATURE REVIEW

In this literature review I examine how mathematics anxiety is defined in the current published works. In the subsequent sections I also review the possible causes of mathematics anxiety, discuss briefly the effects of math anxiety on the learner and discuss how mathematics anxiety relates to teachers. Due to the frequency of the term inquiry-based learning in my teacher education program, a brief review of the literature regarding inquiry-based learning in mathematics is presented. Finally, the last section discusses the research question again in response to the literature reviewed.

Mathematics Anxiety Defined

In order to address a problem, one must first understand what the problem is. Teachers are faced with the challenge of mathematics anxiety that they may observe in their students. Research on mathematics anxiety has its foundation in the general study of the psychology of anxiety. The work of Spielberger (1972) is particularly significant and he is still often cited for his description of anxiety. Spielberger (1972) describes anxiety as a “condition characterized by feelings of tension and apprehension” (p. 24). His description was extended to divide anxiety into two types: state and trait. State anxiety is an emotional condition that varies in intensity and fluctuates over time, while trait anxiety is a general tendency to be anxious (Gaudry & Spielberger, 1971). Mathematics anxiety is a form of state anxiety since mathematics anxiety sets in when students gain feelings of tension and apprehension towards the subject. Recently, some researchers feel that the term ‘mathematics anxiety’ has become a catch-all for any negative feelings regarding math and, therefore, it has lost some of its usefulness (Taylor & Fraser, 2013). While definitions seem
to span many different views, the definition that clarifies what most people think of when they hear the term mathematics anxiety is as follows: “Mathematics anxiety is an inconceivable dread of mathematics that can interfere with manipulating numbers and solving mathematical problems within a variety of everyday life and academic situations” (Buckley & Ribordy, 1982, p. 1; Ashcraft, 2002; McLeod, 1992). The term mathematics anxiety has become synonymous with the terms: math fear, math phobia, math hate and math panic. As described in Chapter 1: INTRODUCTION, the definition of mathematics anxiety used for the purposes of this research paper is summarized as the anxiety related to performance in mathematics which includes: the learning of new mathematical concepts, taking of tests and evaluations, and explaining learned concepts.

**Causes of Mathematics Anxiety**

There is a wide range of possible causes for why someone develops mathematics anxiety. The literature discusses many causes that can be categorized into the following four groups: family influences, society influences, biological influences, and school influences.

Family influences can cause mathematics anxiety when parents’ expectations of their child’s ability are limited (Tobias, 1993). Additionally, if parents tend to avoid mathematics or are afraid of math they can pass that mathematics anxiety on to the next generation by modeling behaviours of their own discomfort with the subject (Furner & Duffy, 2002; Zaslavsky, 1994). Furthermore, students from families of low socio-economic background are at a disadvantage in mathematics since they are not typically provided
with the extra supports at home or in the community to succeed (Furner & Duffy, 2002; Geist, 2010).

Society can generate and perpetuate ideas about mathematics which can have an effect on a student’s attitude towards mathematics. Generally accepted ideas that math is hard and even stereotypes perpetuated in the media can affect how students perceive mathematics. Although society views mathematics as important for everyone to learn, evident by the Ontario law mandating that students learn mathematics until grade 11, there is a prevalent opinion that few people are capable at math (Tobias, 1993).

Many people blame their difficulties with mathematics on their lack of a mathematical mind, the notion that men are better than women at mathematics, lack of a good memory, or having a learning disability (Furner & Duffy, 2002). The misconception of some students that success in mathematics is innate can be another factor of mathematics anxiety. Studies also describe a neurological disorder of mathematical abilities called dyscalculia. Vaidya (2004) defines dyscalculia as either quantitative (a deficit in counting and calculating skills) or as qualitative (a difficulty in comprehension of instructions or lacking skills for an operation). This disorder causes a discrepancy between an individual’s cognitive ability and mathematical ability that affects at least 6% of school-aged children and causes difficulty understanding and manipulating numbers (Wadlington & Wadlington, 2008). Further research on neurological causes of mathematics anxiety is needed to learn how it affects diagnoses, possible treatments, and education.

Finally, a student’s experiences at school can be a determinant for their aptitude in mathematics. Streaming students into specific leveled courses in mathematics in
secondary school can cause students to feel discouraged if they are placed in a lower stream and cause some students to believe it reflects negatively on their ability in mathematics (Zaslavsky, 1994). Similarly, mathematics is often taught in discrete parts that are often seen as abstract and not related to everyday life (Geist, 2010; Tobias, Overcoming math anxiety, 1993). Therefore, a student often goes through school believing mathematics requires memorization and does not develop the deep understanding that helps to impart confidence in mathematical performance (Zaslavsky, 1994). Low confidence in mathematics has been cited as a cause of mathematics anxiety and individuals with low confidence are cited to have increased mathematics anxiety when performing math-related tasks. (Bursal & Paznokas, 2006; Hopko, Mahadevan, Bare, & Hunt, 2003; Ashcraft, 2002; Hunsley, 1987).

**Effects of Mathematics Anxiety on a Learner**

As stated in the sections above, mathematics anxiety is rooted in the study of the psychology of anxiety which classifies anxiety as characterized by feelings of tension and apprehension. Thus, those experiencing mathematics anxiety feel tension, helplessness, mental disorganization and apprehension when learning mathematics or when required to manipulate numbers and solve math problems (Hunsley, 1987; Ashcraft, 2002). Apprehension can lead to avoiding mathematics by not taking mathematics during high school and before the end of their formal education (Tobias, 1993). Additionally, apprehension can lead to worry which is defined by Ellis et al (1993) as “intruding thoughts that reflect self-concern, doubt, or other negative affects” and can have negative impacts on cognitive ability (p. 86).
Anxiety can also be considered as a negative mood that has been linked to poor academic outcomes (Ma, 1999). As a result, students perform lower on standardized tests than those without mathematics anxiety (Ashcraft, 2002). Various studies have reported associations between student anxiety and student outcomes and have shown that mathematics anxiety can produce destructive results due to the cutback in learning effort, the limited perseverance and low independence that one is willing to endure (Bekdemir, 2010; Dane, 2005). Thus, it is students with mathematics anxiety who tend to have poor academic outcomes and poor attitudes regarding effort applied and their abilities. In addition, poor outcomes on tests can lead to poor self-concept and avoidance of mathematics (Wu, Barth, Amin, Malcarne, & Menon, 2012). The effects of poor self-concept or lack of confidence manifests through students’ perceptions of themselves as having low mathematical ability and can result from having mathematics anxiety (Ashcraft, 2002; Hunsley, 1987).

**How Mathematics Anxiety Relates to Teachers**

Mathematics anxiety relates to teachers in a variety of ways since teachers are meant to be leaders of the classroom and guide students through the curriculum. The literature reviewed is summarized below into the categories *The Anxious Teacher*, *Educating Teachers* and *Strategies to Help with Mathematics Anxiety*. The literature defines how teachers with mathematics anxiety may affect their classroom practice and the role of teacher education programs.
The Anxious Teacher in the Classroom

Many primary school mathematics teachers and pre-service teachers, have mathematics anxiety themselves (Perry, 2004). This can be an issue since teachers who have mathematics anxiety can instill a sense of anxiety in students by exhibiting nervousness or negative attitudes towards math (Geist, 2010; Bekdemir, 2010; Furner & Duffy, 2002). While some tension is important for learning situations, instructors should avoid creating environments that involve negative situations such as nervousness and dread (Ho, Senturk, Lam, Zimmer, Hong, & Okamoto, 2000). This is true since a crucial component of the learning environment is the emotional and affective feelings that students bring into the classroom regarding a specific subject area (Taylor & Fraser, 2013). Equally as critical is the fact that the teacher contributes to the learning environment as well. There are several studies that identify many implied and apparent behaviors exhibited by mathematics instructors that cause mathematics anxiety in students. Some of the behaviors include: exhibiting gender bias; having unrealistic expectations; communication and language barriers; quality of instruction; evaluation methods; and difficulty of material (English, 2002; Jackson & Leffingwell, 1999; Rodger, Murray, & Cummings, 2007). The roles of teachers, especially their positive support and equitable treatment of students, are factors that were important to the learning environment (Taylor & Fraser, 2013). Research of pre-service teachers found that: mathematics anxiety is prevalent among university students enrolled in teacher education programs; student mathematics anxiety was caused by past teacher’s behavior and teaching approach; and the percentage of students who had negative experience goes up
with the transition from the elementary and junior high school to high school level (Bekdemir, 2010). Thus the literature supports that a teacher’s attitudes and teaching strategies can play a key role in the development of student math anxiety.

**Educating Teachers**

Recognition of the importance of mathematics anxiety is considered by some as crucial for improvement of math education (McLeod, 1992). Many studies focus on what teachers can or should do to help students overcome their anxieties, but there is limited focus on how the teacher would overcome their own anxieties. Bekdemir (2010) reminds teacher candidates to not transfer their own anxieties of mathematics to prospective students because many students believe past teachers’ behaviour and teaching approaches are the basis of their anxiety. He also notes that teacher education programs should be aware that teacher candidates have their own background in mathematics that may cause anxiety and that the program should provide teacher candidates with skills to handle anxiety by encouraging professional and personal development (Bekdemir, 2010).

Bekdemir (2010) reminds teachers that stressful learning experiences related to mathematics can cause them to develop math anxiety. He stresses that teachers should find ways to decrease their anxiety level to prevent the effects of anxiety on their teaching practice. He suggests that pre-service teachers employ anxiety-reducing techniques that they can use in the classroom in addition to developing an awareness of their own anxiety levels. Further research is suggested to find ways for the candidates to cope with their anxiety and to determine how teachers avoid transferring their own anxiety to their students.
Strategies to Help with Mathematics Anxiety

As mentioned above, the appearance of mathematics anxiety occurs mostly in students in grades 9 and 10, and is usually due to an embarrassing moment (Ashcraft & Moore, 2009; Bekdemir, 2010). Since mathematics anxiety is caused by troublesome moments or negative experiences in mathematics, teacher strategies should include careful examination of instructional strategies that minimize the creation of occasions that build negative experiences and teachers should be calm and understanding, especially when students are asking for help (Bekdemir, 2010).

The research suggests that there are numerous activities that both teachers and students can do that assist in reducing mathematics anxiety. For example, Hackworth (1992) suggested that when students discuss and write about math feelings they can reduce anxiety because it increases awareness of their emotions. In addition, developing calming or positive ways to deal with fear of math, and taking frustration breaks are strategies that students should practice to overcome their anxiety (Hackworth, 1992). Teachers can help their students with math anxiety by becoming acquainted with good math instruction and study techniques, creating problem-solving techniques and encouraging students to be active learners (Hackworth, 1992; Bekdemir, 2010). Mathematics teachers at the intermediate and senior levels can use different strategies, like those above, to motivate students and assist with coping with mathematics anxiety. Little is mentioned in the literature about how well teachers with mathematics anxiety can successfully employ these strategies and positively affect their students. Tobias (1987) claimed a method to reduce math anxiety. She feels that learners must first recognize
when they are anxious about the math they are doing, then they must use techniques to cope such as controlling their breathing, visualizing success, using positive “I” messages with the goal to clear up the anxiety without ceasing to work on the math problem. Thus, through these strategies, teachers and students may be able to develop more confidence with mathematics.

In addition to strategies to reduce anxiety, teachers need to be educated on alternative forms of assessment that can help students gain confidence. Some alternatives that can take the pressure off the student to always perform well on a right or wrong paper-and-pencil test include: journal writing, self-reflections, portfolios, and interviews/observations (Furner & Duffy, 2002).

Finally, the research discusses prerequisite math skills for success in mathematics which include:

1. The ability to follow sequential directions
2. Keen sense of directionality of one’s position in space, and of spatial orientation and organization
3. Pattern recognition and extension
4. Visualization – the ability to conjure up and manipulate mental images
5. Estimation – ability to form a reasonable educated guess about size, amount, number and magnitude
6. Deductive reasoning – the ability to reason from general principle to a particular instance
7. Inductive reasoning – natural understanding that is not the result of conscious attention or reason.

(Mahesh Sharma, 2001 as referenced in Vaidya, 2004)

Teachers who are aware and ensure their students develop these skills will create math learning that is significant and goes beyond being temporary (Vaidya, 2004). Vaidya (2004) presented best practices in response to the prerequisite skills for success in mathematics, which included teaching math as a second language, teaching focusing
strategies and using visualization to help with sequencing. She discusses that mathematics requires instructional strategies that address the language of mathematics specifically since it poses a challenge for students. Teachers also need to explicitly teach students how to focus and follow steps in a specific order to achieve the correct answer. Additional strategies included providing practice with understanding number concepts, providing guided practice in reading word problems, and increasing pre-number skills and numeration through action teaching (Vaidya, 2004).

**Inquiry-based Learning**

The term inquiry-based learning has become more prevalent in educational policy and curriculum documents related to mathematics education over the past decade, indicating a major educational trend (Artigue & Blomhoj, 2013). Inquiry-based pedagogy in mathematics can be defined as teaching through a problem-solving approach. In this approach students, under the teacher’s guidance, start exploring an open-ended problem that allows for multiple correct answers and approaches with the goal that students learn and understand important aspects of a mathematical concept or idea; then a discussion of different attempts and solutions allows students to clarify their own ideas. Finally, teachers summarize and lead students to understand the key aspects of the mathematics concept based on the problem (Cai, 2010). Additionally, the inquiry process is a collaborative process, with particular emphasis on collective sharing and is not necessarily limited to the space of the classroom or even the school (Artigue & Blomhoj, 2013; Cai, 2010).

Inquiry-based learning was not traditionally used in mathematics education and its recent appearance seems to have been from increased studies in both mathematics and
science education (Artigue & Blomhoj, 2013). However, in order to be able to plan for and support inquiry-based learning for students, teachers need to experience and exercise inquiry in mathematics themselves, and need to develop their attitude about inquiry in their own teaching, which can be very difficult (Krainer, 2008). This is important since the role of the teacher in inquiry-based learning involves supporting and guiding the development of productive inquiry and involves teacher–student(s) discourse that contributes to the acquisition of meaning from the inquiry activity (Artigue & Blomhoj, 2013). The teacher needs to exercise inquiry in mathematics themselves in order to create opportunities for discourse, since discourse is unlikely to develop unless classroom participants have opportunities to engage in rich mathematical work, initiated by the tasks presented (Munter, 2014).

The acquisition of knowledge is gradual and results from innovation and construction of concepts. Thus inquiry-based learning positions students as the thinkers and decision makers and provides students with opportunities to acquire knowledge (Artigue & Blomhoj, 2013; Staples, 2007). For example, students solving non-routine problems have to develop their own strategies and techniques; they have to explore, conjecture, experiment and evaluate; and they are given substantial mathematical responsibilities (Artigue & Blomhoj, 2013). Specific practices of inquiry-based learning in mathematics are diverse and combine inquiry processes, for instance: problem solving, modelling, exploring, analysing documents and data, experimenting, explaining, reasoning, representing and communicating (Artigue & Blomhoj, 2013).
Response to Literature

My research aims to add to the existing literature by examining the perspective of two experienced intermediate and senior teachers about their experiences with mathematics anxiety as they have observed it in their classrooms. I feel it is important to include the teacher perspective when researching mathematics anxiety in the classroom because it is the teacher’s role in the classroom that can have the greatest impact on the learning environment. Additionally, there is value in learning about the teacher perspective since it is both the students and teachers’ perspectives that have an impact on the learning process. Furthermore, it is my goal to understand what strategies the teacher believes to be useful to address mathematics anxiety and to add to the body of literature on effective educational strategies for increasing student success in mathematics.
Chapter 3: METHODOLOGY

Procedure

This research project investigated the role of senior teachers’ perceptions of teacher and student mathematics anxiety in senior-level mathematics classrooms. The goals were to provide insight to the processes that teachers’ use to overcome and cope with mathematics anxiety and describe the strategies these teachers use in their classrooms to improve student success in mathematics. This project relied on qualitative research strategies which included reviewing the literature, conducting two interviews with intermediate and senior teachers, and analyzing the data collected to find themes and trends. Each section below describes the details of the process and the limitations to the study.

Literature Review

I conducted a review of the literature before collecting the data to inform myself of the relevant background information already available. For this research paper, the topics examined in the literature review discussed the definition of mathematics anxiety, the causes of mathematics anxiety, the effects of mathematics anxiety on the learner and how mathematics anxiety relates to teachers. Additionally, a brief review of strategies used to address mathematics anxiety in the classroom and a review of inquiry-based learning were conducted.

Since the focus of this paper was to examine how the teacher perceives mathematics anxiety in the teaching profession, the literature provided an understanding of the current issues in this area which guided my thinking and my development of interview questions.
Instruments of Data Collection

Data was collected in the form of two informal, semi-structured interviews. The interviews were face-to-face and were with two experienced intermediate/senior (grades 9-12) teachers of mathematics in the Ontario public school system. The interviews represented the perspectives of intermediate/senior teachers who had been teaching for 25 years and 4 years. In order to learn the teachers’ experiences and beliefs regarding the research questions, I conducted two face-to-face interviews of 42 minutes and 45 minutes.

Participants were contacted via email and interviews were arranged at a suitable time conducive to their schedules. Interviews were held privately in a quiet location chosen by the participant to ensure easy accessibility to the location for the participant. An audio record of the interviews was saved with my participants’ consent. Interview questions included the background of the participant, their current beliefs about teaching mathematics, and the strategies to address mathematics anxiety in their classroom. It was important to put the teachers’ experiences in context in order to understand the teaching strategies and traits being exemplified in their answers.

The interview style was informal but professional to encourage conversation and an open and honest dialogue. I accomplished this by introducing myself briefly and proceeding to express my appreciation for their participation. I accomplished open and honest dialogue through the interview questions which followed a logical progression from background information to mathematics anxiety specific questions to teaching practices (See Appendix B: Interview Questions for a full list of questions). I allowed participants to expand on their responses by asking them to “please explain” and by being flexible with the
order of my predetermined questions. I skipped questions that were already addressed and added questions, as needed, for clarification.

Examples of the questions I asked my participants included: What inspired you to become a teacher? Are you familiar with mathematics anxiety? What do you understand this to be? If you observe mathematics anxiety in your students, how would you address it?

Participants

For this study, I interviewed participants that I have not worked closely with to minimize the "backyard" effect that can result from recruiting participants who know me well and may answer questions in a manner that they believe will help my research.

Tom

My first participant, Tom (pseudonym), was a senior level mathematics teacher with 25 years of experience. Tom had taught all mathematics courses from grades 9 through 12. He was currently teaching a grade 9 and 10 essential split class, a grade 12 college and a grade 11 college class. His next semester would have him teaching grade 12 university, grade 11 college, and grade 12 workplace. Tom's undergraduate degree was in engineering, a field which he worked in for 9 to 10 years.

Sybill

My second participant, Sybill (pseudonym), was a senior level (grades 9-12) mathematics teacher and was currently teaching grade 9 applied and grade 10 academic. Her initial qualifications did not qualify her to teach mathematics; however she took an additional qualification course to add mathematics as a teachable.
Data Collection and Analysis

I collected data through two informal, semi-structured interviews that were tape-recorded. I began data analysis by transcribing the audio recording of the interviews using my computer's media player to strictly playback the recording at half-speed. I ensured the validity of my data by reviewing the transcripts several times while listening to the audio recording, thus ensuring the accuracy of the transcription process. The interviews were transcribed into smooth verbatim transcripts to facilitate the analysis process.

I then read each transcript taking note of significant quotes and codes by organizing them in a table (See Table 1 in Appendix C: Tables and Figures). Once I generated a table for each participant, I printed out the codes and physically sorted them into groups based on common ideas which became categories. The categories were either put together into groups by a common theme or became the theme grouping. Chapter 4 and 5 describe the findings from the data and the discussion, including implications and limitations that the findings have on the research.

Ethical Review Procedures

I conformed to the ethical review approval procedures for the Master of Teaching program by ensuring that all correspondence and communication with my participants was kept secure and confidential, thus maintaining the participants' identity and privacy. The participants were provided with a letter of consent (Appendix A: Letter of Consent for Interview) via email prior to the interview so that they were able to review the letter alone. I asked the participants if they had any questions prior to asking them to sign the letter of consent. A copy of the signed letter of consent was provided to them for their records. I
reminded my participants throughout the recruitment, interviewing and post-interview processes that they can withdraw at any time. I offered to share a copy of the transcripts and the final copy of this paper for their reading. Anonymity was secured by providing my participants with the pseudonyms Tom and Sybill. References to institutions such as the regional school board they work for and specific locations were removed from the transcripts in order to maintain confidentiality.

**Risk**

There were minimal risks involved for the participants. When conducting interviews, however, there were minor risks associated with asking questions of a personal nature. I had anticipated that by asking my participants about their experiences with mathematics anxiety that I could be asking them to reflect on feelings that were difficult to cope with. I addressed these concerns by reminding each participant that they could decline to answer any question at any time. Additionally, I took note of the participants’ non-verbal cues to ensure that the participant was not at risk.

**Benefits**

Benefits to the researcher included the partial fulfillment of graduate requirements for the Master of Teaching program at the Ontario Institute for Studies in Education at the University of Toronto. The research project has also added to the body of research on the topic of mathematics anxiety, with benefits that may help students, teachers, principals and faculties of education. Understanding the perspectives of teachers of mathematics anxiety in the Ontario classroom benefits both teachers and students since both can contribute positively in the classroom by reviewing and attempting the strategies that were discussed
in the research. Teachers benefit from the research because it reminds teachers of the prevalence of anxiety in the classroom while outlining strategies that current secondary teachers use to promote student success in mathematics.

**Limitations**

This case study was based on the information gathered through the interviews of two teachers of mathematics. The interviews probed into what the teachers perceived as mathematics anxiety, whether he or she experienced similar anxiety in the past, and how mathematics anxiety can permeate teaching. Since the data of this study was based only on two teachers’ opinions, there was the limitation that conclusions drawn from comparing the two cases could not be generalized. The results would have been more extensive if more teachers were interviewed. Despite the small sample size, interviewing two teachers should provide relatively in-depth understanding of their perspectives through the interview questions designed.

This study was limited to the teacher perspective of mathematics anxiety and did not address the student perspective of mathematics anxiety, or the specific effects of being taught by an educator who experienced mathematics anxiety themselves. The student perspective of the mathematics classroom would verify or enlighten the data collected from the teacher interviews. Since the focus of this study was the teacher perspective, I felt that the interview questions and procedure would provide a relatively honest perspective of the teachers’ classroom.

Personal experiences most likely varied between the teachers interviewed. Comparisons between cases were limited by the variation in past experiences that
accounted for the onset and the coping or overcoming of math anxiety. Variation, however, provided a realistic depiction of society, even though it limited the possibility for comparisons.

The researcher’s perspective further limited the scope of the study. The researcher’s perspective limited the study to focus on only math anxiety. This study did not explore the possibilities of teachers with anxiety in other subjects. The researcher also limited the study by not exploring in-depth the other anxieties that students face in the mathematics classroom. Furthermore, the researcher’s limited experience in qualitative research could have affected the data collection and analysis. Collaboration with advisors and the research supervisor were frequent to maximize the validity of the research.

Finally, time was a limiting factor due to the requirements of the program. More time would have allowed for greater data collection and analyses; however the interview questions and procedures were designed to maximize the data collected.
Chapter 4: FINDINGS

This chapter presents findings collected from two face-to-face interviews of senior-level mathematics teachers. The aim was to present the findings as a narrative with minimal interpretation or explanation. This section provides sufficient details of the data collected to subsequently be discussed in Chapter 5. It is organized by themes and outlines the comments from the participants pertaining to each theme. A brief re-introduction of the participants, Tom and Sybill, is presented prior to describing the themes.

Tom is a senior-level mathematics teacher in the Ontario public school system. He has been teaching for 25 years and has an undergraduate degree in engineering. He has taught all mathematics courses in the Ontario curriculum. At the time of the interview he was teaching grades 9/10, 11, and 12 classes. Sybill is a senior level mathematics teacher with 4 years of experience. She was teaching grades 9 and 10 at the time of the interview. Her initial qualifications did not qualify her to teach mathematics, but she took an additional qualification course to add mathematics as a teachable at the intermediate/senior level.

Participants’ definitions

The results from the interviews included a number of definitions that informed the participants’ thinking on the research topic. Mathematics anxiety was defined explicitly in response to the interview question, “what do you understand [math anxiety] to be?” The definition of inquiry-based learning resulted explicitly in response to the interview question, “what do you understand inquiry based learning to be?” Although not specifically the focus of this study, the participants referred frequently to what mathematics is and is
perceptions of math anxiety in the math classroom

not. Additionally, their definitions of what is necessary for success in mathematics was
important as it guided their thinking when answering questions about the strategies they
use in their classroom. The participants’ definition of inquiry-based learning is also
presented, since it provided context for their understanding of this teaching strategy.

Mathematics Anxiety

When asked what he understood math anxiety to be, Tom’s definition of
mathematics anxiety was two-fold. His first definition was:

When a student is, let’s say, doing their homework and … it’s very easy,
especially in a long, drawn out solution you make one little mistake and you
don’t get the right answer, and so you look in the back to see if you get the
right answer, and you get it wrong, and you try another one and you get it
wrong, so then they get frustrated and they get anxious and it doesn’t want
to make them do any more work. That’s one thing.

Tom’s second definition explained that students study and complete homework but
“blank-out” when they take the test. In discussing where he first learned about math
anxiety he indicated that mathematics anxiety was when students were trying and do their
work but do very poorly on tests. Tom was asked if math anxiety was a topic discussed
among his colleagues, and he observed that it was not “a major concern because the people
that do have math anxiety...are rare”. He referred to students doing poorly on tests and
attributing that to math anxiety. Tom said that math anxiety was a “psychological thing”
and could be explained by “anxiety on other tests” as well.

Sybill defined her understanding of math anxiety as “an extreme aversion to math”
and that it was not just discomfort with math tasks but “feeling physically anxious when
having to perform math tasks”. Her understanding suggested that mathematics anxiety led
to avoidance behaviour like avoiding a course and experiencing anxiety when doing simple tasks, such as giving change at a check-out. In confirming that she felt she had students with mathematics anxiety, Sybill revealed that she thought mathematics anxiety came from the students’ fear of failing, and of not being successful because they had not been successful before. She felt that “a lot of it comes from a poor [mathematics] foundation”.

Finally, when discussing why mathematics anxiety was not a topic of discussion among her and her colleagues, Sybill mentioned that mathematics anxiety, “like any mental health stigma, is the kind of thing where people don’t think it’s real or it is not a legitimate cause to not do well or to avoid math”. Sybill concluded by explaining that mathematics anxiety is not always about the mathematics but can be attributed to other factors.

Both Sybill and Tom defined mathematics anxiety similar to the literature as a dread of mathematics that interferes with performing mathematical tasks within a variety of everyday life and academic situations which includes explaining new mathematical concepts and taking of tests (Buckley & Ribordy, 1982; McLeod, 1992). Interestingly, Tom’s definitions focused on anxiety revolving around test taking while Sybill focused on anxiety related to performing mathematics tasks. Neither participant explicitly defined mathematics anxiety as “state anxiety”, which was described in the literature (Gaudry & Spielberger, 1971). Their definitions corresponded with the definition of state anxiety since they both recognized that mathematics anxiety is a condition that causes an emotional change over time.
Successful Students in Mathematics

Tom shared that to succeed in math you need to believe that math is easy. He felt that “math is easy, you just have to be shown what to do and if you don’t understand you ask questions and practice”. He noted that people come in thinking that math is difficult and “they already got themselves beat before they try anything”. Tom thought that there were three basic skills that students needed to possess in order to succeed in math. These skills comprised of knowing multiplication tables, integers and fractions. He thought that with those basic skills one can do a lot of other math and that those were the three skills the applied students did not have which did not allow them to learn the academic curriculum. He did not believe that it was because the academic material was any harder, but it was simply because they could not do the basic math. He thought that mathematics was progressive and that it was built on a strong foundation. Tom also emphasized that math was all about confidence. He felt that if students believed that they could not do it, then they would lose confidence and were not successful.

Sybill also believed that mathematics was all about confidence. She explained, “If someone goes into a course thinking I am bad at math, that is automatically an excuse for them to not do well”. She indicated that success in mathematics comes from a math foundation. She defined a mathematics foundation as students knowing their multiplication tables, having number sense such as recognising numbers and working with them easily, and having a sense of algebra such as rearranging equations. She also felt that being able to read and interpret questions was critical as it allowed students to move forward in their thinking. She believed that learning mathematics required the student to
sit down to try and learn something. She believed that anyone can learn and the problem was that students were not doing the work required to succeed. She admitted that as a high school student she also did not do all the work and thus struggled when she did not understand the concepts in university. She also noted that mathematics can lead to many career opportunities and reflected on her own missed opportunities because of her weak foundation in mathematics. Sybill noted the problem that contributes to a lack of success was that students lack the work ethic and expected to get something without doing any work for it. Sybill ended the interview by commenting that she did not think it took a “genius” to be able to do math and that, if everyone had a good foundation, there was no reason why one student had to do poorly in math while another did really well. She also did not think mathematics was about being “smart or dumb” but believed that it was about having the tools to perform a task.

Both Sybill and Tom felt that success in mathematics required confidence and a belief that mathematics was easy. The participants’ views were equivalent to the literature findings that stated students may go through school believing mathematics requires memorization and thus do not develop their confidence in mathematical performance (Zaslavsky, 1994). Furthermore, Sybill and Tom’s opinions also aligned with Furner and Duffy’s (2002) perspective that mathematics anxiety can be caused by the misconception that success in mathematics is innate or a result of having a mathematical mind. Although Tom believed that mathematics anxiety is psychological, neither participant explicitly mentioned dyscalculia as a cause for poor performance in mathematics, but they referred implicitly to the definition of dyscalculia, for instance, by describing students as lacking the
prerequisite skills to be successful. Both participants specifically described counting and calculating skills as important for success in mathematics, which also supports Vaidya’s (2004) definition of quantitative dyscalculia. Additionally, both participants did not mention societal or familial influences as a possible cause for mathematics anxiety or for the lack of success in mathematics. The literature, however, stated that society and family beliefs were two of the many causes that led to mathematics anxiety (Tobias, 1993; Geist, 2010).

The literature also states that the streaming of students by level can affect how students perceive their abilities, thus increasing anxiety in the subject (Zaslavsky, 1994). Sybill’s testimony neither supported nor refuted the literature since she only mentioned the levels of streaming (academic or applied) without specifically relating streaming to the success of her students. Tom also mentioned streaming in his responses but, unlike Sybill, he specified that students in the applied stream lacked the basic foundation to be successful. His response supported the literature, although it did not emphasize that streaming itself was the issue. Instead, Tom emphasized what skills his students lacked.

Both participants emphasized that their students lacked the necessary skills and work ethic to be successful in mathematics and that often poor performance was due to lack of homework completion. Both participants linked this to a lack of confidence in mathematics which supports findings from the literature that low-confidence in mathematics has been cited as a cause of increased mathematics anxiety when performing math-related tasks (Bursal & Paznokas, 2006; Hopko, Mahadevan, Bare, & Hunt, 2003; Hunsley, 1987). Both participants felt that knowing multiplication tables and integers
were important skills for success in mathematics. Tom felt that fractions were also important while Sybill thought that having a sense of algebra, such as rearranging equations, and being able to read and interpret questions were necessary skills for success. Their opinion of the skills necessary for success correlated with the literature, which summarized them as: pattern recognition, visualization, estimation, deductive reasoning and inductive reasoning (Vaidya, 2004).

**Inquiry-based learning**

Tom’s definition of inquiry-based learning was described explicitly in response to an interview question that was prompted by the previous response. Tom first mentioned inquiry-based learning as a strategy that elementary school teachers were expected, by their principal, to implement because they were not allowed to teach by rote learning. Tom was asked what he understood inquiry based learning to be when he again mentioned it in the interview.

Tom defined inquiry-based learning as learning by discovery. It was not simply about presenting the material and asking students to learn it, but rather that it required the teacher to use a lot of questions that are meant to guide students to what they need to know. He acknowledged that it involved the use of a lot of critical thinking questions. He explained that inquiry-based learning relied on using critical thinking skills to understand what the questions were asking in order to complete the task. Tom described inquiry-based learning as being more adaptable to elementary school than to secondary or post-secondary schools. He also felt that it was difficult to integrate inquiry-based learning into his classroom because he felt students completed the task he had prepared without gaining
the knowledge they needed to. He conceded that perhaps the approach was effective, but that he was unable to effectively implement it.

Sybill was asked what she thought the meaning of inquiry-based learning was as a follow-up to her responses about teaching strategies. Sybill defined inquiry-based learning from two views: as a lesson with an investigation base and as an overarching project that involved a real world problem without a solution. She felt the students were required to use a variety of concepts that they learned along the way, in order to attempt solving the problem. She also explained that inquiry-based learning was more interesting for the students and for the teacher since this strategy did not require constantly providing students with information. She felt this strategy used a lot of underlying skills in math, as well as problem solving and logic. Sybill concluded that the strategy did not work for all students and that it was time-consuming and difficult to incorporate due to curriculum demands. Both Tom and Sybill noted that inquiry-based learning was challenging for the teacher and did not work for some strands or topics in mathematics.

Both participants’ definitions supported the literature definition of inquiry-based learning in mathematics by describing an approach that uses problem-solving and critical thinking to teach important mathematical concepts (Cai, 2010). The literature emphasized the importance of the collaborative process in inquiry-based learning and that it was not restricted to the space of the classroom, however neither participant mentioned these aspects of the definition. Additionally, a key component of inquiry-based learning not mentioned by the participants but found in the literature was the importance of discourse to support and guide students as they found the meaning of the inquiry activity (Artigue &
Blomhoj, 2013; Munter, 2014). Tom’s personal challenge with implementing inquiry strategies and Sybill’s struggle with the time-consuming nature of these strategies exemplified the research findings that teachers need to experience and exercise inquiry in mathematics themselves in order to effectively incorporate these strategies (Krainer, 2008). Tom’s recognition of the role he played in the effectiveness of inquiry-based learning in his classroom was also supportive of the research. Both Tom and Sybill refuted the benefits of inquiry-based learning in the mathematics classroom by stating that it was not effective for all students and for certain topics within mathematics.

Evidence of Mathematics Anxiety

Participants’ perceptions of students’ mathematics anxiety

In response to the interview question “where did you first learn about math anxiety?” Tom shared that, initially, he attributed poor student performance to students not doing their work. He went on to say that he now sees that students are trying and completing their work but that they do poorly on tests. Tom described that his students would say “I studied, I did my homework, I did all the questions, I got to the test and I blank out”. He described how he would ask to see homework and that the students had completed it all, but they would still do poorly on the assessment. His observations of students in his mathematics courses aligned with how he defined mathematics anxiety (see Mathematics Anxiety above). His first definition of mathematics anxiety described a student who lacked the perseverance to continue practicing math because the student was frustrated from consistently getting the wrong answers. Tom felt that the biggest problem was that students were not motivated to do the necessary work to do well. He also
described his students as lacking confidence, and that his students were surprised when they correctly completed a problem. Tom’s observations of his students focused on their performance on assessments and their overall achievement. For example he noted that he had students achieving “60s and 50s in grade 9 academic” mathematics but that those students were “80s and 90s in math” in the previous year.

When asked how he perceived students with mathematics anxiety Tom shared that a lot of students thought math was difficult and that he noticed mathematics anxiety through student behaviour during assessments. For instance, he recalled when he had students cry during tests. He noted that, sometimes, after implementing his teaching strategies (see Strategies below), the student would calm down and perform better, but that it took time to get students down to calmer state. In response to several follow-up questions, Tom noted that the students struggling in mathematics often do not know what's happening, what to do, or are just lost.

As for Tom’s experiences as a student in math he shared that he was anxious writing tests in high school and university, and that he always felt a strong need to pass and get good marks. When asked to elaborate on his experiences as a student Tom corrected that he did not feel anxiety but felt a lot of pressure, noting that he did not really know the difference between pressure and anxiety.

Sybill admitted that when considering why her students were doing poorly she forgot math anxiety as an option and explained that a lot of the time teachers believe that students were not doing their homework and not putting in the effort required. She admitted that even she had assumed the cause of poor mathematics performance was due
to effort rather than anxiety. When asked if she felt that she had students with math anxiety, Sybill said that she did not and instead said that her students told her they hate math or have never been good at math. She observed that her students were never in the regular math classes because they were always taken out to be placed in a special course. She said her students were really afraid and that they had never had success in mathematics before. She thought they were more scared of failing than of the mathematics tasks and that this fear came from having not been successful in the past. Sybill also pointed out that her students panicked over certain topics, such as fractions. She felt that her students had a poor memory and got worked up easily, which Sybill associated with low-confidence. She pointed out that, if the student did not immediately know the answer, they started to panic. Sybill also discussed her frustration with standardized testing; she felt that it added to the students’ panic and she did not feel that it was a true representation of student performance in mathematics. She explained that some of her students could ask for clarification during tests or take a memory aid into a test in order to calm their anxieties but that the standardized testing rules did not allow such accommodations and therefore the test became a source of anxiety for students and students performed poorly.

When recalling her own experiences in math, Sybill admitted she did not know how she got through high school math. She admitted that she was a student with a weak foundation and that she had to work really hard in university to be successful.

The literature describes students with mathematics anxiety primarily through the description of emotions that they experienced such as tension, helplessness, and negative mood linked to poor outcomes (Hunsley, 1987; Ma, 1999). Tom’s description of students
with mathematics anxiety as being frustrated, unmotivated, lost, confused, sad, and prone to blanking out during tests aligns with their findings. In contrast, Sybill did not describe her students with such a diverse spectrum of emotions. Instead she felt that her students were mainly panicked and fearful, with an emphasis on the fear of failing. Sybill, unlike Tom, noted that her students often were not in the classroom with her, which supports the research findings that mathematics anxiety can lead to avoidance (Wu, Barth, Amin, Malcarne, & Menon, 2012). The literature links mathematics anxiety to poor academic outcomes and poor outcomes on standardized tests (Ashcraft, 2002; Ma, 1999). Tom did not refer to standardized testing with respect to student response and outcome. Sybill supported the research by stating that standardized testing added to the causes of mathematics anxiety in her students. She also felt that the rules in particular were the cause of anxiety for students since they were accustomed to having resources during tests and that the standardized test regulations restricted access to such resources. Both Tom and Sybill described their students as having low-confidence which supports literature findings that students with mathematics anxiety often have poor self-concept and a lack of confidence (Ashcraft, 2002; Hunsley, 1987). When reflecting on their own experiences as students, Tom initially felt anxiety during tests but felt the cause was his desire to have high grades, whereas Sybill identified as having anxiety because she lacked the foundation and work ethic necessary for success.
Participant’s perceptions of teachers’ mathematics anxiety

Tom first shared his perceptions of teachers’ mathematics anxiety in response to the interview question about whether he had had professional development for mathematics anxiety. He felt that a lot of the professional development had nothing to do with math because a lot of staff did not understand math and, in his observations, they stayed away from it. He provided evidence by describing the school’s literacy section. The school had a literacy section assigned to a teacher which was meant to include math literacy, such as numeracy. In the 10 years he had spent at that school, however, he had never seen one of those teachers do anything in math.

Tom shared that he did a lot of tutoring after school and that the reason the students needed a tutor was that the students’ teachers were not comfortable teaching senior courses and so the students did not have a strong grasp of the concepts after a lesson. When asked to explain how he could tell, Tom said that he would look at the students’ notes that they had copied from the board and saw that the questions did not make sense, the process that the teacher had gone through was complicated, and that there were often sections scratched out since the teacher had made a mistake. He said the students would explain that the teacher was doing something wrong and that if the notes were not finished it was because the teacher ran out of time. Tom felt this happened frequently and that the notes were template-like, where the teacher was following a process but not really providing an explanation. Additionally, Tom commented that underqualified teachers may teach courses that they are not comfortable with and therefore do not teach as effectively as a teacher who is passionate about the subject matter.
Tom has attended meetings with elementary school teachers to discuss the transition of grade 8 students to grade 9. He shared that the teachers told him that they had trouble understanding math. He provided an example of a grade 4 teacher that he thought had math anxiety because she asked him for help with the math curriculum and she expressed a fear of teaching mathematics. He recognized that students may fall behind if they have one or more teachers who are uncomfortable with teaching mathematics, admitting that elementary school teachers are challenged because they need to teach everything, and that “math is a difficult thing”. He believed that people who are comfortable teaching their preferred subjects do a better job and students benefit more when their teacher is confident in the subject they are teaching.

Without any prompt from the interviewer or the interview questions, Sybill shared that she believed that teachers experienced more math anxiety (especially elementary school teachers), than students did. When asked why, she replied that when she would tell friends that she taught math they would express amazement or share that they could never teach math. She talked to teachers that were afraid of elementary math and described those teachers as having no idea what was going on and that they were too afraid to do anything about it. Sybill also shared that she tutored students who had teachers that played YouTube videos of other teachers teaching math. She noted that she had used videos as an instructional tool as well, but that she would never substitute her teaching with a video of someone else teaching. She thought that a teacher with no confidence to teach math was probably afraid to teach it. Sybill reflected on the feelings she had when she was asked to teach grade 11 for the first time because she felt anxious about delivering
the content. She was afraid of being in a situation where she would not be able to answer a student’s question. She noted that she was not afraid of the topic of mathematics itself, but rather of appearing incompetent. Sybill also postulated that more elementary school teachers would have anxiety since they are required to teach everything.

The literature findings showed that many primary school teachers have mathematics anxiety themselves which was supported by both participants’ beliefs that more elementary school teachers have anxiety when teaching mathematics (Perry, 2004). Although not defined in the literature reviewed, both participants postulated that elementary teachers forced to teach all subject areas may be anxious to teach those subjects they are not comfortable with, which often is mathematics. Both participants supported their beliefs by describing elementary teachers as being afraid of teaching mathematics, needing help with the elementary mathematics curriculum, and displaying avoidance behaviour by not attending professional development in mathematics or relying on teaching strategies that minimized the teachers’ role in the classroom. The avoidance behaviour described by both participants demonstrates that teachers with mathematics anxiety may not be aware that they should consider professional and personal development opportunities to help develop their skills for dealing with anxiety (Bekdemir, 2010). Although Tom did not feel that he ever had anxieties about teaching mathematics, Sybill noted that her misgivings were due to a fear of appearing incompetent or unknowledgeable because of a poor background in content knowledge. Although she refutes that the topic of mathematics was the cause of anxiety, her statement supports the literature finding that a teachers’ own background in math may cause anxiety (Bekdemir,
2010). Only Tom specifically supported the literature findings that identified that many implied and apparent behaviors exhibited by math instructors can cause students to fall behind and develop math anxiety (English, 2002; Jackson & Leffingwell, 1999; Rodger, Murray, & Cummings, 2007). Sybill and Tom also explicitly identified the strategies used by teachers who have anxieties teaching math, which they felt demonstrated their lack of understanding and fear of teaching math. These strategies were typically ones of avoidance, as opposed to ones that directly addressed their own anxieties.

**Strategies**

Participants answered questions about their perspectives on strategies that helped students address mathematics anxiety and achieve academic success. The interview questions that collected this data were: “if you perceive math anxiety in your students, how would you address it?”; “what do you try to emphasize to your students when you are teaching?”; and “what would you say are the strategies you use in the classroom?”.

Throughout the interview, Tom spoke of the things that he had done or thought of that would be beneficial to the students’ learning of mathematics. He strongly believed that math is about confidence and he tried to give students confidence. He was not explicit in the ways he tried to give students confidence but discussed other strategies to help his students. He shared that he believed that practice and repetition helped students feel that they knew the material better and could help with feelings of anxiety. The literature discusses specific strategies that teaches students to reduce their mathematics anxiety, such as discussing and writing about math feelings, developing positive ways to deal with their fear of mathematics and take frustration breaks to overcome their mathematics
anxieties (Hackworth, 1992). In contrast to the literature, Tom felt that there was nothing he could do for students to help them overcome their anxiety since he was not a psychologist. However, he did comfort students that cried during a test by telling them not to worry, and by allowing the student to relocate to write the test with additional time. In terms of addressing anxiety specifically, Tom thought that if students were able to speak with a professional on the matter, they could be helped. He also claimed that he taught in a calm way and tried to convey the message, throughout the year, that math was very easy.

Teachers can help their students with mathematics anxiety through good mathematics instruction and study techniques by offering problem-solving techniques that explicitly teach students to focus and follow steps in a specific order (Hackworth, 1992; Bekdemir, 2010; Vaidya, 2004). Tom supported this notion, explaining that learning mathematics could be helped by showing students a process. The process included demonstrating what to do and showing a variety of ways to solve problems. He felt that students needed to ask questions when they did not understand, and needed to practice on extra sheets. He thought that the teacher needed to demonstrate process through explanations and completion of example questions with students. He also stated that he employed more creative solutions such as painting the classroom with numbers to make the environment more attractive and conducive to mathematics learning, which corroborates the literature findings that it is important to create a positive learning environment (Ho, Senturk, Lam, Zimmer, Hong, & Okamoto, 2000; Taylor & Fraser, 2013). He explained that students should seek extra help from the teacher, but that the teachers needed to provide good explanations and support as a means of creating an
emotionally positive learning environment. As mentioned above (see Successful Students in Mathematics above), Tom believed that math was based on a foundation of multiplication tables, fractions and integers which he thought could be learned well through rote learning and memorization.

Tom also discussed strategies that went beyond what the classroom teacher could implement. He shared that he had told the administration that the school should include initiatives in numeracy, much like the initiatives that happened for literacy throughout the year to prepare students for the Ontario Secondary School Literacy Test (OSSLT), but that his suggestions had fallen on deaf ears. He thought that having the students and teachers sit down and do numeracy activities once a week would be beneficial in improving students’ performance in mathematics and would serve to reduce mathematics anxiety.

The research in mathematics education stresses that inquiry-based learning is a valuable strategy to encourage students to become active learners because inquiry-based learning positions students as the thinkers and decision makers to provide them with opportunities to acquire knowledge (Artigue & Blomhoj, 2013). Tom refuted this perspective as he felt that inquiry-based activities actually had a negative impact on student learning. He also felt that inquiry-based learning was unsuccessful because:

What also doesn’t help the students is, if you have a student who has poor literacy skills and poor reading comprehension skills, which is what I find in grade 9; then they don’t even understand what the question is asking them. So they can’t be guided to where they want to go. So it’s just a wash. ... I’m not a believer in that.
Tom tried employing inquiry-based learning but felt that his students would complete the task and would not really understand what he wanted them to learn. He felt that inquiry-based learning was difficult to implement for many topics of mathematics and at higher grade-levels in education. Thus, he thought that this strategy left students feeling unprepared. Additionally, he felt that students improved their skills through practice and repetition which could increase their confidence by performing better over time.

Sybill’s strategies to address mathematics anxiety were to start by talking to the student, an example of a strategy suggested in the literature (Hackworth, 1992). Unlike Tom, Sybill felt that directly asking her students why they were feeling the way they were and trying to get to the root of those emotions was a good strategy to address mathematics anxiety. Like Tom, she felt that math was all about confidence and so she framed math in terms of what it is. For example, she told her students “they are just numbers and letters, they cannot hurt you”. She also tried to find out if there were other things causing fear in her students, which was a strategy that helped foster a positive learning environment (Ho, Senturk, Lam, Zimmer, Hong, & Okamoto, 2000; Taylor & Fraser, 2013). Sybill used a classroom website where she would post the lessons. She posted Khan Academy videos to supplement her lessons for students that were absent. Sybill was asked what she emphasized to her students when she taught mathematics, and responded that she tried to make things as simple as possible. She found that summarizing things for her students would help with their difficulty in remembering. Her simple lesson comprised of showing students what they needed to know, frequently asking if they understood, and providing examples. Her teaching strategies support research findings that teaching students to
focus and follow steps in a specific process can help with mathematics anxiety (Hackworth, 1992; Bekdemir, 2010; Vaidya, 2004). She asked students to try practice problems on their own or with a partner and used a document camera in the classroom to demonstrate student work to the rest of the class.

Sybill further exemplified the importance of a positive learning environment for her students by using questions from the homework as test questions (Ho, Senturk, Lam, Zimmer, Hong, & Okamoto, 2000; Taylor & Fraser, 2013). She also completed a challenging question immediately before handing out the test to show her students that the question was not that hard and to ensure that students went into the assessment with a positive and successful outlook on the topic at hand. She emphasized the value of summarizing and showing students that there are only a few options when completing math problems. For example, she tried to use examples that demonstrated to her students that the problem can only be solved in two ways so that she emphasized that students only need to remember the two possibilities. She believed compartmentalizing helps calm students’ nerves since it made the content approachable. She tried to tell her students that they could do it, that they needed to think about what they were doing and that they must complete the homework. She believed that teachers help teach work ethic by using statements with specific consequences. She also discussed using homework quizzes every other day to encourage students to complete their homework. When asked by students “when are we going to use this?” Sybill admitted that she replied honestly, that the material was likely not to be used in the future but that the student still had responsibility to
complete the work. She added that she tried to teach with more visuals and manipulatives, like geoboards, so that students had a concrete object to work with.

In addition to strategies to reduce anxiety, the literature findings state that teachers need to be educated on alternative forms of assessment that can help students gain confidence (Furner & Duffy, 2002). Both participants did not mention that this was important in the math classroom and only discussed using tests or quizzes in their classrooms. They both felt that confidence was extremely important for success in math and attempted to promote confidence by encouraging practice and repetition through the use of extra sheets, visuals and manipulatives, or by allowing students to practice alone or in pairs. When asked about what other strategies could get students comfortable with math, Tom replied that the school offered math help every lunch and that teachers often stayed with students after school; in addition, there was a math remedial course offered after school. Sybill also described that after-school help was offered and that her website offered support as well for students. The website was designed to support student learning by having all the class notes and videos that elaborated on key concepts, including teacher-made videos that could be used by absent students to catch up.

When discussing her definition of inquiry-based learning, Sybill shared her views on the effectiveness of this strategy in the math classroom. She thought it was beneficial for students to experience engaging with mathematics, but felt that there were some things that they could not figure out on their own, such as the quadratic formula. Sybill supported the literature since she recognized that students should be active thinkers and decision makers when acquiring math knowledge (Artigue & Blomhoj, 2013). However, Sybill felt
that inquiry-based learning required too much time and that the overarching project did not have a place in the academic structure of mathematics. In addition, she thought that there were certain types of students for whom inquiry-based learning worked well, but that the strategy was not helpful for all learners, countering current research that finds learning requires innovation and construction, which are the key elements of inquiry-based learning that benefits students (Artigue & Blomhoj, 2013; Staples, 2007).
Chapter 5: DISCUSSION

Introduction

This chapter presents the discussion of the study’s findings that were presented in Chapter 4: FINDINGS. The findings were analysed and organized by themes and a preliminary analysis was done which compared the data to the literature. Further analysis and an explanation of the findings were completed and are presented in the following sections below: Discussion of Findings and Implications/Recommendations. Following those sections, the chapter concludes with a review of the limitations, questions and areas for further study. Below is presented a brief review of the purpose of the study.

Teachers are in a position to influence the attitudes of the students they teach. The purpose of this case study was to explore how senior teachers of mathematics perceive the impact of mathematics anxiety on their students’ academic performance in mathematics. Specifically, this study addressed the question what are the perceptions of two senior-level mathematics teachers on the impact of teacher and student math anxiety on student success in mathematics? Sub-questions to support the research question were how do senior teachers define and perceive mathematics anxiety? and what resources or strategies do teachers perceive to be the best to address mathematics anxiety of their students?

Discussion of Findings and Implications

The major findings of this study were the participants’ definitions of mathematics anxiety, successful students in mathematics, and inquiry-based learning and how they did not always support current research in mathematics education. The participants described their perceptions of mathematics anxiety (student and teacher) in the classroom. Finally,
the participants discussed the strategies that they felt were effective in addressing student mathematics anxiety and promoting student success in mathematics. The meaning of these findings will be explained in the following section as they relate to and answer the research question: what are the perceptions of two senior-level mathematics teachers on the impact of teacher and student math anxiety on student success in mathematics?

It was necessary to understand the participants’ definitions of mathematics anxiety and success in mathematics in order to understand the context of their perceptions on the impact of mathematics anxiety in the classroom. The participants’ definition of mathematics anxiety was consistent with that of the literature (Buckley & Ribordy, 1982; Ashcraft, 2002; McLeod, 1992). This is important to note because it imparts further validity on the previously accepted findings. Consistency in this definition will also help to raise awareness of this issue within the teaching community. This will help new and current teachers to identify mathematics anxiety in their own classrooms, allowing them to start employing strategies to help those students that are affected by it. Additionally, it will prompt teachers to reflect on their own experiences with mathematics anxiety, and take steps towards personal and professional growth. Personally, this correlation has helped to ground the study in a strong foundation upon which to address the research questions.

The participants’ perceptions of mathematics anxiety are also put in context by how they define successful students in mathematics. It was clear from the literature review and from Tom and Sybill’s testimony that they believe that confidence plays a great role in a student’s success. This notion can assist with the development of teaching strategies that promote confidence within the students. Teachers must offer their students the chance to
succeed in mathematics as means to develop confidence and ease the anxiety that can come with failure. This relates directly to teachers suffering from mathematics anxiety, as they too benefit from increased confidence in the material that they are teaching. Based on the observations that Sybill and Tom shared about math anxiety and teachers, teachers should be encouraged to be self-aware, and comfortable with seeking out assistance with those topics with which they struggle. Teachers who have mathematics anxiety tend to impart this anxiety upon their students (Bekdemir, 2010). Conversely, teachers who are confident with mathematics have a tendency to impart this confidence upon their students. This finding confirms the use assessment strategies that promote success early and often. It also supports the notion that educators need to keep up to date with new teaching strategies and content knowledge.

It was clear throughout the data that both Sybill and Tom’s perceptions of students experiencing mathematics anxiety were in line with how the literature describes these students (Ashcraft, 2002; Hunsley, 1987; Ma, 1999). This is important because it demonstrates their ability to recognize this anxiety within their own classrooms. This serves to emphasize that mathematics anxiety is an observable phenomenon in today’s classrooms for both new and experienced teachers. These insights could help other educators look for signs of mathematics anxiety in their prospective students. A crucial finding from the interviews was that both Tom and Sybill’s evidence of mathematics anxiety came from student behaviour during tests. This raises the question of why they failed to identify this anxiety during other tasks in mathematics within their classrooms. It also begs the question that if they felt that tests manifested behaviours of math anxiety
with their students, why did they not infuse other forms of assessments, connected to the learning activities, more explicitly in their mathematics program? The literature describes mathematics anxiety as manifesting not only during assessment but also in the learning process, and teachers need to be cognisant of this in presenting the material to their students (Ashcraft, 2002; McLeod, 1992; Bekdemir, 2010; Taylor & Fraser, 2013).

There was consistency in how the interview subjects and the literature describe how mathematics anxiety manifests in teachers themselves. Interestingly, there was a consensus between participants that it is more likely to be observed in elementary school teachers. The education community may be able to use this information to support elementary teachers during their teacher education programs by providing pre-service teachers with the skills necessary to overcome their own anxieties and address the anxieties of their students (Bekdemir, 2010). This study also revealed ineffective and avoidant strategies that some teachers are currently employing to teach their students mathematics. This should serve as a cautionary tale for math teachers and administrators. We need to support teachers in seeking effective and alternative means to ensure their strategies will not cause mathematics anxiety in their students. Both participants expressed that the fundamentals of mathematics (i.e. multiplication tables) lay the groundwork for success in the future. If elementary school teachers are unable to impart these fundamentals, their students will be more likely to struggle with mathematics anxiety in the future.

The most important findings this study highlighted were strategies to address mathematics anxiety in the classroom. There was an agreement that fostering a feeling of
confidence towards mathematics is crucial in this regard. Although it was alluded to, there must be further investigation into how to build confidence in mathematics through teaching strategies. The scope of this study was limited to mathematics, however, strategies to build confidence are likely applicable across different subject areas. This means that collaboration between teachers of different subjects could be useful in devising strategies to help students build confidence across the entire curriculum.

One strategy that emerged as being successful for both participants was emphasizing process and problem solving when addressing mathematics problems. Sybill, in particular, emphasized this strategy in her lesson plans by explanation, demonstration, confirmation of understanding, and then application of concepts through practice and repetition. Both participants confirmed that repetition of these tasks helped students develop their skills effectively. This finding challenges my understanding of student-centered learning, as I have been encouraged to focus on teaching strategies that allow students to become active participants in their learning. Tom and Sybill have demonstrated a successful teacher-centered approach, and so I will have to find a balance in my own teaching style.

An area in this study where it was unclear how to move forward was teacher strategies for providing emotional and psychological support to those students with mathematics anxiety. The literature suggests that teachers should pursue strategies to avoid highly emotional situations, and use well understood psychological techniques to help students cope with anxiety, should it arise (Tobias, 1987; Hackworth, 1992). This is an important consideration, as evidenced by the data in this study, because some teachers
are comfortable with addressing mathematics anxiety, while there are others who feel unqualified to assist with the psychological needs of their students. This finding raises the importance of teacher education programs that prepare teachers to use psychology techniques effectively in the classroom. This can also extend to professional development opportunities to ensure that experienced teachers are up to date with the latest techniques and can address their own misgivings in a safe setting. This will be an essential tool for reducing mathematics anxiety in both teachers and students.

Current literature and teacher education programs have recognized the value of inquiry-based learning as it applies to mathematics and other subjects. In contrast, the participants in this study questioned its usefulness in mathematics, and openly refuted its applicability to their own classrooms. These findings seem to contradict Sybill’s and Tom’s view that it is imperative that educators alleviate student stress and anxiety by infusing teaching strategies that build confidence. Moreover, the research in the area of inquiry-based learning stresses how inquiry builds understanding and confidence. This brings several important questions to light: Have the participants in this study been offered the proper professional development to effectively implement inquiry-based learning in their lessons? Is inquiry-based learning universally applicable, or should it only be used when teaching certain subjects? How can teachers balance the curriculum requirements with the time it takes to implement effective inquiry-based learning strategies? It is important for advocates of this strategy to recognize these concerns and create opportunities for teachers to become more comfortable with it. It is equally important for challengers of this strategy to give it a fair assessment by truly understanding the role the teacher plays in creating and
supporting these activities. What is interesting to note is that both Tom and Sybill offered accurate definitions of inquiry-based learning when prompted. I believe, however, that neither participant was able to implement inquiry-based learning in its most effective form due to either a lack of confidence in the strategy or a lack of knowledge on how it works.

**Recommendations:**

The findings of this study in conjunction with the literature review have revealed that there is still extensive work to be done to get to a point where we can effectively address mathematics anxiety. As a new teacher, the following insights will guide my thinking as it relates to mathematics anxiety in the classroom:

- Modify teacher education programs to include opportunities for pre-service teachers to identify and address possible math anxiety.
- Provide opportunities in classroom practice to identify student math anxiety early so that teachers can provide the appropriate support.
- Educate principals and school district administrators on the issues of math anxiety so they can provide support to teachers through curriculum related documents and professional development.
- Support teachers in developing the appropriate content knowledge to teach mathematics effectively.
- Ensure that lessons follow a logical progression and that activities allow for early success to inspire confidence.
- Invite educators to continuously reflect upon their strengths and weaknesses as math teachers and math learners.
- Ensure that curriculum documents and professional development initiatives support teachers and emphasize teaching strategies that allow educators to confidently and effectively implement and understand inquiry-based learning.
Limitations

This study interviewed two intermediate/senior teachers about their perceptions on mathematics anxiety in the Ontario classroom. The study provides rich detail about the teachers, their thoughts and experiences. The study is therefore limited to their opinions and conclusions drawn from comparing the two cases may not be generalized. Future studies should consider a larger participant size in order to minimize this limitation.

The study is also limited to the teacher perspective since both participants were intermediate/senior mathematics teachers. Future studies should collect the student perspective so that the data could be verified for accuracy. Including the student perspective could add value and validity to the usefulness of the strategies presented in the findings.

In addition, the study is limited by the senior-level teacher’s perspective since both teachers were currently teaching secondary school mathematics. Future studies can minimize this limitation by obtaining the perspective of teachers from primary/junior, junior/intermediate, and intermediate/senior divisions, thus introducing depth and breadth to the study.

Each participant had their own personal experiences that defined who they were and defined their perspectives on mathematics anxiety. As a result, comparisons between cases were limited due to the variation between participant responses prompted by their experiences. Variation, however, provided realism in terms of the variety of opinions that can occur within teachers on a topic.
Finally, time was a limiting factor due to the requirements of the program. More time would have allowed for greater data collection and analyses; however the interview questions and procedures were designed to maximize the data collected.

All that said, the onus is on the individual reader to assess which aspects of this study is relevant to their own educational situation.

**Further study**

Although this study was able to shed light upon the effect of mathematics anxiety on both teachers and students, there remain several questions that require further investigation.

- How do we build confidence in our students with regards to mathematics? What strategies are cross-curricular?
- What strategies can we use in our teaching to effectively identify math anxiety in our students?
- How do we use inquiry-based learning effectively in the mathematics classroom?
- How do we overcome some of the challenges with the implementation of inquiry-based learning in mathematics?
- How can we use existing resources in boards of education to assist students with mathematics anxiety?
- How can we help educators identify their own math anxiety, and, in addition, provide the necessary support to assist them to become confident in mathematics?
References


Appendix A: Letter of Consent for Interview

Date: Interview Date
Dear Participant Name,

I am a graduate student at the Ontario Institute for Studies in Education at the University of Toronto. I am currently enrolled as a Master of Teaching candidate. I am studying the perspectives of intermediate-senior teachers on mathematics anxiety in Ontario classrooms for the purposes of investigating an educational topic as a major assignment for our program. I think that your knowledge and experience will provide insights into this topic.

I am writing a report on this study as a requirement of the Master of Teaching Program. My course instructor who is providing support for the process this year is Dr. Patrick Finnessey. My research supervisor is Dr. Cathy Marks Krpan. The purpose of this requirement is to allow us to become familiar with a variety of ways to do research.

My data collection consists of an interview that will be tape-recorded and is 30 minutes (up to 45 minutes) in length. There can be possible follow-up questions via email or a telephone call at your convenience. I would be grateful if you would allow me to interview you at a place and time convenient to you. I can conduct the interview at your office or workplace, in a public place, or anywhere else that you might prefer.

The contents of this interview will be used for my assignment, which will include a final paper, as well as informal presentations to my classmates and/or potentially at a conference or publication. I will not use your name or anything else that might identify you in my written work, oral presentations, or publications. This information remains confidential. The only people who will have access to my assignment work will be my research supervisor and my course instructor; however a pseudonym and any identifiers will be removed to maintain confidentiality.

You are free to change your mind at any time, and to withdraw even after you have consented to participate. You may decline to answer any specific questions. I will destroy the tape recording after the paper has been presented and/or published which may take up to five years after the data has been collected. There are no known risks or benefits to you for assisting in the project, and I will share with you a copy of my notes to ensure accuracy.

Please sign the attached form, if you agree to be interviewed. The second copy is for your records. Thank you very much for your help.
Yours sincerely,

Daniella Carvalho  
416-319-5240  
daniella.carvalho@utoronto.ca  
Instructor’s Name: Patrick Finnessey  
Email: pk.finessy@utoronto.ca  
Research Supervisor: Cathy Marks Krpan  
Email: cathy.marks.krpan@utoronto.ca

Consent Form

I acknowledge that the topic of this interview has been explained to me and that any questions that I have asked have been answered to my satisfaction. I understand that I can withdraw at any time without penalty.

I have read the letter provided to me by Daniella Carvalho and agree to participate in an interview for the purposes described.

Signature:  ______________________________

Name (printed):  ______________________________

Date:  ______________________________
Appendix B: Interview Questions

Interviewee Background

1. How long have you been teaching and what subjects do you teach?
2. What inspired you to become an educator?
3. Do you feel that your content knowledge is sufficient to teach mathematics? Please explain.
4. Do you feel your teacher education prepared you to teach math? Please explain.

Topic questions

5. Are you familiar with student math anxiety?
   i. What do you understand this to be?

6. Where did you first learn about math anxiety?

7. Is this a prevalent topic among your colleagues?
   i. If so, why do you think it is? If not, why do you think this is?

8. Do you think it is important to address student math anxiety? Why? Why not?

9. Have you had any professional development related to teacher and/or student math anxiety?

10. If you perceive math anxiety in your students do you address it? If so how?

11. Do you feel you have any students that have math anxiety?

12. Have you needed to help a student with their anxiety?
   i. How did you help?
   ii. How did you know what to do/say?
   iii. What advice would you give to teachers (new or experienced) with regards to helping students with their anxiety?
   iv. What advice would you give to teachers with regards to dealing with their own anxiety?

13. Have you needed to address math anxiety outside math class?

14. Do you feel that you have a memorable (positive or negative) experience from your mathematics education that influences your teaching? Please explain

15. What kinds of resources do you find helpful for alleviating student math anxiety in your math program?
Appendix C: Tables and Figures

Table 1: Sample table of significant quotes and codes generated from Tom’s transcript during the coding process. Similar tables were created for Sybill’s interview.

<table>
<thead>
<tr>
<th>Tom: Codes/ Significant quotes</th>
<th>Tom: Line Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence</td>
<td>72, 220 good section; 223; 225; 228-229</td>
</tr>
<tr>
<td>frustrated</td>
<td>32</td>
</tr>
<tr>
<td>anxious /anxiety</td>
<td>32, 63; 72; 78; &quot;she’s got math anxiety&quot; 213-214;</td>
</tr>
<tr>
<td>test blank out</td>
<td>34-35, 42, 60-61;</td>
</tr>
<tr>
<td>(completing) homework</td>
<td>34-35, 42</td>
</tr>
<tr>
<td>don’t do their work</td>
<td>41, 54-55,</td>
</tr>
<tr>
<td>don’t ask questions / need to ask questions</td>
<td>41, 87; 281</td>
</tr>
<tr>
<td>trying</td>
<td>42</td>
</tr>
<tr>
<td>cry</td>
<td>43</td>
</tr>
<tr>
<td>lost</td>
<td>44</td>
</tr>
<tr>
<td>calm them down</td>
<td>44</td>
</tr>
<tr>
<td>don’t worry</td>
<td>44</td>
</tr>
<tr>
<td>bring to another room</td>
<td>44</td>
</tr>
<tr>
<td>give extra time</td>
<td>45</td>
</tr>
<tr>
<td>motivation</td>
<td>55-56 (good quote); 324-325</td>
</tr>
<tr>
<td>rare</td>
<td>53</td>
</tr>
<tr>
<td>not a major concern/not discussed</td>
<td>52-53</td>
</tr>
<tr>
<td>i’m not a psychologist</td>
<td>61</td>
</tr>
<tr>
<td>unable to help / lack of tools, resources</td>
<td>61-63,</td>
</tr>
<tr>
<td>help you do the problem</td>
<td>62</td>
</tr>
<tr>
<td>show you different ways</td>
<td>62</td>
</tr>
<tr>
<td>talk to someone</td>
<td>64</td>
</tr>
<tr>
<td>uncertainty</td>
<td>63-64, (teacher is); 77</td>
</tr>
<tr>
<td>do more work to feel you know material better /confident</td>
<td>67-68; 71-72</td>
</tr>
<tr>
<td>need to pass /get good marks</td>
<td>67, 76-77; 100-101;</td>
</tr>
<tr>
<td>pressure</td>
<td>75, 77</td>
</tr>
<tr>
<td>prepare</td>
<td>78; 176; 304</td>
</tr>
<tr>
<td>teach in a calm way</td>
<td>80</td>
</tr>
<tr>
<td>its psychological</td>
<td>81; &quot;my psychological piece&quot; 225-226</td>
</tr>
<tr>
<td>math is easy</td>
<td>81-82</td>
</tr>
<tr>
<td>process: be shown what to do/ taught</td>
<td>86-87; 139-140; 144; 259-260; 272-273; 277; 296</td>
</tr>
</tbody>
</table>