Deconstructing Teacher Math Anxiety

By

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Abstract

This research study focuses on deconstructing math anxiety from the perspective of the teacher. More specifically, it focuses on how a small sample of educators who have had negative early math experiences are using this knowledge to shape their current instructional approaches to teaching math. The participants interviewed within this study were two experienced primary-junior teachers in the Greater Toronto Area who have been teaching for 19-35 years. The findings suggest that educators who have math anxiety typically hold negative attitudes towards teaching math, specifically at the junior level. With that being said, they also suggest that educators who have math anxiety may have more compassion towards their own math anxious students, due to the fact that they have experienced this anxiety themselves firsthand. Furthermore, the findings also suggest that math anxious educators may utilize more student-centered approaches to teaching math, as a means of ensuring that their math curriculum is filled with positivity and enjoyment, as opposed to the traditional and teacher-directed experiences they had growing up. This study can not only assist math anxious educators in gaining insight into how their own math anxiety impacts their daily practice, but can also inspire all educators to utilize the instructional approaches which work towards mitigating math anxiety for all.

Keywords: math education, math anxiety, teacher math anxiety, instructional approaches, mitigating anxiety, student-centered math education
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Chapter 1: Introduction

1.0 Research Context

Math anxiety is an issue faced by many students across the world, which greatly impacts math achievement within school. Math anxiety is not only a general fear of math, but its definition tends to narrow in on the feelings that students get when engaged in mathematical tasks (Bekdemir, 2010; Gresham 2009). These feelings can include nervousness, fear or even panic during a math class, which can impact a student’s ability to concentrate and retain information (Gresham, 2009). Not only do these feelings tend occur when students are presently engaged in math, but the anticipation of math and what is to come can be just as intimidating for them (Geist, 2015). With that being said, it is important to look at the various causes of math anxiety, in order to not only get a sense of where this anxiety commonly derives from, but also to successfully navigate intervention as well.

Negative experiences in math within elementary and secondary schooling are known to be a prominent cause of math anxiety for students, as these experiences are often remembered years later, and impact inquiry and motivation for further engagement (Bekdemir, 2010; Harper & Daane, 1998; Peker, 2009). Furthermore, Gresham (2009) argues that these negative school experiences impact an individual’s own sense of self-efficacy when it comes to math, which is why these individuals often have no desire to pursue math further within their studies. With that being said, another common cause of math anxiety for students includes methods of instruction, which relates directly to the first cause (Brady & Bowd, 2005). The negative experiences that hinder a student’s confidence in math often have to do with the instructional methods that are employed by educators within the math classroom, which tend to heighten anxiety for these students (Harper & Daane, 1998). According to the literature, when it comes to math education
there are two common instructional approaches that are often utilized by educators. The first is a more traditional approach, which tends to be more teacher-directed and product focused. This approach encompasses aspects such as an emphasis on the right answer, skill and drill problems, memorization, and standard pencil and paper testing, which all tend to greatly increase anxiety for students who already have low self-confidence when it comes to math (Brady & Bowd, 2005). This approach is in contrast to more student-centered and holistic approaches to teaching math, which have a focus on hands-on, experiential and collaborative learning (Bekdemir, 2010; Brady & Bowd, 2005). Through this approach, math anxious students often feel less pressure, as they are encouraged to take learning at their own pace, and to demonstrate this learning in multiple different ways.

1.1 Research Problem

With an emphasis placed highly on students and the ways in which they acquire math anxiety, it is interesting to look at math anxiety from the perspective of the teacher. More specifically, looking at the ways in which teacher math anxiety can impact the instructional approaches they tend to utilize within the math classroom, as well as their overall attitudes towards the subject. Teachers who have had negative early experiences with math often have less confidence with their math abilities, and generally have a lower sense of math proficiency as well (Gresham, 2009; Harper & Daane, 1998). This is because those who have dealt with math anxiety within their own schooling know just how defeating it can feel, and thus, tend to avoid it as much as possible while proceeding through higher education (Gresham, 2009). This then leads some educators believing they are not proficient in math, and results in teachers who only feel comfortable and confident teaching math at the primary level, as it is the most basic form (Chen, McCray, Adams & Leow, 2014).
Teachers who have math anxiety also may have concerns regarding the possibility of impacting a student’s attitude and self-confidence when it comes to math, since there is often a direct link between teacher and student confidence (Chen et al., 2014). Some teachers also fear transferring this anxiety to their students, as they can often sense an attitude shift from subject to subject from their teachers. The instructional approaches utilized by math anxious teachers tend to be more traditional in nature, in terms of the way they teach and prioritize the math curriculum. It has been found that teachers who are comfortable with mathematics teach it in a way that is more student-directed and inquiry-based (Stipek, Givvin, Salmon, MacGyvers, 2001). This differs from some teachers who have math anxiety, who often utilize more traditional methods of teaching math, and who often spend less time planning and implementing math lessons (Isiksal, Curran, Koc & Askun, 2009). With that being said, there is some research which suggests that some teachers use their math anxiety and the negative experiences they have had within their own schooling to inform their current teaching pedagogy (Gresham, 2009; Peker, 2009). It is argued that these teachers are more compassionate and understanding of students who are struggling within math, since they have been there themselves and know exactly what this anxiety can feel like.

1.2 Purpose of the Study

The goal of my research was to learn how teachers with math anxiety who have had negative early math experiences are using this knowledge to shape their current instructional approaches to teaching math. This has lead to acquiring a better understanding of how early math experiences can shape an educator’s attitude towards the subject and the instructional methods they tend to utilize within the math classroom in order to work towards mitigating student math anxiety.
A further purpose of this research study was to support educators in understanding the ways in which their own math anxiety is impacting their current practice, and to discuss some of the negative impacts this anxiety has on their students. This research study will hopefully inspire educators to better adjust instructional methods they are utilizing, which may potentially be adding to the anxiety their students are facing on a daily basis.

1.3 Research Questions

The primary question which guided this study was: How are a small sample of Canadian primary and junior teachers with math anxiety who have had negative early math experiences using this knowledge to shape their current instructional approaches to teaching math?

Sub-questions that further guided this inquiry include:

- What are these teachers’ current attitudes toward math and towards teaching math, based on their own schooling experiences?
- What are these teachers’ perspectives on the causes of their own math anxiety?
- What have these teachers observed from their own math anxious students, and what indicators do they look for as a result of this anxiety?
- What range of instructional strategies do these teachers enact to mitigate student math anxiety?

1.4 Background of the Researcher

The topic of math anxiety is particularly of interest to me because of the fact that I have always struggled with math growing up, within both elementary and secondary school. I do not remember a lot when it comes to what I learned or how I learned within elementary school, but some of my most vivid memories include my struggles with math, and how confused I was at times. My earliest memory of confusion with math was in my Grade 2 classroom. I still
remember being handed a sheet of paper that consisted of around ten division questions, and my teacher explaining that it was easy, and it was “just the opposite of multiplication.” It was frustrating to me that she assumed everyone was on the same level in terms of understanding and pace, and I felt as though I was the only one who did not understand. These struggles only got worse, especially as I got older and moved into more complex forms of math.

I can also still vividly remember how it feels to be anxious about math. I recall in Grade 6 I would wake up every day worrying about our morning math class, and would talk myself through it regularly. I also remember how it feels to be put on the spot in terms of answering math questions aloud in front of the class, and how embarrassing it would be to get an answer wrong. Whenever this particular Grade 6 teacher was away the principal was commonly the supply, and would always test our multiplication skills by calling upon random students, which I feared more than anything at that age. It still amazes me how many of these negative math memories I still have ingrained in my mind, even years later. This is in line with the research which suggests that negative math experiences are often remembered even decades later, which is why this research is so important, because of the real psychological impact it has on students (Geist, 2015; Jackson & Leffingwell, 1999).

As I got older, I tried to avoid math as much as I could, as I only took the required amount in high school, and my undergrad did not require additional mathematics courses. I still feel as though my math anxiety is present currently, but because I often do not engage with math on a regular basis like I used to, it is not as noticeable to me. With that being said, I was interested to know just how negative experiences like the ones I have described can impact a teacher’s instructional approach to teaching math, in order to prevent similar experiences from occurring for their students. Ultimately, these findings have greatly helped to inform my own
teaching within the classroom. More specifically, I have come to a better understanding of the most successful instructional practices commonly utilized by a sample of teachers who similarly have math anxiety, which aim to limit the addition or transference of this anxiety to students.

1.5 Overview

In order to respond to these research questions, I have conducted a qualitative research study using purposeful sampling to interview two teachers about how their own math anxiety has impacted their current instructional approach to teaching math. In Chapter 2 I reviewed the literature in the areas of teacher math anxiety, and how this anxiety impacts their attitudes regarding math, their students, and their current instructional approaches to teaching math. Next in Chapter 3, I elaborate on the research design, and provide a rationale for the many decisions I have made throughout this study. In Chapter 4 I reported my research findings and discussed their significance in light of the existing research literature. Lastly, in Chapter 5 I identified the implications of the research findings for my own teacher identity and practice, and for the educational research community more broadly, as well as outlined specific areas for further research within this area.
Chapter 2: Literature Review

2.0 Introduction

In this literature review I have explored the impact of math anxiety, with a focus not solely on students but teachers as well. More specifically, I have discussed the varying definitions of math anxiety as well as some of the causes of this anxiety found from within the literature. These causes include past negative school experiences, in addition to various instructional methods utilized by teachers that students were exposed to within school. I then touched upon some of the suggested impacts of math anxiety for students, which include lower academic performance, low motivation, and an avoidance of math within all levels of education. Finally, I have discussed the various findings on teachers who identify as having math anxiety, and how this anxiety impacts their attitude towards math, their students, as well as the instructional approaches they tend to utilize within the math classroom.

2.1 Math Anxiety

Although math anxiety does not have one leading definition, it is nevertheless a serious issue that many students face today. Gresham (2009) began her definition by noting that math anxiety is more than just genuinely disliking a particular subject, but rather its roots are much deeper. This can be specified to the emotional feeling students get when they are engaged in mathematical tasks. As further defined by Gresham (2009), students who have math anxiety often feel a sense of “hopelessness, tension, or panic” when engaging in math problems (p. 22). This is an automatic response that occurs for these students, which results in them commonly believing they will not succeed from the moment they begin. This ultimately impacts their ability to perform to a high standard, due to the fact that they have already discredited themselves greatly without a genuine effort being put forth. This point is also supported by Peker (2009) in
his definition of math anxiety, as he believes it can “interfere with the manipulation of numbers” and solving problems (p. 336). This reiterates the aspect of being unable to think carefully and clearly while working with numbers, because their anxiety interferes with their ability to focus. Bekdemir (2010) also argues that math anxiety causes a fear of math, which inhibits performance and prevents learning. With these definitions in mind, math anxiety continues to be a prevalent issue that is present within all schools around the world. This is ultimately why it is such a significant topic of focus, in order to help improve math education greatly.

2.2 Causes of Math Anxiety for Students

Math anxiety is one of the most crucial problems in learning math for students (Peker, 2009). With that being said, it is important to explore the various causes of math anxiety for students, in order to come to an understanding of potential ways to alleviate this anxiety for students to some degree. The main reoccurring cause of math anxiety for students within almost all of the literature was a past negative school experience (Bekdemir, 2010; Harper & Daane, 1998; Peker, 2009). Harper and Daane (1998) argue that the “elementary mathematics classroom might be considered a beginning point for creating mathematics anxiety in many students” as a result of lowered confidence (p. 29). Jackson and Leffingwell (1999) go one step further and argue that these negative experiences that are had within early classrooms are so unforgettable for individuals, that they are often remembered even decades after they occur. This can result in these individuals believing they may never be successful when it comes to math, and therefore never pushing themselves to reach higher limits. This lowered confidence as a result of negative classroom experiences with math can also hinder a student’s natural curiosity for the subject, and may result in students feeling unmotivated when it comes to fostering their math inquiry.
Another cause of math anxiety that was explored within the literature was that of prior formal instruction. Brady and Bowd (2005) and Sloan (2010) identify specific examples of factors that contribute to math anxiety, which directly relate to a teacher’s instructional methods. These examples include skill and drill math problems, the emphasis on the right answer, rote memorization, little connection to the real world, increased seatwork assignments, as well as more whole-group instruction. These are all examples of more traditional approaches of teaching mathematics that are still encountered in many classrooms today. These traditional methods might be successful for some students, but may increase anxiety for students who already are hesitant when it comes to engaging in math. This is also strongly supported by Geist (2010), who explains that educators often look at students in the same light, in terms of “ability, preferred learning styles and pace” (p. 25). This points to the fact that differentiated instruction can be so beneficial for math anxious students who are not confident in their math abilities. Knowing where each student is developmentally within a class can help to ensure that needs are being met, and that each student can reach their fullest potential in a way that is meaningful to them.

In study conducted by Jackson and Leffingwell (1999), they found that teachers may also contribute to a student’s math anxiety by sending messages to students through covert and overt behaviours. Overt behaviours can include verbally expressing things that might have embarrassed a student, while covert behaviours can include more subtle actions, like sighing when a student has answered a question incorrectly. This is supported by Brady and Bowd (2005) in that they argue that when teachers generalize and make assumptions within their class, students who have math anxiety may feel as though they are different, because they are not understanding math in the same way as their peers.
2.3 Math Anxiety and Student Academic Performance

Math anxiety has a significant impact on student math achievement, and one’s overall ability to perform well on an academic level. As stated by Hughes, Lourea-Waddell and Kendall (2008), students who exhibit math anxiety often perform more poorly and have higher rates of dropping out of school than those students who do not have math anxiety. This relates to the idea pointed out by Bekdemir (2010), which states that a student’s motivation and overall success is often affected by math anxiety, due to a “cutback in learning effort, and limited persistence” (p. 312). When students are performing poorly, their motivation and self-efficacy is greatly decreased, and they often feel defeated before they even begin. They may also often begin to negatively self-talk, which could also greatly inhibit their achievement as well (Peker, 2009).

The idea of avoidance relates greatly to the concept of motivation, as many students who have math anxiety tend to avoid math at all costs, because they are afraid of the potential embarrassment and failure that might occur as a result of it. This idea is supported by Geist (2015), in that he suggests the anticipation of math is what is often the most frightening for students, and is what they will try their hardest to avoid. Hughes et al., (2008), suggest that one way students can avoid math is through exhibiting somatic complaints, such as “stomach-aches, nausea and headaches” (p. 218) These complaints can result in students staying home from school, or missing class to go to the office, which ultimately results in them missing valuable instruction time within class. For those math anxious students who remain in class, they are usually distracted from course content, and unable to truly focus and concentrate on the tasks at hand (Hughes et al., 2008).

Not only can math anxiety result in students avoiding math classes altogether, or being unable to concentrate, but it can also impact a student’s decision to take math as they proceed
through higher education. Students who try to avoid math during their early years will be far more likely to avoid it altogether when they grow up and attend further schooling (Bekdemir, 2010). This idea is supported by Lake and Kelly (2014), as they argue that students often shy away from math courses when their previous experiences with math have been negative. This also leads them into the mindset that they are not successful at math, which lowers their confidence when it comes to teaching it. Andrews and Brown (2015) also add that avoiding math classes as one proceeds through higher education limits their career choices substantially in the future, in terms of choosing a career path that does not obtain mathematical requirements.

2.4 Teachers and Math Anxiety

With a focus generally on student math anxiety and what impact that has on their overall success, teachers who have math anxiety can often times be overlooked as individuals who can add to this anxiety. As individuals who are teaching students math, and who appear to be role models for students, the focus should certainly not be single sided. As argued by Chen et al. (2014), teachers who are more confident teaching math often have students who also display confidence in their math abilities. This is because the research shows that there is a direct link between teacher and student confidence (Chen et al., 2014). Much of the current research focuses on student math anxiety, with less focus on pre-service teachers, and even less of a focus on teachers currently in the field. The emphasis from the literature has been placed in three main areas, which include attitudes and beliefs about math and about teaching math, how a student may be impacted by a teacher who has math anxiety, as well as instructional approaches to teaching math, which are enacted by teachers who have math anxiety. These three findings have been explored further, in order to get a sense of how this anxiety impacts both teachers and students.
2.4.1 Attitudes and beliefs. A teacher’s attitude regarding math can speak volumes in terms of coming to an understanding of their early math experiences, and how they generally feel towards the subject. As pointed out by Wilkins (2010) the attitude a teacher holds for a particular subject can have a “strong influence on the way that the subject is taught” (p. 25). This is because most often if a teacher dislikes a particular subject, they will then feel less motivated to spend the time to ensure that their lesson plans are as valuable and engaging for students as possible. A teacher’s beliefs about a subject will ultimately shape what actions are taken within the classroom, and how much time is spent lesson planning and teaching math (Chen et al., 2014; Brady & Bowd, 2005). Gresham (2009) also adds that pre-service teachers who held negative attitudes towards math had higher levels of math anxiety. This is in contrast to those who reported having more positive attitudes, as they had less anxiety and felt a sense of excitement towards teaching math. In Wilkins’ (2010) study, five hundred and thirty in-service teachers were surveyed to determine their attitudes towards all subject areas. Math was among the three subjects that teachers voted disliking the most, but interestingly enough, the upper elementary grade teachers voted that they enjoyed teaching math. As he stated, this particular study points to the fact that primary teachers may have prominent negative attitudes towards math, and might not be as confident teaching math at higher levels where it becomes more complex (Wilkins, 2010).

This also relates to the topic of teacher proficiency, and how confident a teacher is with their current understanding and knowledge of math. Within a study conducted by Chen et al., (2014), preschool teachers explained that although they do not believe they are proficient in math, they feel as though they can teach it at a younger grade level. This points to the possible idea that teachers who have negative beliefs or attitudes towards math, and who believe they are
not mathematically proficient will typically favour teaching the primary, since it is the most basic form of math. Gresham (2009) conducted a study on pre-service teachers’ self-efficacy beliefs, and the results from this study indicated that there is a direct link between a teacher’s math anxiety and their teaching self-efficacy. This alludes to the idea that if an educator has math anxiety, it may be more likely that they will have doubts about their ability to learn new math concepts that might be challenging for them, and to then teach these concepts successfully to their students. This idea is supported by Lake and Kelly (2014) as they state that teachers at the primary level may already have the mindset when they first start teaching that they will not have to teach complex math to students or reteach themselves various concepts that they might have forgotten or are unfamiliar with. In this sense, some teachers may find security in this, especially if their level of schooling in math has been limited.

2.4.2 Impact on students. Since it is known that children are very impressionable, it is interesting to note the impact that a teacher’s math anxiety can have on students. The literature speaks directly to both pre-service and in-service teachers, looking at how they either feel their math anxiety will eventually impact students, or the ways in which it is impacting their students currently. Gresham (2009) argues that teachers who have math anxiety are often afraid of “transmitting their avoidance and fear of mathematics to their students” (p. 23). This is supported by Jackson and Leffingwell (1999), as they explain that students “tend to internalize their instructors’ interest in, and enthusiasm for, teaching mathematics” (p. 585). Students can sense when their teachers are genuinely excited about what they are teaching, and can sometimes appreciate the effort that they have put into making their lessons engaging for them. Sloan (2010) agrees with the fact that teachers can often pass on anxiety to students, when they themselves appear to be anxious about math in front of the class.
With this idea in mind, it is interesting to look at the research that suggests female students may be more at risk than male students when it comes to this transmission. As mentioned by Beilock, Gunderson, Ramirez and Levine (2010), “children are more likely to emulate the behaviour and attitudes of same-gender vs. opposite gender adults” (p. 1860). This highlights the idea that female students may be more at risk more frequently in terms of math achievement, because of the gender divide within the field of education for teachers. This is supported by Jameson (2014) in that female teachers who have math anxiety might impact their female students’ overall perceptions in terms of math gender stereotypes about who is typically “more successful” at math. This could greatly hinder confidence and overall math achievement for female students, because they may begin to believe that they themselves will always fall short to the males within their class.

Not only can math anxiety be transmitted to students by an anxious teacher, but it may also impact what kind of teacher a student may become in the future (Lake and Kelly, 2014). This idea relates to the notion of a mathematics anxiety circle that can often be formed (Bekdemir, 2010). The math anxiety circle suggests that a student who has negative early math experiences in school and who develops math anxiety may grow up to be a teacher who carries this math anxiety with them in their own practice. This teacher could then potentially pass their anxiety on to their students through instructional practices or through sharing of beliefs and attitudes about math, which in turn creates anxiety for their students (Bekdemir, 2010). This idea outlines the importance of not only the instructional approaches teachers tend to utilize within the classroom, which will be discussed next, but the overall quality of experience that these students are having within their math classes each day.
2.4.3 Instructional approaches. Not only can math anxiety result in teachers holding negative attitudes towards math, but these negative attitudes can impact the type and quality of lessons that they implement for their students as well. The research suggests that this idea is two-fold. The first side is the idea that teachers who do not have math anxiety, and who have more positive attitudes towards math will implement more positive and purposeful math lessons within their classes. Wilkins (2010) explains that those who obtained more positive attitudes taught math in a way that promoted “student exploration and discovery of topics, understanding of procedures, and encouraged students to justify and discuss their answers” (p. 26). This is supported by Gresham (2009), as she found that pre-service teachers who had high self-efficacy beliefs tended to focus more on experimentation and consistently working to improve their teaching strategies. This is in contrast to teachers who demonstrate high levels of math anxiety. Brady and Bowd (2005) explain a study indicating that teachers who are more anxious generally spend less time lesson planning for math. With that being said, they also tend to adopt more traditional behaviours and teaching approaches when it comes to math, which generally emphasize memorization, getting the right answer, as well as skill and drill questions (Bekdemir, 2010). They also tend to have a more dominant role within the classroom, utilizing textbook teaching rather than a more inquiry based approach (Stipek et al., 2001).

Although the other side of this literature is limited, the importance is crucial and pertinent to this research topic. This side outlines the fact that teachers who have math anxiety use their own negative experience in school with math to drive their current instructional practices. Peker (2009) argues that although pre-service teachers can identify as having math anxiety, many plan to ensure that the way they teach math is meaningful to their students. This idea is also supported by Gresham (2009) in that her findings suggest that teachers who have math anxiety become
more compassionate of their students, since they can relate to the “struggles students might experience with traditional practices” (p. 28). These findings may allude to the fact that a teacher’s math anxiety may solely be negative, as these teachers are using their own experience as a point of reference for their own practices within math. These teachers ultimately may feel more compelled to ensure that their lessons are exciting and engaging for their students, in order to prevent them from going through a similar schooling experience as they went through. This then creates the case that teachers with math anxiety might employ successful instructional strategies just as their counterparts, in a potentially more meaningful and determined context.

2.5 Alleviating Math Anxiety

Not only does the literature highlight the impact of teacher math anxiety on their instructional approaches and their students’ overall experience within the classroom, but they also outline some suggestions that they hope will alleviate math anxiety in some way for students. One way to alleviate math anxiety within teachers was through professional development within mathematics, in order to not only increase self-confidence when it comes to math, but also to help these educators gain more positive attitudes about the subject itself (Chen et al., 2014). Chen et al. (2014) further argue that a student’s overall success within math is directly related to their teacher’s proficiency in math. Gresham (2009) supports this claim, and adds that when a teacher has a high sense of self-efficacy within a particular subject, they are more inclined to take risks and experiment with instructional strategies and materials that may aim to support student learning more successfully. With that being said it is important for educators to be cognizant of the areas in which they are more proficient in, and which areas they would benefit from professional development.
Another suggestion for alleviating math anxiety which was pointed out within the research was to ensure that teachers try to remain as empathetic and patient as possible, and to refrain from making statements that could be demeaning to students. This is shown by Harper and Daane (1998) as they state that building a strong and supportive classroom community is so essential in allowing students to feel comfortable taking risks, especially within an intimidating subject like math. Brady and Bowd (2005) outline sources of math anxiety that relate to this idea greatly. They suggest that teachers who make assumptions out loud about math being easy, or who do not explain concepts or vocabulary fully are doing their students an injustice, and ultimately adding to the anxiety they may currently have. This relates to the idea that a teacher’s attitude influences how a subject is taught (Wilkins, 2010). Teachers need to better understand and empathize with students who find math to be frightening, so that they can ensure that they are not only alleviating some of the anxiety they have, but also ensuring that all students have the opportunity to succeed at their own pace.

Lake and Kelly (2014) also argue that it is truly important to focus on how math is taught within classrooms. Teachers must be considerate of the fact that traditional instructional methods of teaching math tend to add to the anxiety that students who do not learn in a more structured and rigid manner face, and ultimately can result in them wanting to deter from math altogether (Geist, 2015). The research suggests that inquiry based, process orientated methods of teaching math where students have the opportunity to take the lead in their learning are the most beneficial and effective, as opposed to the teacher and textbook directed traditional methods. (Harper & Daane, 1998; Stipek et al., 2001). Again, the research emphasizes how important it is for teachers to build a classroom culture that is comfortable and supportive, in order for students to feel as though they can take risks and make mistakes within their classroom. This will help to
ensure that concerns are being diminished, and that they are being as successful as possible and learning in a meaningful way.

2.6 Conclusion

In this literature review I examined the impact that math anxiety can have on both students and teachers. This review highlights the fact that math anxiety strongly impacts a student’s academic performance, motivation and their overall tendency to avoid math, especially as they proceed through higher education. It also highlights the fact that there are also suggested impacts for a teacher who has math anxiety, in terms of their attitudes, instructional approaches and their students. With that being said this literature review raised questions about instructional approaches that are commonly used by both teachers who have math anxiety and those who do not.

Although there is some existing research on the impact of teachers who have math anxiety, I have contributed to this research by focusing on teachers who have had negative early math experiences, and how they are using this knowledge to shape their current instructional approach to teaching math. I was ultimately curious to know whether a teacher who has math anxiety would be more likely to adopt more traditional methods of teaching math, or if they would adopt a more student-centered approach and exhibit more empathy and patience with their struggling students, because of the fact that they have been there themselves.
Chapter 3: Methodology

3.0 Introduction

In this chapter, I explain my research methodology, which encompasses my research design, as well as my rationale for the many decisions made throughout this study. I begin by introducing my research approach and accompanying procedures, as well as discussed the instruments of data collection that I have utilized within this study. This is followed by an outline of the sampling criteria that was followed while recruiting participants, a discussion of the procedure for finding participants, as well as an introduction of each participant in greater detail. I then proceed to discuss how I have analyzed the data from this study, have gone over the process of identifying and addressing potential ethical issues in order to reduce the risk of this study, and then conclude with a discussion of the various limitations and strengths that are evident within this study.

3.1 Research Approach and Procedures

This study was conducted using a qualitative research approach, which included both a literature review and semi-structured interviews with two teachers. Although qualitative and quantitative research approaches are effective and have their place, given my research purpose and question, a qualitative research approach was the best method for this particular study. Qualitative results yielded the most detailed and descriptive responses to my own research question, which helped in gaining a better understanding of how negative early math experiences impact teaching practices. As defined by Yilmaz (2013), qualitative research allows for the collection of data to occur in natural settings, “in order to gain insights not possible using other types of research” (p. 311). This idea is supported by Neuman (2014) as she argues that through qualitative approaches, researchers can obtain deeper understandings of a phenomenon, as
opposed to broad conclusions from quantitative approaches. These deeper understandings may consist of the interviewee’s own insights, opinions, and beliefs, which are all constructed from their own personal and lived experiences (Yilmaz, 2013). They can also provide valuable insight into the ways in which people think and feel about this phenomenon, which are then accredited by examples of things they have undertaken or seen previously. Caporaso (1995) also introduces the notion of gaining empathetic understandings from participants while utilizing a qualitative research approach, as interviewees are providing rich descriptions and details from their own first hand experience in the field. They may also feel passionate about the particular phenomenon, and thus, really position themselves within the research question to provide honest and heart-felt responses.

This differs greatly from the numerical data yielded from quantitative research, which can be produced from fixed questions which are then mathematically measured to determine common treads, relationships, similarities and even differences (Yilmaz, 2013). These fixed questions can often produce forced, pre-determined answers from participants, as opposed to a method that allows for depth and flexibility (Caporaso, 1995). Carr (1994) adds that qualitative research is often used “as a vehicle for studying the empirical world from the perspective of the subject” as opposed to the researcher (p. 716). Therefore, given what I wanted to learn, qualitative research was the best method for this study. This method not only allowed me to come to an understanding of how negative early math experiences are impacting current teaching practices in math, but also provided me with a multitude of real examples in how this anxiety is also impacting attitudes towards teaching math and students as well.
3.2 Instruments of Data Collection

The single instrument of data collection for this study was my semi-structured interview protocol. Semi-structured interviews can be described as an interview with an individual or a group, where the interviewer asks the interviewee a set of predetermined open-ended questions (DiCicco-Bloom & Crabtree, 2006). These questions are used as a general outline for the interview, but are not completely fixed in terms of order and content; they often begin with more broad and general questions, where more specific ideas will emerge as a result of the interaction (Pathak & Intratat, 2012). Semi-structured interviews ultimately allow for flexibility throughout the interview, if perhaps the interviewee has already covered a following question, or if they feel as though the content must be adjusted given some information that the interviewee has shared. This is in contrast to highly structured interviews, or unstructured interviews, which are also common within qualitative approaches; semi-structured interviews allow for new questions and probing to occur during the interaction between both individuals, which the other two do not.

Given my research question, a semi-structured interview allowed me to obtain the most relevant information while learning about the impact that early math experiences can have on current teaching practices. I have conducted two face-to-face interviews, which were recorded in full. My interview protocol consisted of a list of pre-determined questions, as well as various sub questions that were asked in accordance to the responses they provided. Semi-structured interviews also allow for new questions to emerge within the dialogue, which might not have been planned or foreseen by the researcher (DiCicco-Bloom & Crabtree, 2006). This allows for a more natural and open conversation to occur, where real answers are able to flourish. My interview protocol was divided into five sections, which included background information,
teacher beliefs and perspectives, teacher practices and experiences, supports and challenges, as well as next steps. Some examples of questions include:

- Can you describe your own experience with math growing up within elementary school?
- How would you describe your current attitude towards math and teaching math?
- What range of instructional strategies do you enact to minimize students’ experience of math anxiety?
- What forms of assessment and evaluation do you utilize while teaching math?

3.3 Participants

Given the small-scale nature of this study, two participants were interviewed to determine how are a small sample of elementary school teachers who have math anxiety are using their early math experiences to help shape their current instructional approaches to teaching math.

Within this section, I first go over the specific sampling criteria I established at the beginning of this study, and then discuss the process of recruiting my participants. Lastly I introduce each participant in greater detail, providing a description of their educational backgrounds.

3.3.1 Sampling criteria. In order to recruit the most suitable participants for this area of study, the following sampling criteria were applied:

1. Teachers who are currently teaching at an elementary school level.
2. Teachers will have a minimum of five years of teaching experience.
3. Teachers who have had or currently still have math anxiety.

The sampling criteria I have stated ensured the results from my two interviews yielded the most relevant data pertaining to my research purpose and question. I was interested in interviewing teachers who are currently teaching at an elementary school level. This is because the focus of this study was to determine how a teacher’s negative experiences in elementary school shape
their own teaching practices within their elementary classrooms; are there similarities or differences between the two? I was also interested in interviewing teachers who have had a minimum of five years of teaching experience. This allowed for a more situated teacher, who has had the time to settle into the field, and who has had the opportunity to define their own teaching practices for a few years now. Lastly, and most importantly, I was interested in interviewing teachers who have had or currently still have math anxiety. This criterion was pertinent to my research, as I am looking for parallels between personal experiences with math in school, and their own teaching practices.

3.3.2 Sampling procedures. The recruitment process for participants is crucial to any research study, as it is a detailed description of how you plan on locating your participants who you wish to interview. Anderson, (2010) suggests that within qualitative research, small sample sizes are more beneficial, because of the vast amount of detailed work required. The sample size of this particular study was in fact small, as only two teachers were interviewed. There are many sampling procedures that are common within qualitative research, which can also be combined together within practice. Purposive sampling can be defined as assembling individuals who are the most knowledgeable and informative, and who may provide the researcher with detailed information and in-depth understandings (Anderson, 2010; Yilmaz, 2013). Convenience sampling refers to the researcher choosing participants who are most accessible to them, who happen to be available or who are most willing to partake in the research study at the time (Anderson, 2010; Onwuegbuzie et al, 2012). Representative sampling can be defined as a researcher who selects a sample of participants from multiple areas or schools, in order to represent a wider array of participants from multiple and diverse locations (Anderson, 2010).
The last method includes theoretical sampling, which includes using various insights gained from previous research, in order to inform current selection (Anderson, 2010).

Due to the constraints of this research study, I have employed a combination of both convenience and purposeful sampling. Since I was immersed in a community of teacher colleagues and mentor teachers throughout the past six years, I relied on my existing contacts and networks to recruit participants. With that being said, since I have developed multiple relationships with teachers and principals throughout my undergraduate and graduate programs, I have surely chosen the participants who I believe were the best candidates given my research question, and who met my sampling criteria successfully. I contacted various teachers and Principals in person who I have worked with in the past and provided them with an overview of my research study. This allowed me to ask potential participants, as well as allowed the Principal to distribute my information to teachers they believed fulfilled the criteria.

3.3.3 Participant biographies. Both participants are elementary school teachers who have been working in the field anywhere from 19 years, to 35 years. These participants also recognized that they have experienced math anxiety growing up, or have had negative experiences with math within their own schooling experience.

Gwen was an elementary school teacher, who is currently retired, but taught in two separate schools for 35 years, both within the TCDSB. Within her first school she taught Grade 3, and within her second school she taught everything from JK-6. Gwen shared that she did not have any additional education experiences related to math, aside from the PA day initiatives and various math workshops that were required. With that being said, Gwen did not take any additional qualifications in math, because of the fact that she was never comfortable with the subject due to her math anxiety.
Bianca is an elementary school teacher who has been teaching for 19 years now in two separate schools. She has previously taught Grade 1, Grade 2 and Grade 4 in her first school within the TCDSB. Bianca currently works in a kindergarten classroom in a different school, still within the TCDSB, and has been working at this grade level for three years now. Similarly, Bianca shared that she did not take any additional qualifications courses within math, since it was never a subject area that she was interested in because of the negative experiences she did have.

3.4 Data Analysis

Data analysis allows the researcher to uncover various reoccurring themes and concepts from their own study. It can be defined as a “systematic examination of something to determine its parts, the relationship among parts, and their relationship to the whole” (Onwuegbuzie et al., 2012, p. 24). This definition is expanded by noting that data analysis involves discovering meaning, where researchers organize data in order to “see patterns, identify themes, discover relationships, develop explanations, make interpretations, mount critiques or generate theories” (Onwuegbuzie et al., 2012, p. 24-25). Anderson (2010) argues that while reporting the findings, researchers should make it a point to include issues or questions that participants raised within the interviews, as opposed to just relying on the more prominent or anticipated themes within the area of study. Presenting the qualitative data in order to illustrate the findings is also an imperative part of data analysis, and can be done through the sharing of various quotes from the participants. As mentioned by Anderson (2010), the researcher should not just simply list quotes that pertain to a particular theme or concept, but should also discuss why those particular quotes were chosen, and what significance they have for the research study. It is not only beneficial to include quotes as raw data within the analysis, but it is also important to include non-verbal
communication means, such as emotions, tone, body language, etc., which can also serve to assist in coming to a better understanding of how participants truly think and feel about the phenomenon (Anderson, 2010). Irvine (2010) also argues that direct quotes not only present data in an authentic way, but they also allow the researcher to respect the voice of participants.

The methods discussed above have been utilized while interpreting my own data from this study. Once I interviewed my two participants, I then transcribed all two interviews, and began the coding process. I took note of categories, reoccurring themes, challenges and divergences that emerged within both interviews. I also included issues and questions that were introduced by the interviewees, as well as presented the evident null data as well. From there, I worked to synthesize these themes where appropriate. This allowed me to make meaning of the data that I collected, where I then discussed why these findings were significant, given what the existing research has already found. I then discussed the significance of this research not only for my own practice, but for the greater educational community as well.

3.5 Ethical Review Procedures

Within both qualitative and quantitative research approaches, ethical issues are sure to arise. What is important is for researchers to identify and address these ethical issues beforehand, in order to reduce the risk of the study. This is supported by Irvine (2010) as she stated that participants must be accepting of the study and enter voluntarily, and researchers must be transparent in terms of obligations and potential consequences. One of the most important ethical issues is participant safety and anonymity. Within my study, it was made clear that each participant’s identity would remain confidential, which included assigning them a pseudonym, as well as removing identifying markers related to their schools or their students. This was extremely important, because of the fact that these educators shared their own personal opinions
and specific personal examples, and this information could potentially “jeopardise his or her position in a system” (DiCicco-Bloom & Crabtree, 2006, p. 319). When participants are aware of the fact that they are answering anonymously, they generally begin to feel more comfortable sharing genuine answers that may steer away from the safe and typical responses.

It was also made clear that participants had a right to withdraw from participation in the study at any given stage, and had the right to refrain from answering any question they did not feel comfortable with. This is described by DiCicco-Bloom and Crabtree (2006) as a genuine right that participants have, as they suggest asking participants for consent multiple times throughout the process, which allows them to continuously consider to exercise this right. This also includes allowing participants to read and review the transcript, in order to provide them with the opportunity to retract statements that they are uncomfortable with. This adds to the level of comfort that participants’ experience, especially if they know that if they feel distressed or unsafe, they have the option of withdrawing without any repercussions.

It was important that both of my participants knew that there were no known risks associated with this research study. Ells (2011) argues that measures should be taken in order to not only minimize risks within research studies, but to also protect the well-being of the participants as well. Also, it is important to touch upon the aspect of privacy and security. All data, both written and audio recordings, have only been accessed by my course instructor and myself, and have been stored on a password protected computer, which will be destroyed after five years. Lastly, participants were asked to sign a consent letter (Appendix A), which addressed the above ethical implications, and specified participant expectations. The method for limiting potential ethical issues from arising listed above helped to establish a more safe and comfortable climate for participants (DiCicco-Bloom & Crabtree, 2006). This has overall aided
in ensuring that personal experiences, attitudes and beliefs could be comfortably shared, in order to honestly answer my proposed research question in an authentic way.

3.6 Methodological Limitations and Strengths

There are always strengths and limitations in design and application within any research study, despite best efforts to try and minimize limitations; it is often the case that they are out of the researchers control (Yilmaz, 2013). This was the case for this particular study, as three limitations included the scope of the research, one-time interviews, and a small sample size. This study only included conducting interviews with teachers, as the parameters did not allow for interviews with different stakeholders, such as student or parents. This is a limitation for this study, because of the fact that we are missing multiple perspectives, which would validate and add to the ideas that the teachers are presenting. With that being said, another limitation that relates greatly to this is the fact that the researcher is only able to conduct one-time interviews with each participant, which means that I was not able to collect my thoughts and reconvene, or observe teaching practices enacted within the actual classroom; I was only able to hear from these teachers, as opposed to seeing it first hand. This also relates to an aspect brought up by Onwuegbuzie et al. (2012), as there are limitations evident with a one-time interview, as it is a lot more difficult to probe further or ask for clarification after the interview has been completed. Lastly, the small sample size of this research study only allowed us as researchers to simply inform the topic of math anxiety. This is another limitation of this study, because of the fact that we cannot use these findings to generalize more broadly speaking. Although this is supported by Anderson (2010), she suggests that findings can still be transferred to another study. She also argues that a small sample size is recommended for qualitative research, because of the “detailed and intensive work required for the study” (Anderson, 2010, p. 4).
Despite the unavoidable limitations mentioned, there are many evident strengths within this particular study. These strengths include the process of interviewing, the flexibility within semi-structured interviews, as well as the opportunity for teachers in the field to self-reflect on their own practice. Within the two conducted face-to-face interviews, researchers had the opportunity to delve into the protocol questions, where they responded in depth with real examples to demonstrate their commitment. This differs greatly from conducting a simple survey, as teachers are able to explain themselves in detail, which better validates each teacher’s voice and experience successfully. With that being said, Anderson (2010) argues that with this depth comes volumes of data that can be time consuming to code and interpret. The structure of each interview is another strength within this study, as semi-structured interviews allowed for flexibility, in order for a genuine conversation to occur. This idea is supported by Anderson (2010) as she states that “the data based on human experience that is obtained is powerful and sometimes more compelling than quantitative data” (p. 2). This also allows the researcher to ask for clarification if needed, to ask for another example of a concept they have introduced, or to just simply ask a question that was unforeseen; researchers are ultimately not restricted to a set list of questions (Anderson, 2010). Lastly, through the process of interviewing teachers where they are providing rich detail and examples, self-reflection was almost unavoidable. Reflection of practice is so beneficial for educators, as it allows them to come to their own realizations, and provides them with the opportunity to constantly refine their own teaching practices.

3.7 Conclusion

In this chapter I explained the research methodology for this study. I began by outlining my utilization of qualitative research, which included a literature review and two semi-structured interviews. I also outlined two semi-structured interviews as my single instrument for data
collection within this study. Next, I outlined the sampling criteria of this, which comprised of an elementary level teacher who has been teaching for a minimum of five years, and who can identify as having math anxiety. I then touched upon my sampling procedure, which included a combination of convenience and purposeful sampling, and then introduced my participants. The next section within this chapter was data analysis, which encompassed the process of interviewing, transcribing, coding, and then categorizing data in order to recognize various prominent themes. I then proceeded to address the evident ethical issues of the study, such as safety and anonymity, the right to withdraw, as well as privacy and security, in order to try and minimize potential risk. Lastly, I discussed the methodological strengths and limitations of this study. The limitations included the scope of the research, one-time interviews, and a small sample size. The discussed strengths of this study included the process of interviewing, the flexibility within semi-structured interviews, as well as the opportunity for educators to reflect on their own practice.
Chapter 4: Research Findings

4.0 Introduction

This chapter presents the findings that were derived from the data analysis of two research interviews. My research question “How are teachers with math anxiety who have had negative early math experiences using this knowledge to shape their current instructional approaches to teaching math?” was explored throughout the data analysis process, in terms of the experiences these educators have shared, and their own teaching practices, which were then compared to what current literature states. The findings are organized into four main themes:

1. Although teachers have expressed low comfort levels with math due to negative past experiences, this has resulted in exhibiting compassion for their own math anxious students.

2. Educators’ lack of confidence in math is a result of the instructional approaches they themselves experienced in school, and they exhibited concern of their anxiety transferring to their own students.

3. Educators share that their math anxious students typically feel overwhelmed and stressed due to the pace of the math curriculum, and exhibit various indicators as a result of their anxiety.

4. Educators share that quality lesson planning and providing students with additional support are instructional strategies they enact to mitigate student math anxiety.

Each of these themes have two to three subthemes, which were derived from the interview and analysis process. For each of these themes, I have first reported my findings, as well as discussed the significance in terms of how it is beneficial to the already existing literature on this topic. Finally, I have summarized my findings and made recommendations for next steps.
4.1 Although teachers have expressed low comfort levels with math due to negative past experiences, this has resulted in exhibiting compassion for their own math anxious students.

Both participants spoke of their own negative experience with math growing up, resulting in their current negative attitude towards math and towards teaching math. More specifically, these participants both agreed that their math education growing up was very structured and challenging, which greatly impacted their decisions to not pursue math further. Furthermore, both participants spoke of their current comfort level around math, which is reliant on the complexity of the math they teach. Both agreed that the content is far less intimidating at the primary level, and experienced a higher level of anxiety teaching at a junior level. Lastly, both participants argued that since they have experienced this math anxiety in school firsthand, they allow these negative experiences to guide their current practice, thus showing more compassion for their own math anxious students. This theme is important because an educator’s attitude towards a subject provides context for the steps they take within the classroom, in terms of preparation and instruction.

4.1.1 Educators indicated that their comfort levels around math relates to the complexity of math to be taught and having enough time to prepare for instruction. Despite having math anxiety growing up and still experiencing it to some degree today, both participants agreed that they always felt less pressure and stress with the math content at the primary level. Having taught from Kindergarten all the way up until Grade Six, Gwen stated that she was never nervous when it came to math at the Kindergarten or Grade 1 level, since she understood the content and it was a lot less intimidating to her. This was similar to what Bianca experienced, as she discussed that currently teaching at the Kindergarten level does not bring forth the type of
anxiety she felt towards math within her own schooling, since the level of understanding is very simple and the content is much more basic. Both participants also expressed that although they have had the chance to work within the primary and junior grades, they prefer to teach at the primary level.

Both participants also agreed that the level of anxiety they face surrounding math instruction increases when they teach within the junior grade level. With the highest grade level taught by Bianca being Grade 4, she expressed that she felt an increase in anxiety with her math instruction in comparison to Kindergarten. With that being said, she stated that even math in the fourth grade was not as anxiety inducing for her, and is probably the highest grade she feels confident teaching. This is similar to Gwen, who has taught up to Grade 6 math. She expressed that she felt a lot more nervous teaching math in the sixth grade, and also explained that there is the added pressure of the EQAO testing as well, in order to ensure that students are performing at the Ontario standard level. The literature confirms that educators who are math anxious typically favour teaching math at a younger grade level, especially if they have had the opportunity to teach the content for a few years, and experience an increase in anxiety when teaching at the junior level due to low self-efficacy beliefs (Chen et al., 2014; Gresham, 2009). The preferences and discomforts expressed by both participants suggests that the literature is still relevant within this area, as math anxious teachers still typically favour teaching at the primary level.

**4.1.2 Educators indicated that the negative experiences they had within their own math education greatly impacted their decision to not pursue math further.** Both participants described the negative experiences they had within their own math education. They both recalled that their school experiences were traditional in nature, as lessons were always very structured, uninteresting and challenging. Bianca defined her experience as being more product-oriented, as
there was always a specific procedure to follow in order to get to a specific answer, and it was immediately wrong if the student did not come to that one answer. Both participants also recalled specific incidences or teachers from their past, who made their math education a very negative experience for them. Gwen described her process of learning to tell time, and how upsetting it was for her when she approached her teacher for assistance when she was having trouble grasping a concept, and received no sympathy or guidance from her. Bianca recalled a specific teacher, by name, who she still remembers to this day, and explained,

In high school I had a specific teacher I will never forget, Mr. Fiend, he was a nightmare! He just made math very stressful! There was low participation in his class, and a high percentage of students failing his class because he was very condescending, pinpointing specific students to go up to the board to solve these long long questions that were so challenging. He didn’t make it fun and it was just very hard to understand and very stressful, and that’s what I recall from math, and I got so turned off that you know I just didn’t do well.

Bianca admitted that she could recall this vivid description of her specific math experience because of how traumatising it was for her. She further emphasized that it was this experience and several others just like it that “turned her off” from math altogether, and greatly impacted her decision to not pursue math further within her own schooling. She decided to pursue her other interests in the Arts, English and Geography, as opposed to working with numbers. This result was true for Gwen as well, as she admitted that she went into the languages within her own schooling and stopped taking math related courses as soon as she could. The literature argues that negative experiences individuals have within their early math education are often remembered years later, and greatly impacts an individual’s motivation to pursue math within
further schooling (Bekdemir, 2010; Harper & Daane, 1998; Peker, 2009). The experiences both participants have had ultimately suggest that this literature is still very relevant, and that negative experiences in the mathematics classroom are still impacting future schooling decisions.

4.1.3 Educators recognize that because of these negative experiences within their own math education, they have more compassion for their own math anxious students. Both participants argued that because of the negative math experiences they have had within their own schooling, they feel as though they are more understanding and show more compassion to their own math anxious students. Bianca recalled a time when her Grade 6 teacher got upset with her when she was unsure of how to solve a particular math problem, and exclaimed that she was “bad at the subject.” This was so upsetting to her, because of the fact that she was trying her best, and it did not seem like it was good enough for her teacher. She further emphasized that she would never say something so negative and hurtful to any of her students, because she not only still vividly remembers this experience years later, but also because she knows how degrading it felt.

With this being said, both participants described their motivation to provide their students with a different experience than what they had growing up. Bianca directly stated “I learned from my own bad experiences and try to make it a more positive one for my students.” This points to the idea that although these participants have had negative experiences within their math education and hold negative attitudes towards the subject, they ultimately have used these negative experiences to guide their current practice, in order to ensure that their students do not go through the same type of anxiety as they did. Gwen also added that she does not want her students to stress over math the same way that she did as a child, as “stress is such a big part of our lives, and it starts at such a young age these days.” Lastly, Bianca states that although every
student is not going to love math, there is a big difference between preferring other subjects over
math, and being afraid of the subject altogether. She further explained that “showing more
compassion to students who are having a difficult time results in students taking risks and
believing in themselves a lot more.” The literature states that teachers who have experienced
math anxiety growing up are more compassionate and understanding of students who are
struggling with mathematics (Gresham, 2009; Peker, 2009). This ultimately suggests that the
literature is relevant within this area, and that there are still educators who are allowing their own
negative experiences learning math to guide their current practice in both positive and negative
ways.

4.2 Educator's lack of confidence in math is a result of the instructional approaches they
themselves experienced in school, and they exhibited concern of their anxiety transferring
to their own students.

Participants shared that their own math anxiety is a result of the different instructional
approaches utilized by their educators within their own schooling. This not only included
methods of teaching and the types of activities they engaged in, but also included the assessment
methods utilized by their educators as well. Participants also shared that their math anxiety is a
result of a lack of experience and confidence engaging in the subject, especially in terms of not
pursuing the subject further within their own schooling and not taking any additional
qualifications within math. Lastly, both participants exhibited the concern of anxiety
transference, in that they have always feared that their own math anxiety would transfer to their
students. This is important because math anxiety is caused by many different factors based on
individual experience, ultimately impacting teaching practices utilized within classrooms. If
these factors are successfully outlined, future practice can be altered in order to help ensure that learning math is a more enjoyable process for all.

4.2.1 Educators share that their math anxiety is a result of the instructional approaches utilized by their educators in school. Both participants shared details about the instructional approaches utilized by their educators within their own schooling. Gwen recalled the thing she remembers most vividly within her own math education experience was the anxiety she felt as she got into more complex forms of math within school. She theorized that this says a lot about how she was taught math, and the overall experience she had; it was not one that was receptive to how she learned math. Bianca’s experience was very similar in nature, as she continuously mentioned a “pen and paper” instructional approach to learning math, which she described as never straying away from the math textbook and the content within it. She also recalled that her experience of learning math in school was very procedural and “cut and dry” where she would always be expected to go through a specific process in order to reach a specific answer. She directly stated,

Back in my day when I was young it was the one answer and it had to be that one way and that’s how you get it. And I think that is also one of the reasons that a lot of people experience math anxiety.

The assessment techniques utilized within their own schooling was also a common finding between both participants. Gwen recalled being handed pop quizzes within math class that frightened her greatly, and also remembered the anxiety that chapter tests would bring forth for her. Bianca discussed her experience with math tests, which she knew was always at the end of each unit. She explained that she always felt as though she was ready for her tests, but when the time came, she would freeze up and start to panic when the questions differed from what she
studied. This idea is in line with the literature, in that traditional testing methods within math tend to significantly increase anxiety within students (Brady & Bowd, 2005; Sloan, 2010).

4.2.2 Educators share that their math anxiety is a result of their lack of experience and confidence in their math abilities. As mentioned previously, Gwen and Bianca indicated that their math anxiety resulted in them not pursuing math further within their education, due to the negative experiences they had within school. This resulted in both participants explaining that they only took the required amount of math within high school, and stopped taking math related courses as soon as they could. Bianca stated that she believes the fact that she stopped taking math within her own schooling showed just how she felt about the subject, which greatly impacted her level of understanding within math as well. Both Gwen and Bianca also shared that their lack of confidence in their math abilities relates not only to the limited math education experiences they had within their own early schooling, but also relates to the absence of higher level math related courses and additional qualifications within teachers college and their teaching career as well. When asked if she had taken any additional math related courses, Bianca directly stated “No, none, because it was always a subject area I disliked, so I never took additional qualifications or teacher qualification courses in math, especially because in the elementary panel it is optional.”

With that being said, both Gwen and Bianca shared that they have taken math related workshops and PA day math initiatives, specifically when these courses were not optional. Bianca continued to explain that she definitely believes this to be a reason why she lacks confidence in her math abilities, because of the fact that she tries to avoid it as much as possible. The literature suggests that the negative math experiences educators have had in their own experience greatly impacts their own self-efficacy when it comes to math (Gresham, 2009). Both
participants revealed their lack of understanding and confidence towards math, which is a main reason why they did not pursue it within their further schooling, thus ultimately suggesting that these findings are still relevant. Also, although the literature suggests that professional development is one way where educators can alleviate some of their anxiety, this study showcases how some educators can exhibit resistance towards learning math, even within professional development (Chen et al., 2014).

4.2.3 Educators share a concern that math anxiety may be transferred to their students. With the causes of math anxiety being explored, educators also shared their concern of math anxiety transference to their students. This idea can be described as students picking up on an educator’s hesitance and resistance towards math, thus adopting that same attitude towards the subject. Bianca explained that “children pick up everything you do and do not say” and believes that anxiety transference is very common. She directly stated “If a teacher has a level of interest in something or is passionate about something, it is going to rub off on their students. They are going to pick up on that.” She went on to say that she commonly worried about her students picking up on the level of disinterest she has in math, which she expressed is undesirable for her. Gwen mentioned a similar point, in that she feels as though her students not only notice a difference in her level of enthusiasm for some subjects over others, but that they also notice the instructional quality of her lessons as well. The literature also addresses the concept of anxiety transference, and states that since there is a direct link between teacher and student confidence, some educators fear transferring their anxiety to their students. (Chen et al., 2014; Gresham, 2009; Bekdemir, 2010).
4.3 Educators share that their math anxious students typically feel overwhelmed and stressed due to the pace of the math curriculum, and exhibit various indicators as a result of their anxiety.

Both participants shared their observations and experiences teaching math anxious students, and explained that these students typically become overwhelmed by the fast-paced nature of the math curriculum. Participants also shared that their math anxious students also display a great deal of stress as a result of not only their lack of understanding, but also because of the nature of the math curriculum, and how each unit is very dependent on the last. Lastly, participants shared indicators of math anxiety that they observed within their own practice from students, which includes a “blank stare,” remaining quiet, guessing, a general reluctance to participate, as well as blending in. This section is significant because of the fact that it is not only important to understand the relationship between math and student stress, but it is also important to be aware of the many indicators of math anxiety in order to properly support students who may need extra guidance and support.

4.3.1 Educators share that students who have math anxiety often feel overwhelmed and stressed due to the fast-paced and accumulative nature of the math curriculum. Both participants shared that they have noticed their math anxious students typically becoming overwhelmed by the pace of the math curriculum. Both participants noted that because of the fast-paced nature of the math curriculum, student stress is very apparent, especially within the older grades. Bianca stated that when she taught Grade 4, it was very obvious which students were struggling with the math concepts. She further explained that since the strands within math build upon each other, the students who were displaying difficulty in math early on often had difficulty throughout the entire year, thus resulting in stress and anxiety over the subject. Gwen
had a similar experience, and described a scenario where one of her students was going through a very hard time within her Grade 5 mathematics class, and would have a breakdown almost every day in class because she was not understanding the material. She explained that it was “heartbreaking to see, and to know that [her] math instruction was the cause of it.” She exclaimed that this student always needed extra time to work through problems at her own pace, and expressed that she felt overwhelmed because “to her it seemed as though she was the only one who didn’t understand.” The literature suggests that a teacher’s more traditional instructional approaches to teaching math can result in students becoming overwhelmed by the curriculum, especially in terms of a heavy reliance on textbooks that move at a quick pace (Brady & Bowd, 2005; Sloan, 2010).

4.3.2 Educators recognize several math anxiety indicators that they have noticed from students within their own practice. Both participants spoke of various indicators of math anxiety that they have observed from their own students within their own experience. One indicator discussed by Gwen was the common “blank stare” typically given by her math anxious or hesitant students. She described this as students who have a “lost look on their face” when they are either engaging in a math assessment, or when simply engaging with a certain math concept individually or in a group setting. She directly stated that “They simply stare at me, or the material I am showing, without any expression or movement.” Bianca introduced the indicator of remaining quiet, as she directly stated that “it is usually your quiet ones” in relation to students who are experiencing math anxiety. She exclaimed that these students will typically remain reluctant to raise their hands to share an answer or an opinion to a posed question, and are less likely to participate in group discussions.
Gwen spoke of guessing as another common indicator of math anxiety or having difficulty with math. In her own experience, math anxious students would typically guess when it came to math assessments, and their answers would be far off from what was expected. She continued by stating that student guessing is also paired with a general avoidance of and lack of participation in the subject for fear of embarrassment. Gwen directly stated, “When [students] are unsure a lot of times they don’t seek help, and would rather just guess and hand it in as quick as possible.” Also, Gwen argued that these students prefer to blend in with their peers, especially in terms of participating in group work. She directly states that “They want to be with someone who they know understands the math” as it gives them a sense of comfort and allows for their partners to provide all of the mathematical explanations for them. This again is supported by Bianca, as in her experience, her struggling students preferred to blend in with the class and not bring the difficulty they are having to the forefront. This suggests that the literature is still relevant, in terms of a lack of participation from math anxious students due to a fear of embarrassing themselves in front of their peers (Peker, 2009).

4.4 Educators share that quality lesson planning and providing students with additional support are instructional strategies they enact to mitigate student math anxiety.

Based off of their own experience within school, and their own experience teaching math, both participants shared the instructional strategies they enact within their own classrooms that help to mitigate student math anxiety. Both participants recognized that quality lesson planning is an instructional approach that they enact, which not only includes basing lessons off of student interests and to the specific needs of the class, but also taking the time to successfully prepare for lessons through various routes like collaborating with colleagues. Participants also recognized that providing additional support to students who are having difficulty can be very beneficial,
such as providing small group instruction or one-on-one time within class, as well as transparent availability before or after school in various ways. A student-centered approach to teaching math will also be explored, as participants shared that an experiential and collaborative approach that is interactive and fun can make all the difference in terms of student enjoyment and motivation to learn math. Lastly, time management and a general lack of time, as well as limited resources are challenges that will be touched upon briefly, which were expressed by both participants in terms of providing students with quality lesson planning and support. The fact that these participants are able to share some of the successful strategies they enact to mitigate student anxiety is powerful, in the sense of inspiring other educators to do the same.

4.4.1 Educators recognize that preparing quality lesson plans is an instructional strategy they enact to mitigate student math anxiety. Both participants argued that based off of their own experience, proper preparation and quality lesson planning greatly helped to mitigate the anxiety their students felt towards math. Gwen directly stated that because of her anxiety, “[math preparation] took longer, [as she would] prepare much more for math than any other subject.” This was because she constantly tried to think of new ways to make math enjoyable for her students, even if it was a small group task, or a fun game that helped to reinforce some of the concepts they were learning. She also mentioned that teaching math at the junior level took a lot more time and preparation, because she was constantly reviewing the material beforehand in order to ensure that she was confident teaching her students. Bianca also explained that she felt more confident teaching when she had reviewed the content beforehand, and when she knew exactly how she was going to teach the material.

Bianca also mentioned that she wanted to not only prepare her lessons well, but that she also wanted to deliver them in a way that hooked the students, to essentially foster their curiosity.
and interest in what they were doing. She mentioned that she would work diligently to try to incorporate some of their interests into the work they were doing however she could, especially for those student who were showing disinterest. This is particularly true within Kindergarten, as she argued that it is so important for students to have positive and meaningful math experiences early on, in order to build a life-long love of learning math. Lastly, Gwen argued that differing math assessment methods is a key to quality lesson planning, such as recording observations, group tasks and presenting findings, as well as even utilizing a portfolio where students collect artifacts throughout the unit that best showcase their learning. With all this being said, both participants argued that a challenge they often face with implementing quality lesson plans is time management and a general lack of time. This is particularly true when both participants taught within the junior grades, as math within the higher grades took a lot of extra time to review the material and then to prepare engaging lessons.

In order to assist with the process of implementing engaging lesson plans, both participants spoke to the value of collaborating with colleagues and others to support them in this process. Gwen emphasized that it is not always necessary to reinvent the wheel, since there are so many excellent resources and ideas that have already been proven to be successful. Again, she also spoke to the value of even just collaborating with close peers who can help clarify or provide new and exciting ideas. Bianca also spoke to the value of colleague support as well, especially with other teachers who are teaching the same grade level. She explained that co-planning can positively add to the math curriculum greatly, because of the fact that educators can add to or comment on each other’s ideas, and then ultimately tailor them to fit the diverse needs of their class. The literature highlights the importance of proper preparation, especially if educators want to successfully implement more student-centered instructional approaches to
teaching math (Harper & Daane, 1998; Stipek et al., 2001). This study points to the fact that the
literature is still current in the aspect of proper preparation beforehand, and the importance of
providing students with positive and quality math lessons that are meaningful to them.

4.4.2 Educators recognize that providing additional support to students helps to
mitigate student math anxiety. Both participants agreed that providing support to students who
are having difficulty with the math curriculum, or who have math anxiety can be so beneficial in
terms of increasing their math confidence. Gwen mentioned that she found it much more
effective when she would slow down her instruction, as well as when she would work one-on-
one or with a small group of students who were displaying difficulty. She mentioned that she
found this really gave her more time to delve into the concepts that were more challenging for
her struggling learners, and is one way that she would work around such a dense and fast-paced
curriculum. For example, she explained an incidence within data management where her stronger
math students were given the task to create a survey question, and then survey their class as well
as another Grade 6 class across the hall. During that time, she had her struggling math learners
on the carpet area, and she went over some of the key components of conducting a survey, as
well as simple ways to represent this information using different graphs.

Bianca emphasized the importance of availability in terms of providing additional
support to students who were having difficulty. She explained that the students always knew she
arrived to school early, and that she was usually available to talk to before school. This also
applied to afterschool as well, as she had started a homework club for the students in her class
one year. Also, she mentioned that it was common that she would stay in her classroom during
recess periods, and allow the students to stay in too if they were engaged in work. She added that
these simple acts show students that their educator is there for them, and wants the best for them,
which makes all the difference. Gwen approached availability in a slightly different manner, where she explained that she was a part of a math committee within her school. Students from all grades were a part of this committee, where older students would assist the younger students, and teachers would be there to assist all as well. She argued that her math anxious students often had a hard time coming forward and attending right away, but that she ensured that they had somewhere to turn when they felt ready. The literature suggests that it is far too common that educators look at students in the same light, which is why it is so important to differentiate instruction based on each students’ individual needs (Geist, 2010). This study supports these findings in that small group instruction is one way for educators to differentiate based on who is having difficulty, and ultimately points to the fact that the literature is current in this area.

4.4.3 Educators recognize that utilizing more student-centered approaches to teaching math helps mitigate student math anxiety. Both Gwen and Bianca have observed the benefit of incorporating student-centered instructional approaches within their own practice while teaching math. A hands-on, experiential and collaborative approach is how both participants tried to structure their math classes, especially because this approach differed greatly from the negative experiences they had growing up. Both participants provided an example of a Bansho approach to teaching math, which they tried to incorporate as much as possible within their own teaching practice. Bianca explained that she loved utilizing this approach because it really showed students that there are multiple ways to solve a problem and come to the same answer. Students are able to visually see and listen to each groups’ thought processes, and then compare these to their own methods for solving a problem. She further emphasized that not only was this an opportunity for students to work collaboratively in groups and be accountable for each of their contributions, but it was also an effective and different form of assessment that is
less intimidating than simply giving students a math test. They also mentioned the use of math centres, especially within kindergarten, in order to reinforce concepts being taught. Both participants argued that although the process of implementing a Bansho approach or math centres was always very time consuming, it was ultimately always worth the effort because of how the students responded and how successful they were in terms of increased levels of understanding and engagement.

Participants also mentioned that they always tried to make their math lessons positive, fun and interactive, because their own experiences were everything but that. Bianca mentioned the use of manipulatives and visuals within her class, in order to assist her concrete and visual learners. Gwen added to this by stating that it was always important for students to know that manipulatives were always available to them and that they were a part of the class where students could take them as needed. With that being said she recognized that with schools having limited resources this is not always possible, but that sometimes it is beneficial to create manipulatives, even by printing off various objects and laminating them. In order to create fun and engaging math lessons, Gwen also utilized technology within her class, and has used various math related programs like Math Prodigy. She explained that Math Prodigy is a website where students can learn valuable math skills by playing games, and student progress is then tracked for educators to see. Both participants also spoke of using a smartboard with a lot of student interaction, as well as generating fun lesson ideas through various websites like Pinterest and Teachers Pay Teachers.

One important aspect of the student-centered approach to teaching math that both participants touched upon was the idea that the foundation and process of learning math should be co-created by both the students and the teacher. In terms of building a successful foundation
for learning math, both participants described using the growth mindset, and seeing significant changes in their students’ general attitudes towards the learning process. Gwen mentioned that she would always remind her students of the growth mindset within the mathematics class most often, since students would often profess that they “could not do it and would never be able to.” Gwen also discussed the process of teaching math, and how she would always break down certain math problems with students, and take on a more collaborative approach to teaching. Bianca agreed with this statement, and stated that although at times she felt nervous to teach a strand that she was not very confident in, she tried not to stress over it too much because she explained to her students that it is acceptable to make mistakes, and that even teachers make them. She directly stated that “If I didn’t understand, and even teaching a lesson if I were to stumble, the kids would teach me.” This ultimately created a more natural teaching and learning relationship, where students began to understand that everyone makes mistakes, and that these mistakes allow learning as a whole to occur. The literature mentions that student-centered approaches are ones that are co-created by students and educators, and which are hands-on, interactive, experiential and enjoyable (Harper & Daane, 1998; Stipek et al., 2001). This ultimately suggests that the findings are still relevant, in terms of the benefits that can come from utilizing a more hands-on and collaborative approach to teaching math.

4.5 Conclusion

In conclusion, I discussed the participants’ own attitudes towards math and towards teaching math, which were more negative because of the more structured and challenging experiences they have had within their own schooling. These negative experiences ultimately impacted their decisions to not pursue math further and their comfort levels teaching math at higher grade levels. With that being said, their math anxiety has resulted in them having more
compassion for their students who are struggling within math, just as they did. Participants also shared various causes for their own math anxiety. The instructional approaches utilized by their educators within their own schooling was the first shared cause, in terms of teaching methods, types of activities they were engaged in, as well as assessment methods that typically increased their anxiety. A lack of experience and confidence within math was the second shared cause, in that participants tried to avoid math as much as they could within their own schooling, as well as when it came time to choose additional qualifications as well. Lastly, both participants shared a concern of transferring their disinterest and anxiety towards math to their students, as they know that students can typically gauge how one feels about a subject based on enthusiasm and lesson quality. Next, participants shared their experiences teaching their own math anxious students. They both explained that these students typically became overwhelmed by the fast-paced nature of the math curriculum, and commonly felt alone in their struggles. Both participants also shared various indicators to look for in terms of identifying students who have math anxiety, which include a “blank state”, remaining quiet, guessing, avoidance, lack of participation and blending in. These are crucial in terms of identifying students in order to provide them with the proper support they need.

Lastly, participants shared instructional strategies they enact to mitigate student math anxiety, which include quality lesson planning that is based off of student interest and structured with the help of colleagues, providing additional support to students, as well as utilizing more student-centered approaches to teaching math that emphasize collaborative and enjoyable learning. These findings point to the fact that the literature is still very current in terms of how educators who have math anxiety are feeling about math and teaching math, the general causes of math anxiety, how students experience the math curriculum today, as well as more successful
instructional approaches to teaching math that typically mitigate anxiety for students. It is ultimately apparent that more traditional methods of teaching math still tend to increase anxiety within students, and that student-centered approaches to teaching math are ones that allow for each individual to feel more confident and at ease within the math curriculum. Next in Chapter 5 I discuss implications for these findings, provide recommendations and note areas of further research.
Chapter 5: Discussion

5.0 Introduction

In this chapter, I provide a brief overview of my key findings, and provide a rationale for why each of these findings are significant. I then discuss the implications of these findings, for both the whole educational research community, as well as for myself as a teacher and researcher. Next, I outline my recommendations based on these findings for both teachers and schools in general. I have also discussed two areas for further research within the areas of teacher compassion for students, as well as anxiety transference. Lastly, I have concluded this chapter with general comments regarding this area of research.

5.1 Overview of Key Findings and their Significance

It was evident that the experiences both participants had within their own math education negatively impacted their current attitude towards math and towards teaching math. Both participants argued that the complexity of the math they teach greatly impacts their comfort levels, as they feel a lot less pressure and are more confident teaching math at the primary level. They also argued that the negative experiences they have had within their own schooling impacted their decisions to not pursue math further within their own education. This is due to the fact that participants not only vividly remember negative experiences and teachers they have had within their past, but that these experiences essentially impacted their desire to engage in math altogether. It was interesting to note that although these participants have had negative experiences growing up within their own education, they believe they have more compassion as a result of these experiences, and are more understanding of their students who are also exhibiting a similar level of hesitance towards math. Both participants shared that they know how embarrassing struggling with math can be since they have experienced it themselves, and
both stress the importance of providing their students with a difference experience than what they went through. These findings are significant because they showcase just how influential these negative experiences can be in terms of engaging in further math education, and also argue that although these negative experiences were traumatic for these individuals, there is a positive that has come about as a result (Bekdemir, 2010; Gresham, 2009; Harper & Daane, 1998; Peker, 2009).

Both participants shared their perspectives on the causes of their own math anxiety. They argued that due to the instructional approaches they experienced within their own schooling, they felt an increase in stress and anxiety, especially as they progressed each year. The standard structured and procedural way of teaching math was not receptive to how both participants learned when they were in school, which is why an increase in stress and anxiety was evident. Participants also shared that their lack of experience and confidence in their own math abilities is another cause of their own math anxiety. Participants argued that because of the fact that they only took the required amount of math in high school, and never engaged in any higher level math related courses or additional qualifications, they have a lower level of confidence with math as a result. The idea of anxiety transference was also mentioned by both participants, as they strongly believe in the notion that students are capable of picking up on their hesitance and resistance towards math. They also believe that students not only notice the level of enthusiasm teachers have while teaching certain subjects over others, but also notice a difference in general lesson presentation quality as well. These findings are significant because they not only help other individuals understand the causes of math anxiety, but also help educators to become aware of personal bias when it comes to teaching various subjects over others (Gresham, 2009).
Participants also outlined what they have observed from their own math anxious students, and general math anxiety indicators they have noticed within their own practice as well. In general, both participants agreed that their math anxious students generally feel overwhelmed due to the fast-paced nature of the curriculum. They also noted that their math anxious students also tend to feel a sense of stress with the accumulative nature of the math curriculum, as brand new concepts build off of what was previously taught. Participants also shared the math anxiety indicators that they have observed within their own practice. Students who exhibit a “blank stare” or remain quiet are typical indicators. A reluctance to raise a hand or participate in class discussion is another indicator, which also pairs with a general avoidance of math for fear of embarrassing themselves in front of their peers. Also, math anxious students typically prefer not to seek help, and would rather blend in than make it known that they are struggling. These findings are significant because they help educators, especially those who are not math anxious, gain a sense of how the math curriculum makes anxious students feel, and the experiences they go through while engaging in math (Peker, 2009).

Furthermore, both participants shared the instructional strategies they enact to mitigate student math anxiety. They stressed the importance of preparing quality lesson plans for their students, despite the fact that this may take a little extra time and effort. They indicated they consistently try to think of new fun and engaging ways to introduce or reinforce certain math concepts. With that being said, both participants shared that while teaching at a junior level, reviewing unfamiliar math concepts beforehand can help tremendously in terms of increasing confidence teaching the content. They also recognized the importance of not only using different forms of assessment when it comes to math, but also the benefits of collaborating with colleagues as well. Participants also outlined the importance of providing additional support to
students, whether that includes working one-on-one with them, or ensuring availability before, during or after school. This also includes becoming involved in additional school support systems, such as a homework club or being part of a math committee, which math anxious students can attend when they feel ready. Finally, participants shared their beliefs about the importance of providing students with hands-on, experiential and collaborative math experiences. These experiences utilize manipulatives and visuals, technology, a growth mindset, and are ultimately co-created by students and teachers, in order for a more natural teaching and learning relationship to occur. These findings are significant because they showcase the various instructional approaches and strategies that a small sample of teachers utilize in order to help mitigate math anxiety within their students, which can be utilized by other educators as well (Harper & Daane, 1998; Stipek et al., 2001).

5.2 Implications

In this section I have outlined the implications of my findings for a broader educational research community, such as for educators who have math anxiety, and those who do not, as well as for other schools as well. I have also outlined the implications for my own professional identity and practice, as both a teacher and researcher.

5.2.1 The educational research community. The findings of this study are greatly relevant to teachers who have math anxiety. Both participants mention their concern about potentially transferring their anxiety to their students, which is an idea that is grounded in research as well (Chen et al., 2014; Gresham, 2009; Bekdemir, 2010). They both argue that students can generally pick up on hesitance and resistance towards teaching particular subjects over others, and can sense general enthusiasm for subjects, just by voice tone or lesson quality differences. This is why it is so important for educators who have math anxiety to take the extra
time to prepare for math instruction, in order to feel more comfortable and at ease while teaching it. This is commonly what both of my participants did, as they knew it was a subject that they had difficulty with, and thus, set aside more time to prepare successfully for it. They also knew that in order to present quality lessons to their students, which were engaging, interactive and collaborative, they needed to take that extra time to do just that.

These findings are not only relevant to teachers who have math anxiety, but also teachers who are confident in their math abilities as well. As mentioned previously, negative experiences learning math can be remembered years later and impact decisions to pursue it further, which is why it is so important for all educators to utilize the many strategies and instructional methods that allow anxious students to feel more at ease while learning math (Bekdemir, 2010; Harper & Daane, 1998; Peker, 2009). Educators who are more confident in their math abilities generally do not have first hand experience with what math anxiety feels like, and how the nature of the math curriculum can result in math anxious students feeling overwhelmed and stressed. This is why being aware of not only how these students are feeling, but also being aware of the common math anxiety indicators that students may display, can be crucial in terms of helping to identify students who are struggling, and who are working hard to blend themselves in with the rest of the class.

Both participants highlight the importance of providing ample opportunities for additional support within math, which can be so beneficial for students who are struggling, and can essentially be a place these students can turn to when they feel ready. School initiatives for the integration of various homework clubs or committees centered around math help can provide students the avenue for additional support. They allow students the opportunity to not only work alongside other students who are there to help them succeed, but also to help them realize that
they are not alone in their struggles. Both participants share the value in these support systems, in terms of increasing confidence and self-efficacy beliefs when it comes to engaging in math.

5.2.2 My professional identity and practice. As someone who has personally experienced what it is like growing up with math anxiety, these findings are pertinent to my own practice moving forward. It is evident that individuals can experience a lack of confidence with their math skills and with teaching math, due to minimal math engagement within further schooling. As someone who has avoided math after high school, just like my participants, I too believe I have a lower level of confidence teaching math. This points to the idea that although math additional qualifications may not be desirable for me as a math anxious individual, I believe they can greatly assist me in not only gaining more confidence, but also assist me in acquiring new and exciting ways to teach math, and highlighting different instructional approaches to utilize as well. This is crucial, as it is evident that instructional approaches within math make a significant difference in terms of how individuals feel about math, and their decisions to pursue it further as well.

With this in mind, after hearing the many strategies my participants utilize in terms of mitigating student math anxiety, it is evident that student centered approaches to teaching math are more desirable and beneficial for students who are having a difficult time with math. I strongly believe in the importance of students having a fun and enjoyable time learning math, especially within the younger grades in order to build a lifelong love of learning math. This is why it is so important that I plan quality math lessons that center around having hands-on, interactive, and positive experiences, which are co-constructed between my students and myself. It is also important that as an educator I am cognizant of the many math anxiety indicators students may exhibit, such as a reluctance to participate, avoidance of math, or even not seeking
help when needed, in order to not only work towards building up student confidence and level of interest when it comes to engaging with math, but also to become more motivated to provide my students with a different experience than what I went through within my own schooling.

5.3 Recommendations

Due to the fact that math anxiety continues to be a prevalent topic amongst students of all ages, it is important to outline various recommendations that have derived from this study in order to try to mitigate the anxiety students feel to some degree. One of my first recommendations is for teachers who have math anxiety to challenge themselves to take math related additional qualifications. Although this may seem like an undesirable option for individuals who have math anxiety, these courses can greatly support educators in learning new and exciting strategies for teaching math, which in turn increases self-confidence and self-efficacy beliefs in regards to their math skills. Along with this idea of increasing self-confidence while teaching math, it is crucial for educators to review content beforehand, in order for them to be fully comfortable teaching the content and answering questions that may arise. This may look like educators researching individually, or even collaborating with close peers and colleagues, which was a common solution utilized by both of my participants.

Furthermore, another recommendation I have is for educators and schools in general to ensure that there is a medium in place for students to receive additional math support. This can be accomplished in many different informal ways, such as before and after school or even during recesses. This can also be accomplished in formal ways as well, such as through a more structured homework club or a math committee, which were examples shared by my participants. It is ultimately so crucial for students to know that their educator is someone they can turn to when they are experiencing stress or confusion, especially within math. Both participants
ultimately share that it is key for educators to be available and willing to support their students at all times.

Lastly, my final recommendation includes the importance of utilizing student-centered approaches to teaching math. This encompasses everything from hands-on, experiential and collaborative lessons, providing students with a multitude of visuals and manipulatives, utilizing technology and diverse assessment methods, practicing a positive attitude towards math and utilizing a growth mindset, as well as simply co-constructing the math curriculum with students, where a natural teaching and learning relationship can be established. All of these experiences allow students to feel more at ease while learning math, which makes an already frightening process seem a little less intimidating. Both participants share employing a Bansho approach to teaching math, which is something that I believe all educators can easily incorporate into an already existing math curriculum. It is essentially a way for the content to come alive for students, and for them to feel self-motivated to not only learn on their own, but to also learn from their peers as well. When students are going through a process and figuring out problems together as a class, learning can begin to feel so motivating and rewarding in the end.

5.4 Areas for Further Research

I have been able to add to the already existing research on the topic of teachers who have math anxiety, and how that impacts attitudes regarding math and instructional approaches to teaching it. One area for further research can include looking at both educators who have experienced math anxiety within their own schooling and those who did not, and comparing the level of compassion and patience they have towards working with their struggling or anxious learners within math. This topic was briefly touched upon within this research study, as both participants felt as though they had more compassion for their students, since they have
experienced that same level of difficulty on their own. This relates to another possible idea for further research, which includes comparing prior schooling experiences between both teachers with math anxiety and teachers without math anxiety. This can be taken one step further, where researchers could then track student progress over time, in order to see just how these educators are influencing their students in regards to math.

Another area for further research can include looking at the idea of anxiety transference in more depth. This topic was also touched upon briefly within this study, where both educators felt concerned about the potential of their hesitance and resistance towards math being not only noticed by their students, but also transferred to them as well. They also explained that in their own experience their students could notice a difference in enthusiasm and lesson quality for some subjects over others. This could be an interesting pathway for further research, in terms of looking at ways in which students come to these conclusions, as well as ways in which educators can remain as neutral as possible while teaching.

5.5 Concluding Comments

This research study has assisted me in deconstructing math anxiety from the perspective of the teacher; more specifically, looking at educators who have math anxiety, and how that impacts their current instructional approaches to teaching math, and their overall attitudes surrounding the subject. As someone who has grown up dealing with math anxiety within my elementary schools years, and still faces it to some degree today, this study has helped me tremendously in terms of gaining insight into how a small sample of educators are dealing with their anxieties towards math in positive ways.

These participants have shared three main instructional strategies and approaches they utilize, which have proven to be successful for them in terms of mitigating student math anxiety,
and in order for their students to go through a more positive experience that is different from what they went through growing up. The first strategy included properly preparing for lesson plans, and taking the time to review material beforehand, in order to feel more confident and competent teaching the math strands. The next strategy was providing students with different mediums for additional support within math, whether that was before, during or afterschool, or even in school run programs as well. Lastly, educators shared that utilizing student centered approaches to teaching math, which are hands-on, interactive, co-constructed between the teacher and students can make a significant difference in student comfort levels and stress levels.

Although growing up experiencing math anxiety was a traumatic experience for both of my participants, they ultimately shared that they would not change their past, as it has lead them into being more compassionate math teachers in the end. They both strive to make learning math an enjoyable process, and are far more patient with students who are going through a difficult time learning math. Within my own practice, I will utilize all of the instructional strategies and approaches to teaching math that I have gathered from both of my participants, and am very grateful for the insights and experiences they have shared about the topic of math anxiety. I hope that other educators can benefit from these findings just as much as I have, in order for students to go through more positive experiences learning math, and to ultimately help to foster a lifelong love of learning math.
References


Yilmaz, K. (2013). Comparison of quantitative and qualitative research traditions:

Appendix A: Letter of Consent for Interview

Date:

Dear ______________________________,

My Name is Melissa Villella and I am a student in the Master of Teaching program at the Ontario Institute for Studies in Education at the University of Toronto (OISE/UT). A component of this degree program involves conducting a small-scale qualitative research study. My research will focus on the ways in which a teacher’s experience with math anxiety influences their instructional approach to teaching math. I am interested in interviewing elementary school teachers with at least five years of teaching experience. I am also interested in interviewing teachers who have or have had math anxiety within their own schooling, or who have experienced math anxiety. I think that your knowledge and experience will provide insights into this topic.

Your participation in this research will involve one 45-60 minute interview, which will be transcribed and audio-recorded. I would be grateful if you would allow me to interview you at a place and time convenient for you, outside of school time. The contents of this interview will be used for my research project, which will include a final paper, as well as informal presentations to my classmates. I may also present my research findings via conference presentations and/or through publication. You will be assigned a pseudonym to maintain your anonymity and I will not use your name or any other content that might identify you in my written work, oral presentations, or publications. This information will remain confidential. Any information that identifies your school or students will also be excluded. The interview data will be stored on my password-protected computer and the only person who will have access to the research data will be my course instructor Dr. Angela MacDonald-Vemic. You are free to change your mind about your participation at any time, and to withdraw even after you have consented to participate. You may also choose to decline to answer any specific question during the interview. I will destroy the audio recording after the paper has been presented and/or published, which may take up to a maximum of five years after the data has been collected. There are no known risks to participation, and I will share a copy of the transcript with you shortly after the interview to ensure accuracy.

Please sign this consent form, if you agree to be interviewed. The second copy is for your records. I am very grateful for your participation.
Sincerely,

Melissa Villella

Course Instructor’s Information:

Dr. Angela MacDonald-Vemic

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 from this research study at any time without penalty.

I have read the letter provided to me by ________________ and agree to participate in an interview for the purposes described. I agree to have the interview audio-recorded.

Signature: ________________________________

Name: (printed) ________________________________

Date: ________________________________
Appendix B: Interview Protocol

Thank you for agreeing to participate in this research study, and for making time to be interviewed today. This research study aims to learn how a teacher’s experience with math anxiety growing up influences their instructional approach to teaching math. This interview will last approximately 45-60 minutes, and is comprised of about 20 questions. These questions are divided into five main sections, which include background information, teacher perspectives/beliefs, teacher practices, supports and challenges, as well as next steps. I want to remind you that you may refrain from answering any question, and you have the right to withdraw your participation from the study at any time. As I explained in the consent letter, this interview will be audio-recorded. Do you have any questions before we begin?

Background Information

1. How long have you been teaching? Have you taught within multiple schools?
2. What grades and subject areas do you currently teach?
3. Can you tell me more about the school you teach in?
   - Demographics of your current school/classroom?
   - Size of the school?
   - Program priorities?
4. Can you tell me about any formal education experience you have had that have helped prepare you to teach math? (e.g. courses, additional qualifications, professional development)

Teacher Perspectives/Beliefs

5. How do you understand the term ‘math anxiety’? What does math anxiety mean to you?
6. What do you believe to be the causes of math anxiety?
7. How common would you say it is for your students to experience math anxiety?
8. What indicators of math anxiety do you see from students? How do you know they are math anxious?

9. Can you describe your own experience with math growing up within elementary school?
   - What this experience was like for you?
   - Did you know at the time that you were math anxious? If so, how did you know?
     If not, how do you know now?
   - What do you attribute your experience to math anxiety to?
   - How did this impact your experience of schooling?
   - In your experience, what, if any, were the consequences of having math anxiety later in life?

10. How would you describe your current attitude towards math and teaching math?
    - Beliefs and feelings
    - What experiences or factors have contributed to shaping your current attitude toward math?
      i. Schooling for example?

11. In what ways do you believe your own experiences with math in school and your own attitude towards math have shaped how you currently teach it?
    - Traditional versus more modern methods

12. Do you believe that your experience having had math anxiety is transferred to your students?
    - If yes, in what ways?
    - Do you have any examples that you can share?

**Teacher Practices**

13. How, if at all, did your experience with math anxiety impact the time you spend preparing your math lessons?

14. How would you describe your approach to teaching math?

15. What range of instructional strategies do you enact to minimize students’ experience of math anxiety?
    - Methods, approaches, resources used? (e.g. manipulatives, inquiry-based, connecting to real world, collaborative, centers etc.)
Can you provide an example or two of a time where an instructional strategy you enacted was very successful? What were your learning goals for this lesson? How did your students respond? What outcomes did you observe from them?

16. What range of assessment practices, if any, do you enact to minimize students’ experience of math anxiety?

17. What forms of assessment and evaluation do you utilize while teaching math?
   - Traditional Paper and pencil: Relationship between your own discomfort with math?
   - Modern: Relationship between your own discomforts with math?

Supports and Challenges

18. What kinds of support systems and resources are available to you with regards to addressing your own or your students experience with math anxiety? What do you think about the supports and resources that are available?

19. What challenges and barriers do you continue to face while teaching math? How do you respond to these barriers?

20. What challenges do you face when supporting students who experience math anxiety? What would further support you in meeting the needs of these students?

21. What do you think needs to be done by the school system and people working within it to minimize and eliminate these challenges and barriers?

Next Steps

22. What goals, if any, do you have concerning your math instruction?

23. As a beginning teacher who similarity has dealt with math anxiety, what advice do you have for me entering the profession?

Thank you for your participation in this research study.