Playing towards success: Reducing math anxiety through play-based learning approaches

By

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Abstract

This research paper addressed the research question: how is a sample of elementary teachers using play-based learning approaches in math instruction, and what outcomes they observed for reducing and/or preventing math anxiety? In addressing this question, this study utilized the expertise of two educators, who explored their use of play-based learning instruction in their mathematics teaching practice, and why they found it effective in reducing and preventing math anxiety. Five main themes emerged in the course of the interviews conducted with the participants, which ranged from the shortcomings of traditional approaches to teaching mathematics, to the source and creation of math anxiety in students, to strategies to address the occurrence of math anxiety found through play-based learning approaches, to the challenges these teachers faced in implementing play-based approaches to teaching mathematics.

Keywords: play-based learning, mathematics, math anxiety, strategies, elementary
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Chapter 1: Introduction

1.0 Research Context

Mathematics is an essential life skill, and as such, is a fundamental part of elementary education. This is not a point one that is often called into question. Children are expected to learn fundamental mathematical concepts, upon which all future math education will build on. This in itself is not problematic as children are being exposed to mathematical education throughout the elementary years. It is problematic though, that the growing trend seems to be that many adult Canadians are failing to meet a minimum proficiency in mathematics needed to function in society (Dion, 2014). Canadian children, while globally not the worst at math, are a long way away from being amongst the best (Education Quality and Accountability Office, 2012). Why is this the current movement, given that math is considered to be an essential skill?

Math education is progressive, just as literacy is. Before a child can be expected to read, they must first master the concepts and sounds of the alphabet. Math, in theory, carries the same expectation. Before a student can learn to add, they must first understand the concepts and order of numbers, and before they can divide, they must master multiplication (Ashcraft, 2002). Though this is the way that math should progress, in reality, many students do not master concepts like multiplication before being required to move on to a higher level of mathematical complexity (Ashcraft & Moore, 2009). Whether or not students master a mathematical concept, they are often expected to move on to the next one. The mastery of literacy is not taught in this way, so it begs the question: if mathematics is of equal importance, why is its mastery not approached in a way similar to literacy?

The experiences one has with math during their early years of schooling shape the experiences one will have later on (Aiken & Dreger, 1961; Arnold, Fisher, Doctoroff & Dobbs,
2002; Tobias, 1995). If a child struggles with math concepts during the early years and receives little intervention to improve their learning, it is reasonable to assume that they will not enter new mathematical experiences with much positivity (Tobias, 1995). There is a great deal of research that describes this developing aversion to math as math anxiety, or as an “emotional disturbance in the presence of mathematics” (Dreger & Aiken, 1957, pg. 344). Math anxiety is progressive, in that it develops overtime, and is a result of years of negative experiences with learning math (Stuart, 2000). Over the past few decades the occurrence of math anxiety in students has increased, as is evidenced by declining math scores and an aversion to math related careers (Dion, 2014; Tobias, 1995).

The way math is taught and learnt can cause math anxiety, and it is therefore important to turn attention to the way that math is taught and learnt in order to reduce it (Finlayson, 2014; Tobias, 1995). The research also puts forward many suggestions on how to reduce this appearance of math anxiety such as placing an emphasis on process not products, allowing students to work in groups, and the use of concrete manipulatives (Finlayson, 2014), but offers little on what this would look like practically implement in a classroom. This gap in the research is worrisome, especially to beginning teachers, who lack experience with putting these suggestions in place.

1.1 Research Problem

Given that the lack of mastery of mathematical concepts in the elementary years can lead to the development of math anxiety in students, and later an aversion to math as an adult, it is problematic that there is little discussion on how to practically prevent this chain reaction. Proactively addressing this issue in the elementary years requires educators to focus more on the complete development of all mathematical concepts before introducing a new one. As not all
children learn at the same pace, Jachyra & Fusco (2014) note that it can be difficult to move slowly enough for every student, while still challenging and teaching students who are excelling. This is challenging for all teachers, but it is especially challenging to new and beginning teachers. New teachers are aware that they must find a way to meet the needs of every student, but what exactly does this look like? The agreement that mathematical concepts taught in the elementary years need to be mastered in order to succeed mathematically in the later years is present in the literature (Scarpello, 2007; Stuart, 2000), but there is very little on what this looks like in the classroom. Teachers, beginning teachers especially, would benefit from concrete strategies on how to successfully reduce math anxiety in students, and consequently increase student math achievement.

1.2 Purpose of this Study

The purpose of this study is to understand how elementary teachers can positively affect mathematics achievement amongst students while lessening and/or preventing the effects of math anxiety. There is a large body of research that points to mathematics anxiety as a leading cause of poor academic success (Arnold et al., 2002; Finlayson, 2014; Ashcraft, 2002; Wood, 1988). And while this research suggests that educators can reduce math anxiety through altering teaching practices, such as creating a more holistic classroom environment with a student centred program (Taylor & Fraser, 2013), how to implement these changes are essential to understand. This research aims to investigate the potential of a concrete approach that can be used to effectively put strategies known to reduce math anxiety into practice, and increase math achievement in students.

This concrete approach to reducing math anxiety that I set out to investigate in this research is the potential of play-based learning approaches to teaching. Ontario’s education
system has recently embraced the benefits of play-based learning with the introduction of an early childhood education curriculum that centres heavily on it (Ministry of Education, 2010). The Council of Ministers of Education Canada (2012) explain that play advances neural pathways central to brain development, and leads to progression of thinking skills, exploration, problem solving and language expression. Play is cited as being fundamental to learning, yet, it is primarily used only in kindergarten and early childhood years. This research aims to uncover how play-based learning approaches can be successfully applied to education beyond kindergarten, and how they can be used to reduce the appearance of math anxiety.

1.3 Research Questions

In light of the research purpose, one main question was posed in this study. That is: how is a sample of elementary teachers using play-based learning approaches in math instruction, and what outcomes do they observe for reducing and/or preventing math anxiety? Primarily, this study will explore how experienced educators have implemented a play-based learning model into their mathematics teaching. The aim of this question is to provide insight for new and beginning teachers on how to effectively prevent and reduce math anxiety experienced by their students. Three sub questions also guided the study:

1. What are the perceived effects of play-based learning approaches on student math achievement?
2. What are these teachers’ beliefs about the relationship between math anxiety and academic performance in mathematics?
3. What range of factors and resources support and challenge these teachers in enacting play-based approaches to teaching math?
In posing these questions, this research study explored how addressing math anxiety through the use of a play-based learning model can effect math achievement. With Canadian math scores not increasing in global rankings (Evaluation Quality and Accountability Office, 2012), there is a need to uncover an effective way to bolster student math achievement.

1.4 Background of the Researcher

Mathematics was never my best subject, nor was it my worst. In my early elementary schooling, I did fairly well in math, but as the years progressed, I began to struggle more and more with understanding mathematical concepts. By the time I was in grade eleven, I wanted nothing to do with math. I did not realize it then, but now, looking back, I realize my growing aversion to mathematics was the development of math anxiety. I completed my undergraduate education in Sociology; a subject that was far away from mathematics as I could get, and that distance played a role in my decision to complete my Bachelors in Sociology. I thought nothing of math until I entered the field of education. I realized that not only would I have to interact with math again, I would be responsible for teaching it to children.

After getting over the shock of this realization, I made the decision that I did not want my own students to feel about math the way I did. Mathematics is so important and relevant to everyday life, but it was rarely ever taught as such when I was a student. Despite affecting so many children, and closing many career doors, math anxiety is not always effectively addressed in schools. My belief is that the best way to reduce math anxiety, is to stop it before it becomes serious. The intensity of math anxiety increases over time (Stuart, 2000), and as such its effects could be easier to manage at an earlier stage. This research is important to me because I know that I am not the first educator who has anxieties about teaching mathematics, and I know that I
will not be the last. Understanding how to confidently teach math without creating anxiety amongst students is essential for any teacher who wants their students to succeed academically.

1.5 Overview of this Study

In the process of responding to the research questions listed above, this study will first present a comprehensive look of the current literature surrounding math anxiety and play-based learning approaches in Chapter 2: Literature Review. Chapter 3: Research Methodology, will provide an in-depth look into the use of semi structured interviews in data collection, information on participants of this study, and the overall qualitative research design. Findings from this study, along with an analysis and discussion of those findings will be explored in Chapter 4: Research Findings. Chapter 5: Implications will conclude this study with a discussion of implications this research has for various stakeholders, including myself as a researcher and beginning teacher.
Chapter 2: Literature Review

2.0 Introduction

Many school boards across Ontario have highlighted that mathematics education is an area of substantial focus. This is not surprising given that mathematic achievement scores across Ontario are declining rather than increasing (Education Quality and Accountability Office (EQAO), 2012). Dion (2014) suggests that in order to address declining math performance, mathematics needs to be treated as an essential life skill, similar to the way in which literacy is treated. It is not difficult to see that mathematics is essential, especially in a time where science, technology, engineering and math (STEM) careers are prominent. Beyond that, mathematics has a role in day to day life, yet many Canadians do not meet the minimum proficiency needed to function independently in this society.

Understanding this problem, it is clear that something needs to be done in education to better equip students to perform mathematically. There is a growing body of research that explores why students are not excelling in mathematics education, and what can be done by educators to assist students who are struggling (Ashcraft & Krause, 2007; Geist, 2010). Much of this research positions math anxiety as a leading cause of poor math performance, and while it does suggest what can be done by educators to remedy math anxiety, there is very little in terms of practical strategies that teachers can use in order to reduce math anxiety (Ashcraft & Moore, 2009; Brady & Bowd, 2005; Finlayson, 2014; Geist, 2010).

This review of the literature will explore the current research on math anxiety but also explore research on a play-based learning approach, which can be used as a strategy to lesson anxiety. There is not much research on how play-based learning can be used in math instruction, and the research that is available tends to focus on play-based learning in kindergarten, and not
beyond that (Cohrssen, Church, Ishimine, Tayler, 2013). I begin by first defining what math anxiety is. Following that I explore causes of math anxiety, followed by how math anxiety effects teachers and students. I also review what the current literature has stated as strategies for coping/combating math anxiety. Proceeding the discussion on math anxiety, I explore the current literature on play-based learning. I begin with defining play-based learning, followed by its benefits, differences from traditional teaching models, and finally where it is currently being used.

2.1 Math anxiety

In this section, I explore the definition of math anxiety currently visible in the literature. I then explore causes of math anxiety, and its effects on teachers and students. This section will conclude with an exploration of the literature on strategies for addressing math anxiety.

2.1.1 What is math anxiety?

One of the earliest mentions of math anxiety was made by Dreger & Aiken (1957). They classified an “emotional disturbance in the presence of mathematics” as number anxiety (1957, p. 344). While this emotional disturbance was noted as being a contributing factor in poor achievement, it was not correlated to low intelligence. A number of additional definitions have surfaced over the years, but there seems to be a consensus that math anxiety does not stem from low intelligence (Finlayson, 2014; Stuart, 2000; Wood, 1988). Wood (1988) notes that there tend to be two approaches to defining math anxiety.

The first falls in line with Dreger & Aiken’s (1957) definition, as it focuses on the emotional impact individuals’ face when interacting with math of any kind. The second approach in defining math anxiety states that it is a tension that interferes with a person’s ability to perform mathematically. The former definition focuses on the emotional impact on the
individual, while the latter focuses on the effect anxiety has on performance. In using either
definition though, the research consistently maintains that math anxiety is a phenomenon that
hinders a person’s ability to interact effectively with mathematical situations (Dreger & Aiken, 
1957; Scarpello, 2007; Stuart, 2000; Wood, 1988).

2.1.2 Causes of math anxiety

As math anxiety has been identified as a factor in poor mathematical achievement, it is
important to understand what causes it if we hope to address it effectively (Ashcraft, 2002;
Finlayson, 2014; Tobias, 1995). What ends as math anxiety often begins as “a lack of
confidence when working in mathematical situations” (Stuart, 2000, p. 331). But this lack of
confidence is not an inherent trait in children. The causes of math anxiety are environmental, not
genetic or biological, though in public opinion, it is often confused to be this way (Dion, 2014).
The current literature seems to be consistent in this point, though there is some variance in what
the exact environmental factor is.

Children learn from the adults around them, not only teachers but also parents, guardians
and other figures of authority in their lives. The attitudes of these adults can work to shape the
attitudes of children in regards to mathematics, both negatively and positively (Ashcraft, 2002;
Aiken & Dreger, 1961; Finlayson, 2014; Geist, 2010; Scarpello, 2007). Parents who express a
dislike towards engaging in mathematics are more likely to have children who express the same
attitudes (Stuart, 2000). It is important that parents do not reinforce a negative attitude towards
math if we hope to reduce the appearance of math anxiety. Many parents express a belief that
their inability to do math is genetic. Dion (2014) explains that this incorrect correlation can
cause children to give up on math before they even begin, a sentiment that is echoed in the
research (Finlayson, 2014; Geist, 2010; Stuart, 2000).
The attitudes of teachers can also cause math anxiety in children as teachers themselves may be experiencing math anxiety. When teachers are anxious about participating in math they tend to pass those feelings onto their students (Finlayson, 2014). Confidence plays a substantial role in math performance; not just in students but in teachers as well (Stuart, 2000). Finlayson (2014), who makes the claim that teaching style causes math anxiety, explains that many teachers who are anxious tend to teach with a focus on developing a specific skill through the use of memorization, textbooks, and a strict devotion to curriculum. These methods, which are more common to a traditional teaching model, have been positioned in the research as ineffective in reducing math anxiety (Stuart, 2000; Tobias, 1995).

While some in the conversation believe that these teachers can alter their approach to teaching math by altering the environment, others suggest that these teachers are “hostile and insensitive” and incapable of creating an environment conducive to addressing math anxiety (Brady & Bowd, 2005, p. 38). A larger part of the research though is in line with the former portion of the conversation (Finlayson, 2014; Tobias, 1995; Wood, 1988). This belief that teachers feelings toward math can change is important, because with it comes the understanding that educators can address math anxiety and in turn address poor mathematical achievement.

2.1.3 Implications of math anxious teachers for learning

As mentioned, teachers can experience anxiety in performing mathematical problems. The implications of this are great; teachers who experience emotional distress when faced with math, or prefer to avoid it all together, will consequent lack the confidence to teach mathematical concepts to their students (Ashcraft, 2002). Just as confidence is essential to learning mathematics, it is essential in teaching it. The existing body of literature seems to be in consensus; teachers who lack confidence in their own math abilities pass this trait onto their
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students (Ashcraft & Moore, 2009; Finlayson, 2014; Scarpello, 2007; Wood, 1988). It is problematic then that Ashcraft & Krause found that individuals studying to become elementary teachers exhibited high levels of math anxiety (2007). Many individuals with math anxiety exhibit a tendency to avoid math all together (Ashcraft, 2002), however elementary teachers are not afforded this ability and must teach mathematics whether or not they are comfortable with or understand the material.

Elementary teachers have an important task in creating an environment that is conducive with effective math learning, as the early years are critical in forming student attitudes towards mathematical education (Arnold et al., 2002; Geist, 2010). Teachers who are anxious though, tend to adopt a teaching style that focuses on skill development, which the research agrees contributes to the formation of math anxiety in students (Finlayson, 2014; Geist, 2010; Stuart, 2000). Finlayson suggests that teachers adopt this traditional model because it relies heavily on resources that provide correct answers and single strategies, making mathematics less complex to teachers (2014).

In using this traditional style, teachers make use of timed activities, like tests, and memorization strategies (Finlayson, 2014). Ashcraft & Moore (2009) highlight this as problematic because it creates a cyclical pattern—timed activities put pressure on the student to perform and recall memorized facts and ideas. But math anxiety hinders a child’s ability to access their working memory, so they are unable to recall the necessary information, thus worsening math anxiety. In order to end this pattern of worsening math anxiety in students, the literature proposes anxiety in teachers must also be addressed (Brady & Bowd, 2005; Geist, 2010).
2.1.4 Implications of math anxious students for learning

Students who experience math anxiety do so in a way similar to teachers with math anxiety. Like teachers, students with math anxiety present with a “pronounced fear in the presence of arithmetic and mathematics (Aiken & Dreger, 1961, p. 19). The presentations of math anxiety are similar, despite the root cause for the math anxiety (Stuart, 2000), meaning teachers do not necessarily need to understand where the math anxiety stems from in order to recognize and remedy it. It is vital that teachers recognize math anxiety in students at an early stage, for the longer the exposure to math anxiety, the harder it is to address. Dion (2014), like Ashcraft & Krause (2007) recognizes that students who experience math anxiety tend to shy away from mathematical situations, and when individuals avoid STEM careers in a society that is increasingly dependent on technology, it becomes globally problematic (Ashcraft & Moore, 2009; Dion, 2014).

The research is in agreement that math anxiety is not related to intelligence (Dreger & Aiken, 1957; Finlayson, 2014; Scarpello, 2007), however math anxiety does effect achievement (Brady & Bowd, 2005). In understanding this, one must realize then assessments of students with math anxiety, are not reflective of their true intelligence or capability, but instead a reflection of their anxiety (Geist, 2010).

2.1.5 Addressing math anxiety

In understanding that the poor achievement of students with math anxiety is not a reflection of an innate intellectual ability, it is reasonable to conclude that if math anxiety is addressed and lessened, then achievement can be improved (Arnold et al., 2002). In fact, if certain teaching styles, such as a traditional approach explained by Finlayson (2014) as teacher-directed, textbook focused and individualistic, can create or worsen anxiety, it stands to reason
that other teaching styles or “effective instructional practices” could lessen math anxiety, or prevent it all together (Scarpello, 2007, p. 35).

To address math anxiety, the research suggests that teachers must look to the learning environment from which the anxiety stems (Tobias, 1995). Modifying the environment to one that is focused on the development of process rather than product is cited as a way to overcome math anxiety in students. Much of the research is in agreement; process focused, student centred approaches are relevant to lessening math anxiety (Arnold et al., 2002; Ashcraft 2002; Ashcraft & Moore, 2009; Finlayson, 2014), however the literature provides little insight into what this student centered approach would look like. There is not enough known about how teachers can address math anxiety in students when they themselves may be anxious towards mathematics. “Teachers must be knowledgeable and enthusiastic about the subject they are teaching”, but this is not always the case (Wood, 1988, p. 12). As such, both Geist (2010) and Ashcraft & Krause (2007) hint at a need for more understanding into the process of teacher education in effective math instruction, as the environment created by teachers is a substantial source of math anxiety. In doing so, much needed insight will be gained in addressing math anxiety, and consequently improving mathematics achievement (Ashcraft & Moore, 2009).

As mentioned above the learning environment places a role in addressing math anxiety. Taylor & Fraser (2013) explain that creating a positive learning environment is critical to the improvement of math education, noting that learning environments in math classrooms should have the same importance that they have in the classrooms of other disciplines. Altering the learning environment to be more collaborative, with a focus on conceptual understanding and problem solving can reduce the appearance of math anxiety (Finlayson, 2014). But while some research claims that these types of alterations can result in improved attitudes towards math
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(Summerlee & Murray, 2010; Taylor & Fraser, 2013; Townsend & Wilton, 2003) other research suggests that negative attitudes to math are resistant to change (Tobias, 1995). Despite this disagreement, research suggests that if addressed in the early years, negative attitudes towards math can be easier to remedy and change (Cohrssen et al., 2013).

The research also suggests that engaging students is central to addressing aversion to math and ultimately increasing academic scores (Beasley, Gist & Imbeau, 2014). They maintain that engagement is essential to effective teaching, and call for teacher education to include a more in-depth exploration into the benefits of student engagement. Throughout the literature on academic success, particularly in math, student engagement is called upon as a valuable factor, (Cohrssen, Church & Tayler, 2014; Cohrssen, et al., 2013; Summerlee & Murray, 2010), but the research fails to explore, in depth, how to bolster engagement. Beasley et al. (2013) do note that having an understanding of student interests and their learning profiles effect how engaged students can be, but do not explore how to use this information to engage students.

2.2 Play-based learning

In this section, I explore the definition of play-based learning, as explained in the research. I follow with a discussion on the benefits displayed when using a play-based learning model. This section also explores what a traditional model of teaching looks like, and how it differs from play-based learning approaches. Finally, I conclude this section with a review of the literature on how play-based learning approaches are being used in practice in the field of education.

2.2.1 What is play-based learning?

Over the last decade or so, the Ontario education system has been incorporating the idea of play more and more into teaching and learning, especially at the level of early childhood
education (Jachyra & Fusco, 2014). A great deal of research has been dedicated to defining exactly what play means, and more importantly what play is in the context of education (Honeyford & Boyd, 2015; Ministry of Education, 2010) Depending on the players involved, play can have a broad range of definitions. To a child, play can incorporate almost anything, anyone and does not need to fill any specific purpose (Glenn, Knight, Holt, & Spence, 2013; Lester & Russell, 2008). In other words, play is where the means is more important than the end. This differs from the theoretical definition of play, where play is an important learning tool for children, and must include some productive value (Glenn et al., 2013; Honeyford & Boyd, 2015; Stegelin, 2005). Most understandings of play in the educational context tend to lean towards a theoretical understanding, where play is a tool. In fact, in the written curriculum for the kindergarten program in Ontario, the Ministry of Education explains play as an opportunity to “capitalize on a child’s natural curiosity and exuberance” to learn about the world around them (2010, pg. 13).

The understanding that play is a tool that can expand and intensify a child’s learning is one that is essential to realizing the significance of play-based learning approaches, but it is important to also incorporate a child’s perspective of play, something which the current research fails to do. To a child, play is not about learning something, or meeting a goal. Play is about engagement, excitement, and most importantly, fun (Glenn et al., 2013; Lester & Russell, 2008). Children invest a great deal of their time and energy in their play (Shores & Shannon, 2007), so if the understanding of play-based learning fails to incorporate a layer of fun or enjoyment, from the perspective of a child, it will fail to be a useful tool.

Following that, play-based learning, when used effectively, is a tool that incorporates the interests and imagination of students to motivate them to authentically engage with new
learnings and ideas (Honeyford & Boyd, 2015). In order for play-based learning to be successful, it must include the interests of students (Pivec, 2007) and encourage them to think creatively and critically (Council of Ministers of Education, 2012), while providing them ample opportunity to succeed (Summerlee & Murray, 2010).

2.2.2 Benefits of play-based learning

Ontario public elementary schools, as they are known today, segregate learning according to subject area, and teach in a linear fashion, from one subject area to the next. This is noted in the Ontario written elementary curriculum in the way it is structured. While this approach is not without merit, as it is difficult to report on student learning in standardized tests and year-end reports if learning is not conducted in a typical and easy to interpret way (Jachyra & Fusco, 2014), it is not without faults. “Children’s understanding of mathematical ideas do not emerge in a linear fashion”, and rarely does any construct or idea exist without the context of the real world (Cohrssen et al., 2013, pg. 97). To teach any subject, mathematics in particular, devoid of real world context or connection, assumes knowledge is inert and must be broken into abstract parts in order to be understood (Finlayson, 2014; Tobias, 1995).

Play-based learning models approach learning as a holistic task, where lived experiences of students shape and guide learning, and a whole idea is expanded into different, but interconnected parts (Cohrssen et al., 2013; Finlayson, 2014). Studies have shown that approaching learning in this way is beneficial to learners as they can effectively place themselves within the setting of their own learning (Honeyford & Boyd, 2015).

In the realm of early childhood education, where play-based learning is most widely used, play is cited as being fundamental to learning (Council of Ministers of Education, 2012). While play may not be as fundamental at the junior level (Pivec, 2007), play-based learning
experiences at the kindergarten level has been cited as providing children with a way to experiment and manipulate, (Council of Ministers of Education, 2012), to collaborate meaningfully with peers (Honeyford & Boyd, 2015) and to think creatively and critically (Bell, Limberg, Jacobson & Super, 2014; Honeyford & Boyd, 2015; Jachyra & Fusco, 2014). These attributes are all referred to consistently throughout the literature as aspects of effective instruction (Cohrssen et al., 2014; Finlayson, 2014; Stuart, 2000; Tobias, 1995). If play-based learning can indeed offer a way to encourage these attributes, then it stands to reason that it is an effective model to be used outside the realm of early childhood education.

2.2.3 Play-based learning and traditional teaching models

The current literature on play-based learning as a teaching model seem to be consistent in defining play-based learning as an approach that is different from other teaching models. More specifically, play-based approaches are different than traditional teaching models (Finlayson, 2014). Traditional teaching is a term that Finlayson (2014) uses to define an approach to teaching that tends to be teacher centred, with a focus on outcomes and rote memorization. While this traditional approach may look different from learning environment to learning environment, its tendency to rely on independent work, testing and teacher instruction remains constant (Pivec, 2007; Stuart, 2000).

Play-based learning approaches, on the other hand, tend to create student centred learning environments, where assessments value process as much as product, and collaboration between students is vital (Finlayson, 2014; Honeyford & Boyd, 2015). Play-based approaches do not completely shun traditional approaches, as they tend to have a set of expectations for students to meet and there is still a curriculum to adhere to, especially when used in grades beyond kindergarten (Bell et al., 2014; Jachyra & Fusco, 2014).
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Play-based approaches to teaching are often heralded for its ability to foster social development, self-regulation, motivation and engagement, deep critical and creative thinking and cognitive processing (Bell et al., 2014; Pivec, 2007; Shores & Shannon, 2007; Thomas et al., 2011). While some traditional approaches may offer some of these benefits, play-based approaches, when enacted effectively, tend to offer and encourage the development of these attributes simultaneously.

2.2.4 Play-based learning in practice

As mentioned, play-based learning approaches are used almost exclusively in early childhood education, as play is seen as a fundamental part of a child’s communication (Council of Ministers of Education, 2012). At this stage, a child’s play leads the direction of learning (Ministry of Education, 2010); the role of the educator is to pull big ideas from the play and create opportunities for learning. Educators must find a purpose within play, because “play-based learning without learning is just play” (Cohrssen et al., 2013, pg. 97).

Beyond kindergarten though, allowing a child’s play to guide the direction of learning is not always possible. Jachyra & Fusco (2014) note that because of increasing standardized testing in upper elementary schooling, educators tend to shift approaches to focus on teaching academic skills needed to succeed on these tests. They note that while traditional models often do not meet the needs of diverse learners, teachers feel pressured into using these models to ensure students have all the necessary learnings to succeed on standardized tests (Jachyra & Fusco, 2014). When play-based approaches are used with older learners, teachers must see themselves as operating within the discourse of play and intentional teaching (Thomas et al., 2011). That is to say that play-based learning in early childhood settings will necessarily look different because the curriculum expectations are different.
When play-based approaches are used in education outside of the early years, the research has noted that not only are students more engaged and motivated to actively participate in learning, they experience more academic success (Bell et al., 2014; Honeyford & Boyd, 2015; Thomas et al., 2011; Townsend & Wilton, 2003). The confidence that grows when students can see themselves as successful academics cultivates a strong sense of agency (Honeyford & Boyd, 2015) and invites students to push their own learnings and understandings. There is a new trend emerging in the research on play-based learning in education, and that is the use of technology (Pivec, 2007). The current generation of students learn differently than the past generation of learners, primarily because of the introduction of the Internet (Summerlee & Murray, 2010). Due to this, the emergence of technology-based games has made play-based learning more accessible to junior grades. Pivec (2007) notes though, that this emergence is not without flaws, as educators now must find ways to incorporate learning into games that may not have been designed to be used in this way.

2.3 Conclusion

The landscape created by the current research has shown that there is much to gain with the use of play-based approaches, in ways of academic success and social and cognitive development. Despite this, there is very little in the research about how play-based approaches can be used to increase mathematics achievement. This study aims to fill this gap by exploring how play-based approaches can be implemented in mathematics classrooms beyond early childhood, and what effects it has on student math achievement. The literature illustrates a link between the presence math anxiety and poor academic success, and while there is some insight into strategies that can work to reduce math anxiety such as modifying the learning environment and creating student centred learning opportunities, and raise mathematics achievement, there is
very little on how to implement or incorporate these strategies in the classroom. This is problematic because though this research exists, Canadian math scores are not rising, reasoning that these strategies are not being implemented successfully. This research hopes to provide insight into how teachers, especially beginning teachers can implement these strategies with play-based learning and how this teaching approach can affect the presence of math anxiety and increase academic success.
Chapter 3: Research Methodology

3.0 Introduction

In this chapter I review the research methodology used throughout this study. I begin with the research approach and the procedures of this approach. I then discuss the instruments of data collection used, before moving onto a discussion of the participants of the study. More specifically, I review the sampling criteria used to select participants, the recruitment of said participants, in addition to a short introduction on each participant. Next I explore the process of data collection, including, but not limited to the process I used to transcribe and code the collected data. Following this, I discuss the ethical review procedures used in this study and the significance of these procedures. This chapter also reviews the limitations of the methodology utilized, in addition to its strengths. Finally, I conclude this chapter with a summary of methodological decisions central to the success of this study, the rationale for these decisions, and their relevance to the study’s research questions and purpose.

3.1 Research approach & procedures

The experience of teaching is different for every teacher, just as each student is unique in the way they form meaning and understanding (Ellis & Orchard, 2014). As a teacher candidate myself, I have seen that the experiences that have shaped my teaching style, is vastly different from my peers. In entering this research study, I realized that it was not feasible to assume that quantitative research could effectively grasp the complexities and variations of the teaching experience. In order to gain the perspective of the insider, the logical methodological option was qualitative research (Bouma, Ling & Wilkinson, 2009). This study was principally interested in learning how teachers are incorporating play-based learning into the mathematics classroom, and what outcomes they observe in relation to students’ experience of math anxiety. Because I
sought to uncover what is occurring, and the experiences within the classroom, “an inquiry process of understanding” (Creswell, 1998, p.15) was necessary. This qualitative methodology is better suited for this type of exploration.

Bouma et al. (2009) agree with Creswell (1998), as they state that the voice of an individual experience is central to understanding the issue or topic at hand. In order to take full advantage of these voices, semi-structured interviews were conducted with each of the study’s participants. Section 3.2, Instruments of Data Collection, will explore the use of semi-structured interviews in more depth. Prior to the utilization of interviews though, an extensive review of the literature was conducted, allowing this research to be placed in the larger discussion on the topic of education (Bouma et al., 2009).

Data in this study was grouped into overarching themes before being explored in more depth (Creswell, 1998). As this study called for an in depth exploration of the multi-faceted practice of play-based math instruction, it was necessary that the taken approach be detail oriented and focused on the lived experience of each participant (Denzin, 2009). The qualitative approach used throughout the study ensured that the data collected would reflect how teachers are actually experiencing the classroom, which may or may not match with what is stated in theory. Teaching is an individual experience, and this study allowed that individual experience to be highlighted and valued.

This approach allowed for two specific educators to be studied in detail and for their shared experiences and behaviours to be analyzed and interpreted (Creswell, 1998).

3.2 Instruments of data collection

As mentioned in section 3.1, this research study utilizes semi-structured interviews as the sole method of data collection. This form of data collection is widely used in qualitative
research, as it provides the in-depth exploration that qualitative studies call for (Bouma et al., 2009). Semi-structured interviews allow the participants to focus on what they feel most passionate about, or experiences that they believe are most relevant. This is something that can also occur with unstructured interviews (Strand & Weiss, 2005), but unlike semi-structured interviews, unstructured interviews are not directed. The use of semi-structured interviews allowed me, as the researcher, to guide the conversation in a particular direction, without leading the participant to answer in any particular way (Strand & Weiss, 2005). This is essential to gathering data that is relevant to the research questions posed.

Galletta (2013) also attests to this, in stating that semi-structured interviews allow participants to bring new meanings, which may have otherwise been overlooked, to the topics of the research problem. I designed a semi-structured interview protocol that consists of five main categories of questions in order to collect data relevant to the question of how teachers are incorporating play-based learning into mathematics (see Appendix B). Section one relates to the gathering of background information. This helped to create a more holistic picture of the participant and provide some context for their experiences or understandings (Galletta, 2009). Section two of the interview protocol addressed teacher beliefs about play-based learning in mathematics education. Next, I inquired into teacher practices, resources that support them, the challenges they encounter, and their advice for beginning teachers. Keeping with the nature of semi-structured interviews, this protocol was not rigid in design, and therefore, the execution of the sections may not be sequential (Kosnik, 2015).

3.3 Participants

In the following section I discuss the participants. More specifically, I explain the criteria used to select participants, followed by how I recruited the sample of participants. This section
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will conclude with a short biography on each participant with information gathered in the interview process.

3.3.1 Sampling criteria

Due to the scope of this research study, participants selected needed to meet certain criteria in order to gather relevant data. These criteria included:

1. *Elementary educators who are not teaching at the kindergarten level*

   This criterion was essential to this study because research has illustrated that play-based learning is a substantial part of the full-day kindergarten program (Ministry of Education, 2010). This model is used extensively at this grade level, and its success has been researched extensively (Thomas et al., 2011). Despite its success at this grade level though, use of the play-based model tends to taper off as students get older. For this reason, this research looked at those educators who are utilizing this model beyond kindergarten, into the junior level. This criterion worked to fill the gap in the present research on play-based learning.

2. *Educators who have at least five years teaching mathematics not at the kindergarten level*

   This criterion was established to ensure that teacher participants have experience teaching mathematics. A substantial part of this research requires that the participants reflect on the effects of play-based learning in mathematics on student success. This would be difficult for a new teacher to do, as they would not possess a large enough frame of reference to determine student success.

3. *Educators selected must be currently utilizing, or at one point used a play-based learning model to teach mathematics at the junior level*
This criterion was developed in order to ensure that beyond years of experience, participants had experience teaching mathematics using a play-based learning model, in addition to at least one other teaching method (a traditional method, for example). Similar to why the above criterion was set, criterion three was set to ensure participants would have a frame of reference, in terms of teaching model effectiveness. By requiring all participants to have taught math in multiple ways, I attempted to ensure that this research would have a comparative aspect to it. Participants were able to use their experience to draw upon similarities and differences of teaching methods.

4. **Educators who have demonstrated leadership, commitment and/or expertise in the area of play-based math instruction.**

This final criterion was designed to restrict applicable participants to those who have demonstrated expertise in the use of play-based learning in math. While there may be teachers who are using play-based learning techniques, I wanted to include only teachers with a drive to share their understanding and knowledge of play-based learning in math.

**3.3.2 Sampling procedures/recruitment**

Due to the developed criteria listed above, the sampling for this study was non-random (purposeful), meaning that the selected participants were chosen because they met certain guidelines that I laid out (Bouma et al., 2009). Of the non-random sampling procedures, many fit into the realm of possible sampling techniques for this study. Snowball sampling, the process by which current participants recommend or nominate future participants (Bouma et al., 2009; Creswell, 1998) appeared to be a probable option for participant recruitment. Both participants recommended future participants, but due to the time constraints of this study, interviews were only conducted with the original two participants. The recruitment of these participants was criterion sampling, as they needed to meet the criteria listed in section 3.3.1.
Participant recruitment also relied on convenience sampling. Due to the time constraints of this research, convenience sampling allowed me, as the researcher, to have ample time to analyze the data collected. Though convenience sampling is a viable candidate for participant recruitment, it can harm the credibility of the study (Creswell, 1998). The inclusion of sampling criteria helped to minimize this some.

In order to recruit these participants, I contacted curriculum instructional leaders in math from the greater Toronto area, and provided them with the criteria created to select a participant sample, in addition to background information on this research and myself as the researcher. I asked these individuals to extend the offer to participate in the study to teachers and educators who they felt would meet the requirements I had set. Once these professionals were made aware of the study, and passed on the information to other professionals, I was able to select participants who were most suitable.

Though the goal was for these professionals to spread the criteria to teachers who were currently practicing, both of this study’s participants were educators who are not currently practicing teachers, and were individuals who were given the criteria to distribute. While I considered that this might cause limitations as they were not currently teaching elementary school, I ultimately decided that because they had taught with a play-based model in mathematics, they would be able to provide great insight into the questions posed in this research.

This recruitment process did have limitations that could potentially harm the quality of my research, such as lack of willing participants, or participants who do not meet all the criteria set out (Bouma, 2009). Despite this, this process seemed to be the most promising, given the time constraints.
3.3.3 Participant biographies

For this study, I interviewed two educators who have extensive experience using play-based learning experiences in math instruction. While neither educator was teaching in elementary school at the time of the interviews, both were academics and had demonstrated a great deal of experience with effective math instruction. Both participants were recruited through the method explained above.

Meredith, my first participant, taught at the elementary level for more than ten years. She taught English Language Learners, and later became a principal. At the time of the research she was working on obtaining her PhD. Though she never taught math in the public school system, she had extensive experience teaching math using play-based learning to her four children, and supervised play-based approaches to math as a principal.

Liv, my second participant, was working in teacher education at the time of the interview, but had taught at the primary and junior level in private schools for 15 years. She had taught math almost exclusively using a play-based approach, and therefore was well qualified to participate in this study.

3.4 Data analysis

Keeping in sync with the use of a qualitative approach, all data collected from the participant interviews was individually transcribed, and then meticulously coded. The coding process was twofold: firstly, the data from each interview was organized into several categories. Once the data had been organized into categories, I identified themes within them. The initial themes were synthesized and streamlined. In addition to analyzing what was said, I also analyzed the information that was not spoken about or addressed in the interview process. This data, or “null data” was explored and analyzed to determine its importance to the larger
conversation highlighted in the literature review in chapter 2. Null data will also be helpful with future research on this topic (Babbie, 2015).

As with any research, the goal of this study was to answer a question or expand our understanding of something unknown or known little about (Bouma et al., 2009). In order to do this, the analysis of any and all data collected is of high importance. Any meaning created is sourced from the interpretation of the data (Bouma et al., 2009). This stage required a great deal of thought and commitment, as in order produce meaningful findings, I, as the researcher, needed to demonstrate “the willingness to search for, and the ability to recognize meaningful patterns among variables” (Babbie, 2015, pg. 379). Doing this ensured that the data was being used fully and thoroughly, which thus extends to quality research findings. The existing literature was also used to provide context for the interpretation of the findings.

3.5 Ethical review procedures

This research study followed the ethical guidelines set out by the Ontario Institute for Education (OISE) Masters of Teaching program at the University of Toronto. Each participant was contacted prior to their interview and provided with a letter of consent (see Appendix A), acknowledging their participation. This letter detailed the purpose of the study and informs the participant on their rights as a voluntary participant. A signed copy of this letter will be kept for record retention purposes, and will be destroyed with any other data collected after a five year period.

Confidentiality is of utmost importance to the success of this study. Ensuring that identities would remain anonymous through the use of pseudonyms and limiting the number of individuals with access to raw data provides participants with peace of mind and security that they will not be held accountable for what they do or do not say (Galletta, 2013). In addition to
the use of pseudonyms, any identifying markers, such as the name of schools, or location was removed.

This study presented no risks to the participants, but to ensure that they were comfortable with the study, each participant was also given the right to withdraw at any time, even after the completion of the interview. Interviews were recorded using Windows Voice Recorder to ensure accuracy of the data collected. After the transcription of the data, participants were provided with a copy to check for accuracy and validity. All data will be stored for approximately five years on a password-protected computer, accessible only by me, the researcher. At the completion of the research, all participants were provided access to the research paper.

3.6 Methodological limitations and strengths

This section outlines both the limits and strengths of conducting this research. I speak specifically to the strengths and limitations presented through the use of the qualitative research method, the use of a qualitative approach and the use of interviews as the sole method of data collection.

3.6.1 Limitations

Given the scope of the research, the use of the qualitative methodology was limited to interviews conducted with teachers. I was not able to conduct any field observation or speak with any students directly, which given the topic at hand, may have proved to be beneficial. Field observation would have proved another layer or depth to the research findings, as it would have allowed the research to include what play-based math instruction looked like in the classroom, in addition to the teacher’s experience of it. Informal interviews or focus groups conducted with students would have allowed the study to also include the student experience.
Time constraints of this study also limited the amount of teachers that could be interviewed, thus ensuring that any findings would not be able to be generalized to a larger population. Relying solely on interviews as the method of data collection may possibly skew findings, as the participants are able to present their experience as they see fit, which may include a bias (Denzin, 2009).

Due to limitations in the recruitment process and timing, one of the original criteria was removed from this study. Originally, I had included a criteria requesting teachers who had experienced anxiety towards math, either in learning it, or teaching it. Many teachers admit to experiencing math anxiety themselves when teaching mathematics (Finlayson, 2014; Stuart, 2000), and in my own experience as a teacher candidate, I have found that play-based learning has eased many of the anxieties I experience when teaching math. Many teachers may share my experience, so I originally was interested in exploring how that factor fit into the research. But because of the limitations mentioned above, I chose to remove that criterion in order to increase the number of eligible participants. While removing this criterion did limit this study’s ability to explore this facet, it was necessary in order to fit the time constraints of the study.

3.6.2 Strengths

Due to the nature of qualitative research, this study was able to provide an in-depth look at the lived experience of teachers. As mentioned above, in Limitations of the study (3.6.1), this study is not generalizable to a larger population. What it is able to do though, is inform on the lived experience of teachers conducting play-based math instruction.

With the singular dependence on interviews for data collection, I was able to validate the teacher voice by allowing them to create meaning in their own experience. The use of semi-
structured interviews allowed participants to lead the conversation and focus on areas where they identified with the most and elaborate when they felt it was needed (Galletta, 2009).

3.7 Conclusion & preview of what is next

This chapter delved into the methodology used in this study. The use of a qualitative research method allowed the central focus of the findings to be the unique lived experiences of a select few teachers in the Toronto, Canada area. This study adds to the conversation by informing on the practices of actual teachers, working with play-based math instruction. The use of semi-structured interviews allowed participants to highlight areas which they felt most valuable, but was limiting, as it was the sole method of data collection.

All participants of this study met a criteria, outlined in section 3.3.2, and were gathered through convenience sampling. This recruitment procedure was selected due to research time constraints, but I, as the researcher feel that it worked well to gain access to a specific community of teachers.

Confidentiality was treated with extreme importance, as well as transparency of all my research practices. All participants were involved throughout the production of this research study, and were referred to determine validity and accuracy of data. They were also provided with the right to withdraw from the study at any point.

The following chapter, chapter 4, will detail the research findings. It is in this chapter that I will expand on the categories and themes introduced in section 3.4. I will also explore in greater depth the experiences of each participant, and any meaning that I have created from their experience.
Chapter 4: Research Findings and Discussion

4.0 Introduction

This chapter will discuss the findings from the interviews conducted with two Ontario educators. Both educators have significant experience teaching and observing play-based approaches in the elementary mathematics classroom. Through these interviews, several themes emerged, of which I will be exploring in the duration of this chapter. As expected, both participants, Meredith and Liv, spoke at great length about the benefits of play-based learning in math education.

I have organized my findings into themes in relation to the research question posed in this paper, which is: how is a sample of elementary teachers using play-based learning approaches in math instruction, and what outcomes do they observe for reducing and/or preventing math anxiety? The interviews also provided insight into the sub questions posed in this paper, which are: (1) what perceived effects does using play-based learning approaches in mathematical instruction have on student achievement? (2), what are these teachers’ beliefs about the relationship between math anxiety and academic performance? And (3) what range of factors and resources support and challenge these teachers in enacting play-based approaches to teaching math? This chapter will centre on a discussion of five themes and several subthemes that emerged in my interviews. The themes that will guide this discussion are as follows:

(1) Teachers discuss the benefits of play-based learning approaches through the shortcomings of more conventional methods.

(2) These teachers utilized play-based approaches in mathematics foremost to foster student engagement; academic achievement was positioned as a by-product of student engagement.
a. These teachers highlighted the importance of student choice in creating engagement.

b. Teachers highlight a focus on social development as a leading factor of academic achievement in math.

c. Teachers found that students with math anxiety were disengaged with mathematics

(3) Teachers believe that math anxiety stems from more conventional approaches to math that are teacher centred, individualistic, and focus on outcomes.

(4) Teachers remedy/ prevent math anxiety through the use of play-based learning approaches in math instruction

   a. Careful planning and teacher collaboration are needed in designing lessons that do not cause anxiety.

   b. Teachers believe that curriculum expectations should not hinder ability to use PBL approaches.

   c. Teacher assessment practices focus on process over outcomes/ products.

(5) Teachers recognize that PBL models are often approached with hesitation from parents.

   a. Language of “Play” is not associated with sophisticated learning.

   b. Teachers addressed challenges from parents with transparency of play-based learning practices.

Both participants spoke to each theme, but with varying degrees of importance. In each section, I report on what was found through the collection of data, and then move on to reporting on the significance the finding has in the larger discussion of the literature. I look to how my
findings both relate to and differ from what is currently voiced in the current research on play-based learning and math anxiety.

4.1 Teachers discuss the benefits of play-based learning approaches through the shortcomings of more conventional methods

As both participants were speaking to how and why they utilized play-based approaches in their own practice, as expected, both Meredith and Liv spoke at great length to the benefits of play-based learning approaches. It was not expected however, that these educators tended to discuss the benefits of play-based learning approaches in terms of what they could offer over more conventional teaching models. Meredith defined the benefits of play-based learning in terms of a contrast between the two approaches to math education, by explaining that the “traditional one is all about the teacher giving information, but play-based learning lets the student be the key player in learning”. Play-based learning models do in fact place children in the centre of their learning, as is noted throughout the kindergarten curriculum (Ministry of Education, 2010). Through play, children are able to inquire about the world around them; it is the role of the educator to follow their inquiries and find big ideas within them (Cohrssen et al., 2013). Liv, like Meredith, heralded the idea of student centred learning, as it ensured that students held some interest in what they were learning.

Though neither participant was exposed to play-based approaches to learning in a classroom setting as children, they spoke fondly of play-based math experiences at home. While play did not have a place within the walls of school, it was visible and consistently used with family members as a way to engage with mathematical thinking. Both Liv and Meredith explained that their love for mathematics stemmed from these informal experiences with math at
home, and was what guided their own use of play-based learning in their own teaching. Liv in particular spoke to the benefits play-based learning offered to her own learning:

I was always very interested in math puzzles and shared that interest with my dad who provided us with lots of challenges as we were growing up. So I think that was sort of the natural direction for me in terms of understanding what math was… But no, I was in, you know, very standard school system as a kid. (Liv)

Liv’s father was able to encourage her participation with math by including her interest with puzzles. As she was interested in puzzles, she was intrinsically motivated to continue playing and learning. This is in line with benefits of play-based learning stated in the current literature; Pivec (2007) notes that effective play-based learning motivates children because it encompasses a task they have already demonstrated an interest in. Educators who experienced both conventional and play-based learning models seek to use the model that provided them with the richest and most memorable learning experience in their own practice, while other teachers, with negative past experiences with conventional teaching models may be pushed to seek out a method different from what they were taught with (Finlayson, 2014). Liv’s use of play-based learning was shaped both by the motivation to learn play-based math experiences gave her, and lack of positive experiences with a “very standard school system.”

4.2 Play-based learning engages students, and then leads to achievement

In its truest meaning, “play expands intelligence, stimulates the imagination, encourages creative problem solving, and helps develop confidence, self-esteem and a positive attitude towards learning” (Dr. Fraser Mustard, as cited by Council of Ministers of Education, 2012, pg. 1). It is because play is engaging that it is able to do succeed in promoting these attributes. Much of the literature on play-based learning highlights its ability to engage students in learning, as it
takes into account the interests of the students, and is enjoyable (Honeyford & Boyd, 2015; Pivec, 2007). In line with this research, these teachers felt that play-based methods of teaching worked effectively to engage students in learning. It was for this reason that these teachers chose to implement play-based learning approaches. These teachers also perceived that academic achievement in mathematics improved after the implementation of play-based approaches—though this improvement was not their goal, they viewed it as a by-product of engagement.

As such, these teachers tended to focus more on student engagement throughout their interviews. They three themes were highlighted within student engagement, where play-based learning approaches make mathematic achievement possible, all of which will be discussed in this section. First, these teachers emphasised the importance of student choice in creating engagement, second, these teachers found that developing social well-being leads to academic success and last, these teachers found that students with math anxiety were disengaged with mathematics.

4.2.1 Student choice is important to building engagement

While the current literature does not directly focus on the caveat of choice in building engagement in mathematics, it does speak to the inclusion of student interests in creating effective, engaging instruction (Beasley et al., 2014). The level of importance that was placed on student choice was surprising to me as the researcher, as I, nor did the research glean, that engagement was heavily influenced by the presence of student choice. As Liv explained in speaking about a project she assigned in math, specifically geometry,

One very lengthy project that I did with the kids was essentially I had them design a personal space. So I had them – they thought of something that they were really interested in doing, you know, a hobby or, you know, just whatever. It could be
reading. It could be stamp collecting. It could be — oh, you know, there were a whole variety of things they were interested in… So the idea of designing a space for me that shows everybody who I am and what I’m interested in, it was a kind of appealing. (Liv)

The opportunity to demonstrate their own interests in a project, with few boundaries appealed to the students and helped keep them engaged throughout the process. Liv explained that this engaged students as they were able to relate mathematical concepts to their own personal interests. Liv went on to explain that though there were some challenges in completing this project, engagement was not an area of concern, as “there were no issues around kids bringing stuff to school on the right day. There were no issues with kids doing their drawings” (Liv). This lack of ‘issues’ speaks to a presence of high engagement, as students who are engaged tend to participate willingly and without prompting (Honeyford & Boyd, 2015).

In the Ministry of Education’s (2010) explanation of play-based learning, student choice and interests guide the direction of learning; it is the role of the educator to locate learning within the boundaries of student interests. In upper elementary grades, though this type of model of student choice is almost impossible to incorporate, and is noted by the miniscule presence of play-based approaches in junior grades (Jachrya & Fusco, 2014). While Liv did not let student interests create the project or direction of learning, she was able to infuse a high level of student choice by providing freedom in what their projects would look like and what it would incorporate.

While Liv sought out to give her students choice in what they centred their projects on, Meredith found that providing her students with a choice in how they approached problems effective in keeping them engaged. “I teach them many strategies to how to solve problems, and
let them pick which ones work the best” (Meredith). In doing this, Meredith presents her students with the opportunity to explore different paths to solutions. When children are able to participate in exploration of solutions, they are more likely to learn with and from peers and remain engaged in their learning (Honeyford & Boyd, 2015).

**4.2.2 Teachers believed that social and mental well-being developed through play-based learning leads to academic success**

Liv highlighted the idea that when students were consistently engaged in play-based learning models of learning, academic success in math was highly likely. This idea that play-based learning develops social well-being, is not new, as it is an understanding that can be found throughout the literature on play-based learning (Bell, et al., 2014; Pivec, 2007; Stegelin, 2005). What is noteworthy though, is the correlation of social and mental well-being and academic success. Play-based learning approaches are known to nurture and develop cognitive ability, but also social well-being. Liv pointed out that in her experience, when one student who feared they would not do well in math was exposed to play-based approaches, they gained enough confidence to not only defend its use to other teachers, but they also outperformed her own academic expectations. With this particular student, Liv positioned the new found confidence as “absolutely critical to the success she experienced in doing math.” This is important to note, as confident students are less likely to attribute failings and mistakes in academics to their own abilities (Beasley et al., 2014).

Meredith too, found that the social and mental well-being gained through play-based approaches lead to academic success in math. She focused in on play-based learning’s tendency to promote critical problem solving as opposed to the memorization of formulas (Townsend & Wilton, 2003). With this focus, making mistakes in problem solving could become something
more than a source of anxiety, as it usually is in traditional teaching approaches (Finlayson, 2014). Meredith tried to help students learn that “it is not the end of the world if you [make] a mistake.” This educator positioned mistakes as positive and as a source for building resiliency in students. As such, she found that students were more willing to try new techniques and tactics until they experienced success. Play-based approaches require collaborative work, and as such, children are more exposed to learning processes of their peers. This is beneficial to developing a high social and mental well-being, because students are able to see that everyone makes mistakes—collaborative work normalizes errors as a part of learning and discovering (Honeyford & Boyd, 2015).

4.2.3 Math anxious students are disengaged with math

These teachers found that students with math anxiety were disengaged with mathematics. The emergence of this theme was expected, as children often avoid experiences where they have consistently failed in the past (Shores & Shannon, 2007). This avoidance held true for Meredith, as she verbalized an experience of one student who was hesitant in engaging with math, because the “information itself was scary”. She went on to state that in avoiding mathematical situations this student experienced less academic success. This avoidance can become more problematic the longer it continues, as these math anxious students continue to avoid new mathematical learning. Eventually this is reflected in these students’ career choices and avoidance of math related fields (Dion, 2014).

Math anxious students often enter an academic year with an understanding that they are not good at math, nor could they ever be. These teachers pointed out that this thinking actually prevented students from wanting to engage in math activities, even when they were play-based activities. Liv explained that students’ avoidance from participating in play-based learning may
stem from past experiences with traditional approaches to learning math, and consequently do not wish to try a new approach:

She came into my class in the fall in September and she said, ‘I’m going to fail math this year. I’m terrible at math. I’ve never done well at math. My mother can’t do math. I can’t do math. You know, it’s just sort of this genetic thing.’ (Liv)

This sort of thinking is difficult to overcome, Liv explained, because these students have come to believe that mathematical ability or inability is stagnant or unchangeable. Play-based approaches though, can slowly work to remedy this belief held by some students, as play requires them to actively participate in learning experiences. Liv pointed out that the flexibility of play-based approaches allow students who experience anxiety to choose a level of participation that they are comfortable with, and eventually can come to participate and maybe enjoy math more, as was the case with the student in the above example. By the end of the school year, the student was pleasantly surprised with how well she performed academically, and was beginning to enjoy thinking mathematically.

This finding is essential, as it responds to the question: how can play-based approaches effect student academic achievement in math, which was posed in this study. Students with math anxiety can experience less anxiety when dealing with mathematical concepts and thinking, if they are exposed to play-based approaches to learning. This exposure though, needs to be consistent and long term, as visible results, such as improved academic success may not be visible in the short term.

4.3 Math anxiety stems from traditional approaches to teaching

These teachers believed that math anxiety in students tended to stem from more conventional teaching methods in math education. More specifically, students appeared to
express anxiety towards mathematics when they were exposed to traditional assessment methods like individual testing, and when instruction was solely teacher centred and allowed for very little interaction. This finding was consistent with the current literature, as these methods do not accommodate different types of learners, suggest that there is only one correct way to ‘do’ math and penalize exploration, all of which lead to anxiety (Finlayson, 2014; Geist, 2010; Taylor & Fraser, 2013).

Both Liv and Meredith pointed out that math anxiety acted as a barrier between a child and academic success. When anxiety is present, a student has no motivation to engage in mathematics (Scarpello, 2007; Shores & Shannon, 2007). Here, Liv explains:

Anxiety is partly due to a state of powerlessness and frustration [is when] the child still holds all the power, can make decisions to continue to walk away, to, you know, whatever, whatever he or she decides to do. So I think that removing power and authority and respect from a child’s learning environment is awful… (Liv)

Liv’s comment on the powerlessness that math anxious students experience is interesting, as it brings to light the effectiveness of play-based learning models. Traditional models of teaching mathematics do not give students the autonomy to self-regulate, or to decide what they need in order to learn. Liv explained that in order for instruction to be effective, the power to dictate one’s own learning conditions needs to be given to students. Because traditional models assume that educators hold the power and dictate the requirements for all students, they are more likely likelier to produce anxiety in students.

In that same breadth, play-based approaches do not remove all the frustration that comes with learning a new concept, as Liv pointed out. Frustration is necessary, but with frustration, a
child can still chose to walk away, and therefore can demonstrate some power over their own learning.

4.4 Play-based learning models prevent/ remedy math anxiety

While participants believed that traditional models of teaching were found to create math anxiety, these teachers reasoned that play-based models of teaching remedied and prevented math anxiety from forming. The ideas of this theme— that there was a correlation between play-based learning and math anxiety, was not unexpected, as it directly related to one of the questions posed in this research. Both Meredith’s and Liv’s understanding that the appearance of math anxiety was minimized through play is of substantial importance, as it addresses a gap that was found in the literature. To reduce the appearance of math anxiety, Stuart (2000) called for a change in the way math was taught, and this call for change is echoed throughout the literature. While it is understood that effective teaching to the newest generation of learners would need to look different from traditional approaches, the research lacks a consistent picture of how teachers can effectively teach new learners.

To that end, three sub themes emerged in relation to the efficacy of play-based learning models in reducing math anxiety. First, these teachers felt with careful planning and collaboration in creating/ designing lessons, math anxiety could be reduced or even prevented, secondly, these educators highlighted the use of curriculum expectations as guidelines, and not as a hindrance to the use of play-based learning, and lastly, these teachers stressed that process focused (as opposed to outcome based) assessments contributed to the reduction of math anxiety.

4.4.1 Math anxiety can be prevented with careful lesson planning and collaboration

Throughout her interview, Meredith maintained that careful planning and teacher collaboration are needed in designing lessons that do not cause math anxiety. This point is
valuable to the conversation of this study, as it addresses how teachers can prevent math anxiety from forming in their students. The literature too, points to this idea, but lacks the specificity that Meredith maintained. Scarpello (2007) made the recommendation that “effective instructional practices” (pg. 35) are necessary to lessen anxiety, but does not go into detail about what exactly that is. Meredith adds to Scarpello (2007) by suggesting that the potential for math anxiety begins with the instructor, and that instructor has the responsibility to ensure the learning environment prevents anxiety instead of creating it.

We teach, as teachers we are supposed to teach the children how to fish. We’re not supposed to give them the fish, because we are giving them like long life experience… I don’t want to give you the fish. I help you [learn] how to fish by giving the curricula, but it’s up to you to dig deeply and reach research and see how we can transform your classroom (Meredith)

As Meredith explained, educators who use the available resources to plan creatively can “transform” a child’s experience with learning. Using an analogy of fishing, she hinted at the experiential nature of play-based learning, where the child learns through doing, rather than being told what to do. While this is not an easy task, it is necessary to ensure students are not exposed to environments that create math anxiety. Meredith ensured that her classroom environment was effective by displaying a variety of math games for students to access as they needed, and often invited them to explore strategies to problem solving that they knew of, but had not applied, such as using two-sided counters in multiplication.

Meredith expanded on the need for careful planning through her own use of colleagues in planning play-based activities and lessons. She stated that it was beneficial to seek out other teachers with similar ideals and collaborate in lesson design. In doing so, she brought to light a
pattern that was surprising. Play-based learning approaches provide ample opportunity for student collaboration, and group work. Much of play-based approaches to learning depend heavily on peer to peer relationships and cooperation (Bell et al., 2014). With her call for collaboration in planning, Meredith pointed out that characteristics of play-based learning can actually assist educators in creating effective instruction, and thusly speaks to the effectiveness of play-based learning.

Through collaborative planning, Meredith was able to teach a lesson with her fellow teachers, about multiple problem solving strategies. Each teacher focused on a different strategy and taught it to a small group of students, before that group of students moved on to learn about another strategy, with another teacher. This co-taught lesson allowed each educator to focus on one strategy, instead of several, ensuring that they could explore it with greater depth with students. Meredith found that students were equipped with a better understanding of each strategy, than if she had taught it herself, but also “all [the teachers] learned from each other about another way to teach” (Meredith).

4.4.2 Curriculum expectations should not hinder the use of play-based approaches

These teachers believed that curriculum expectations should not hinder an instructor’s ability to use play-based learning approaches. Meredith, in her role as a principal, often found that educators claimed that the Ontario elementary curriculum was not conducive with the implementation of play-based learning approaches. With the presence of standardized testing in upper elementary grades, teachers may feel that play-based approaches might not teach academic skills needed to succeed in these tests (Jachyra & Fusco, 2014). Despite this, Meredith explained that play-based learning approaches to teaching are a “vehicle to deliver the curriculum, [and] not the curriculum itself.”
This is an important distinction to make, as the Ontario curriculum provides the requirements for learning in a given academic year, but do not provide instruction on how to deliver those requirements. Meredith supposes that the delivery of the curriculum is the choice of the educator, therefore the educator can choose to design lesson deliveries in a way to create math anxiety or to lessen it. This finding was eye opening, as it brings into question why play-based models are not being used beyond kindergarten, especially since play-based models can alleviate anxieties that are caused by traditional approaches.

4.4.3 Assessment practices focus on process instead of outcomes

These educators’ assessment practices tend to focus on process over outcomes/products. This finding was surprising, as the literature presented the idea that standardized testing—a prominent part of elementary education, especially in the junior grades, value and assess outcomes and not processes. Liv asserted that the presence of outcome focused standardized testing was a cause of math anxiety, a finding that was consistent with Taylor & Fraser’s (2013) explanation that high pressure environments like testing, worsen math anxiety in children. As it is not an experience that can be removed from education by educators, in order to lessen anxiety for mandatory testing, Liv explained that play-based approaches are effective. She explained that with careful planning, play-based learning can in fact teach the academic skills used on testing. This was surprising, as it contradicted Jachyra & Fusco’s (2014) finding that play-based approaches cannot appropriately teach skills needed for mandatory testing.

In the same breadth, Liv explained that in using play-based models to teach academic skills, teachers need to be wary that they are assessing in a manner that is reflective of what they are teaching. She explained that,
If you’ve allowed kids to learn by *doing* primarily…then that is what you’re using to assess. So if you turn around and give them a pencil and paper test where it looks extremely different than what they’ve actually been doing, then I would say that the test is not absolutely fair. (Liv)

Play-based learning approaches tend to be more collaborative and process based (Honeyford & Boyd, 2015), and assessment needs to reflect that. She spoke of teachers needing to “bridge the gap” between the skills gained in play-based approaches and the skills required to succeed in standardized testing. These skills are not different or incompatible, but are actually the same, just approached in different ways. Liv explained in teaching effectively, even when using a play-based approach to teaching math, students were able to succeed in standardized tests, with little to no perceived presence of math anxiety.

**4.5 Parents are hesitant about accepting play-based learning models**

These teachers recognized that play-based learning approaches to teaching are often approached with hesitation from parents. This theme, while important, came as a surprise, as the current literature did not present this as a challenge to the use of play-based learning models. Instead the main challenge of implementing play-based learning approaches, was cited as its incompatibility with curriculum expectations (Jachyra & Fusco, 2014). Despite this, this was the only challenge that Liv claimed was worth noting, as she felt curriculum should not impede the implementation of play-based models, as is discussed in section 4.4.2. Meredith too, noted this challenge. She notes that because play-based learning “looks so different… from the way most of these parents learned math,” they had a hard time accepting that it could be effective. This theme is important to the findings of this study, as it addressed a real challenge that these teachers faced when implementing play-based approaches.
Within this theme of the challenges to implementing play-based learning approaches into math classrooms, two sub-themes emerged. These themes are of substantial importance to this study, as they speak to both a cause for challenges, and a solution to that challenge. The first addresses a probable cause for this hesitation put forth by parents, which is that the word “play” itself is not associated with sophisticated learning or thinking. The second sub-theme was that these teachers maintained a transparency of their teaching practices in order address any challenges put forth by parents.

### 4.5.1 “Play” is not associated with sophisticated learning

In maintaining the presence of this challenge, Liv noted the word and colloquial understanding of play could be a potential cause for the hesitation to accept play-based learning, especially in the junior elementary years.

I think the word play, gets a bad rap…because I think that when parents or teachers who aren’t familiar with it encounter that term, they automatically think of play in kindergarten, and they think of materials as in line with kindergarten play... We also have this misconception, I believe, and that is that very sophisticated mathematical thinking can only be done in the abstract which is very far from true.

(Liv)

The common understanding that play is for fun and children, and not for learning in upper elementary grades, prevents parents from accepting play-based learning as an effective instructional tool. In her discussion, Liv called for a need to change the way play-based learning is presented, specifically in grades beyond kindergarten. Even though the benefits of play-based learning are widely cited (Ministry of Education, 2010), its association with “play” is enough to call its efficacy into question.
4.5.2 Transparency of teaching practices addresses challenges posed by parents

These teachers were able to address challenges from parents with transparency of play-based learning practices. Even with the language of “play” challenging the use of play-based learning, Liv notes that it is still possible to show parents how effective play can be through transparency. Meredith, in addressing the challenges put forth by parents, stated that it was important to ensure that the relationship between teachers and parents remain open and free of misinterpretation. To this end, she would encourage parents to ask questions about her approach to teaching math. She also referred to the substantial body of research on play-based learning as a source of constant support, as she could easily “find high-quality research, and read them and see what the researchers have to say about this model” and share that information with questioning parents.

While Meredith identified this as a challenge, she noted that parents who questioned what she was doing was not a bad thing, because “at the end of day, parents will just want what is best for their children, you know?” She explained that she would take any challenges as a chance to improve her practice and justify just how effective play-based learning models could be. Liv also thought that these challenges were an opportunity for betterment, citing that she “introduced [a] family math night so parents could come in and, you know, see exactly what was going on and listen to the kids, and what they were learning.” This practice allowed parents to come in and experience how effective play-based models could be for themselves.

Beyond that, Liv stated that as a teacher using play-based learning approaches to teaching, she made sure that all her activities and plans made clear connections to the curriculum expectations. In doing this she was able to be transparent in exactly what was being accomplished in each of her lessons and activities. As mentioned above, this finding was quite
valuable to this study as the current research offers no solution to the challenge of hesitant parents, as it fails to even consider parents as a challenge to the implementation of play-based learning approaches. This theme then, adds to the literature, and provides teachers, especially beginning teachers, with a concrete way to address this challenge.

4.6 Conclusion

It is important to note that many of the themes which emerged in this study are in line with several areas of the current literature. In line with the current literature, play-based learning approaches were found to lessen and prevent the occurrence of math anxiety in students, and traditional approaches to teaching math often resulted in forming or worsening math anxiety. In the conversation of anxiety this study found that engagement was often the main focus of teachers. More specifically, teachers were able to address the presence of anxiety by engaging students in mathematical learning. Unlike the current literature, this study found that building engagement was done most effectively through providing students with choice and including their interests.

Continuing on from there, these teachers found that through engaging students meaningfully, they were able to perceive a change in academic performance of students, in that they achieved higher levels of academic success. These teachers maintained that academic success did not occur because of play itself, but instead strategies and practices inherent to play-based learning, such as betterment of social well-being, created the potential for academic success. Academic success was also made more possible due to the tendency of play-based learning approaches to reduce math anxiety. These teachers called for careful planning and collaboration between teachers in planning play-based lessons, to ensure that they would meet the needs of a variety of learners and minimize the emotional disturbance of math anxiety.
Lastly this study found that the most substantial challenge to the implementation of play-based learning approaches was hesitation from parents, and not an incompatibility of curricula expectations as was suggested by the current literature. These teachers maintained that curriculum should not hinder the use of play-based learning, and neither should the colloquial understanding of the word “play”. The findings of this study suggest that transparency was the most effective tool in addressing challenges posed by parents. Play-based learning approaches to teaching and learning can be quite effective in lessening mathematics anxiety, and increasing mathematics achievement. This study though, also cautions teachers to take care in creating a play-based learning approaches, as several factors can create or worsen math anxiety. This study also suggests that teachers who introduce play-based learning models be patient, as improvement in academic achievement is not instant, rather it is a long process towards mathematical success.

In Chapter five, the final chapter of this study, I discuss the implications of this study for a range of educational stakeholders, such as beginning teachers, and I also list a number of recommendations for educational stakeholders and areas for further research.
Chapter 5: Implications

5.0 Introduction

In this final chapter, I explore the implications of this research. This chapter begins with a summary of the key findings of this study, which was explored, in detail, in chapter 4. I explore the implications of this study in depth, beginning with what the findings mean to me, both as a researcher and a beginning teacher, followed by an exploration into the implications this study has for the educational community and various other stakeholders. I follow that with a list of recommendations based on the information that this study presented. Finally, I discuss areas for potential future research that were uncovered through this process.

5.1 Summary of findings

In chapter 4, I discussed the findings of this study. Through the course of the research, five themes emerged in addressing the main research question, which was: how is a sample of elementary teachers using play-based learning approaches in math instruction, and what outcomes do they observe for reducing and/or preventing math anxiety? The findings are as followed.

Teachers discussed the benefits of play-based learning approaches through the shortcomings of more conventional methods. They noted how conventional or traditional methods often utilized a teacher directed model, where the textbooks, worksheets and individual study were prioritized. In discussing the benefits of play-based learning, these teachers highlighted that this approach was in opposition to the former. Where traditional methods were teacher directed, play-based approaches were student centered, valued collaboration and praised effort (Finlayson, 2014). While the literature does present traditional methods of teaching as different from play-based approaches, these teachers built on this and suggested that these
characteristics placed play-based learning approaches above other traditional methods as they led to increased academic achievement.

The second theme that emerged from the research was that play-based approaches in mathematics were foremost used to foster student engagement. Academic achievement was positioned as a by-product of student engagement. While teachers saw the need for students to succeed mathematically, the introduction of play-based learning approaches was intended to increase student engagement, not necessarily bolster achievement. These teachers perceived academic achievement to be a by-product of engaged students, which fell in line with the current literature (Taylor & Fraser, 2013). They had observed that engaged students were more self-motivated and interested in participating and taking risks in problem solving. These teachers noted that in students who presented with math anxiety, play-based approaches were more effective in lessening anxiety than other approaches. It was also noted that play-based learning approaches increased student engagement by providing students with choice in how they addressed problem solving.

The belief that math anxiety stemmed from more conventional approaches to teaching was the third theme that emerged. As mentioned in the first theme, traditional models of teaching positioned teachers in an authoritative role, which left little room for student input or decision-making. These teachers felt that this approach to teaching itself caused math anxiety because it does not allow students to work collaboratively, make mistakes or think critically about problem solving. These teachers referenced the learning environment created in traditional approaches to teaching to be harmful and stressful to students. Students who presented as having math anxiety in their classrooms were all students of more conventional approaches in prior math education.
These teachers spoke about why they utilize play-based approaches, which was to reduce and/or prevent the occurrence of math anxiety in their students. Thusly, the fourth theme that emerged in this study was that these teachers used play-based approaches to learning mathematics to remedy and/or prevent appearance of math anxiety in students by creating a learning environment that allowed for collaboration between students in learning and teachers in planning. This theme directly correlates to the main research questions posed, as in doing this they saw that students gained self-confidence and resiliency in their mathematical thinking. These teachers perceived that play-based learning approached did in fact reduce the appearance of math anxiety in their students. This belief was supported through observation of students known to have math anxiety. Students with math anxiety slowly became more comfortable with working mathematically after the introduction of play-based learning approaches. As these students became more comfortable with mathematics, these teachers did notice a change in their attitudes towards math and in their grades, which reflects the understanding that poor academic achievement in math anxious students is not a result of low intelligence (Dreger & Aiken, 1957).

Teachers mentioned that careful planning and collaboration was necessary in planning play-based learning approaches, and that the curriculum expectations should in no way hinder one’s ability to use this approach. They also highlighted the importance of focusing on assessing processes rather than outcomes in play-based approaches in order to lessen math anxiety.

The final theme that was presented in this research was the recognition of parents posing the greatest challenge to teachers using play-based learning approaches. Parents of students tended to challenge these teachers’ use of play-based learning approaches, as it appeared to be drastically different from traditional models that they may have been more familiar with. One teacher suggested that the language of “play” itself is not very sophisticated and is often met with
hesitation, especially in junior grade levels. Play is most commonly associated with kindergarten (Ministry of Education, 2010), and these teachers felt that this may have contributed to parental hesitation. These teachers though, did not believe that that the challenges presented by parents was impossible to overcome. Hesitation from parents was met by transparency by these teachers. These teachers underscored the importance of informing parents of what students were learning in their mathematics education. This ranged from inviting students to teach their parents what they were learning, to phone calls home.

5.2 Implications

In this section I explore the implications of this study. There are various stakeholders in this research, including me, both as a researcher and beginning teacher. I discuss these implications first, followed by the implications of this research to the educational community.

5.2.1 Implications for the researcher

This research endeavour was a one that I undertook because of my own experience as a math student. As I began down the path to becoming a teacher, I realized that I did not want my students to feel the same way about mathematics as I did growing up. This process has bought to light the importance of utilizing other teachers as a resource in my practice as a beginning teacher. Both educators who participated in this study highlighted the resource that beginning teachers can find in more experienced teachers. This is a resource that new teachers should take advantage of when embarking on utilizing play-based learning approaches. As a beginning teacher myself, it is important that I actively seek out experienced teachers who are using play-based models in math, to observe their practices and inquire about how to implement play effectively in my own practice.
Beginning teachers should also realize that the process of using play-based learning approaches in mathematics is highly front-loaded. Meaning, a great deal of time and planning must go into the beginning stages of planning. More specifically, for me as a beginning teacher, I will be expected to ensure my classroom has resources, like two-sided counters (manipulatives), available for students to use, and to arrange student seating in a way that promotes collaboration. As a beginning teacher using play-based learning in math instruction, a great deal of time would also be needed to learn about student interests and needs. To do this, I might engage in get-to-know-you activities at the start of the year, and provide a space where students can share their interests, likes and dislikes. Understanding every students’ needs and interests is central to creating effective play-based learning approaches.

5.2.2 Implications for the educational community

This research highlighted several implications for various stakeholders in the educational community, one of which is school boards and school administration. Many school boards in Ontario are currently highly invested in increasing mathematics scores in elementary students. While the current research has suggested that a shift to more student centred approaches can help to lift mathematics achievement in students, very little has been said about what this student centered approach looks like. This research has presented a glimpse into an effective strategy to increase student achievement scores in mathematics. Play-based learning has been well received in kindergarten classrooms, and this research has uncovered the positive implications of play-based learning approaches beyond kindergarten. If school boards and Principals are concerned with improving math achievement and they take the commitment to differentiating instruction seriously, then it is important that they consider the relationship between math engagement and math achievement and explore the potential of play-based approaches for math instruction.
Teachers are a substantial stakeholder of this research as they are the individuals tasked with educating students. This research can give teachers a concrete strategy to engage students with math anxiety. As mentioned throughout this study, the literature highlights that engagement in children leads to higher achievement, both academically and socially. The implications of this research are great, in that teachers can use play-based learning approaches to motivate and engage students, which was shown to lead to higher grades. This research has also brought some much-needed awareness to the idea of play. Play is not just for the realm of kindergarten, and this research has shown just that. Teachers can better engage students with play, and this research has shown that it is quite effective.

5.3 Recommendations

The implications of this research study has informed several recommendations, which are as follows.

1. Given the significance that participants attached to the role of planning and collaboration for implementing play-based approaches to math instruction, it is important that administrators committed to increasing math achievement enact leadership by structuring periodic release time for teachers to co-plan and collaborate by sharing knowledge of play-based approaches to learning across grade levels.

2. Play-based learning approaches tend to favour assessing process more than outcomes, and as such testing is very minimal, if at all present in play-based approaches. This recommendation is not to remove testing all together, but for school boards and schools to remove the requirement of standardized testing. This testing is not indicative of a student’s true understanding, and is linked to the formation of mathematics anxiety. These participants emphasize process over outcome as valuable in play-based approaches.
to math instruction, and it is important that teachers be prepared to learn how to assess process-oriented outcomes specific to play-based approaches to math instruction so that the effectiveness of this approach can be measured and evaluated.

3. This recommendation is a call for more professional development in the use of play-based learning approaches. This approach is currently very under-utilized, as it is used almost exclusively in kindergarten classrooms. Given that common perceptions of play-based learning associate it with kindergarten, it is important that teachers have the opportunity for professional development that introduces them to specific models of play-based approaches to teaching math in primary/junior grades, to provide them with evidence-based knowledge so that they understand its potential and value in combatting math anxiety. This professional development should include demonstrations on what play-based learning looks like in a classroom environment, how to set it up, and how to plan play-based approaches effectively.

5.4 Next steps for future research

There is a great deal of literature on the causes and effects of math anxiety, and a new, but rapidly growing body of research on the benefits of play-based learning approaches. There is also a great deal of research currently available on the effects of motivation and engagement on student achievement. But there is very little in terms of play-based learning approaches in mathematics education. The Ontario school boards have recently shown a great deal of interest in increasing mathematic scores of our students, yet there is not much in the literature on how to do that, and what that would look like. This research suggests that future research into this area should explore play-based approaches in mathematics instruction in greater depth. Given the extent that parent attitudes toward play-based learning impact teachers’ instruction, it is
important that research look further into how teachers are communicating the learning goals and instructional strategies of their play-based approaches to math instruction to parents. Another area of future research that this study presents is how teachers are working collaboratively to enact play-based approaches to cross-curricular instruction across grade levels.

Further research is also needed in the long-term effects on math achievement that result from play-based approaches to math instruction. Due to the limitations and scope of the research, gender differences in mathematics learning were not explored, though they were addressed in the current literature (Geist, 2010). The effects that play-based learning approaches have on girls with math anxiety should be further explored. While not explored in this study, Geist (2010) suggests that gender differences exist in how math anxiety affects students, in that girls tend to have a higher occurrence of math anxiety. Given that this research suggests that play-based approaches can be used to reduce/prevent math anxiety, it may be beneficial to look into the effects the introduction of play-based learning may have on boys and girls.

5.5 Conclusion

Mathematics will now and forever be an essential skill. Many children grow up thinking that they are not, nor can they ever be, good at math. But research has shown that an inability to do mathematics is not an inherent or genetic trait, as it is so often believed to be. The environment in which children learn math is critical to the attitude they will develop towards their own math education and understanding. As teachers are the primary educators of mathematics, they play a critical role in fostering a nurturing environment. This research has shown that teachers can create an environment that engages student in mathematics through play-based learning approaches. This approach engages students by utilizing student interests in a way that does not look or feel like traditional learning. By allowing students to take a leading
role in their mathematics learning, teachers can teach them how to think critically and resiliently, all of which are skills that will benefit students’ academic achievement. Play-based learning approaches to teaching mathematics can reduce the occurrence of math anxiety, and its introduction as a teaching method, can effectively address Ontario’s low mathematics achievement.
References


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Appendix A: Letter of Consent

Date: ___________________

Dear ___________________,

I am a graduate student at OISE, University of Toronto, and am currently enrolled as a Master of Teaching student. For the purposes of a graduate research paper, I am studying how teachers are incorporating play-based learning into mathematics, and what outcomes they observe on math achievement. I think that your knowledge and experience will provide insights into this topic.

I am writing a report on this topic as a requirement of the Master of Teaching Program. My course instructor who is providing support for this assignment this year is Dr. Angela MacDonald. The purpose of this requirement is to allow us to become familiar with a variety of ways to do research. My data collection consists of a 45-60 minute interview that will be audio-recorded. I would be grateful if you would allow me to interview you at a place and time convenient to 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 and/or potentially at a research conference or publication. I will not use your name or anything else that might identify you in my written work, oral presentations, or publications. This information remains confidential. The only people who will have access to my assignment work will be research supervisor and my course instructor. You are free to change your mind at any time, and to withdraw even after you have consented to participate. You may decline to answer any specific questions. I will destroy the audio recording after the paper has been presented and/or published which may take up to five years after the data has been collected. There are no known risks or benefits to you for assisting in the project, and I will share with you a copy of my notes to ensure accuracy.

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

Sincerely,

Researcher name: Anita Vidya Bhola
Phone number: 416-560-8780
Email: anita.bhola@mail.utoronto.ca

Instructor’s Name: ___________________________
Appendix B: Interview Protocol

Thank you for taking the time to participate in this research study. The aim of this study is to gain insight into how teachers are teaching math with a play-based learning model, and how its use influences student math achievement. This interview should take approximately 45-60 minutes, and I will ask you a series of questions concerning your experiences of teaching math. I will also ask you a handful of questions about your own experiences and anxieties about learning and/or teaching math. I want to remind you that you can refrain from answering any of my questions. I would also like to remind you that this interview will be recorded, and that this recording will remain confidential. Before we begin, do you have any questions?

Section 1: Background Info
1. How many years have you worked as a teacher?
   a. How long have you taught math?
   b. What grade are you currently teaching, and how long have you taught it? What grades have you previously taught?
   c. Can you tell me about the school you currently work in? (e.g. size, demographics, program priorities)
2. Why did you want to become a teacher?
3. As you know, I am interested in learning how teachers enact play-based approaches to learning math. Can you tell me more about what personal, professional, and educational experiences informed your interest in this topic and prepared you for this work?
   **Listen, and then probe as necessary** E.g. Growing up, how did you feel about learning math as a student? How did you learn math?
4. Why did you begin using a play-based approach to teaching math?

Section 2: Beliefs & Values
5. What does play-based learning mean to you?
   a. What does it involve?
   b. What are the learning goals and common characteristics that you associate with play-based learning?
6. Have you ever used a model other than play-based learning? If so, what were student responses like?
   a. What are some key beliefs that informed your use of other teaching models?
7. In what ways do you believe student responses differ with a play-based model from other traditional teaching models?
8. What benefits for students have you observed from play-based learning, generally speaking?
9. Current research explains that play-based learning is effective because play expands intelligence, stimulates the imagination, encourages creative problem solving, and helps develop confidence, self-esteem, and a positive attitude toward learning. (Dr. Fraser Mustard). Understanding this, why do you think play-based learning is most commonly used only in kindergarten classes?

10. Do you think that play-based learning approaches might be relevant in other grade levels? If so up to what grade, and why?

11. What have you observed when it comes to students’ attitudes/feelings toward math education.
   a. Do attitudes differ when using a play-based model vs. a more traditional one?

12. What is your understanding of math anxiety?
   a. What sort of attitudes/feelings does a student with math anxiety exhibit when it comes to math education?
   b. What do you believe are indicators of math anxiety?

13. Do you think a play-based model responds to students with math anxiety? Why or why not?
   a. What outcomes have you observed from students? (how does it affect these learners?)

Section 3: Teacher Practices

14. How would you introduce a math lesson through a play-based learning model?
   a. What are your learning goals and instructional strategies?
   b. What sort of initial reactions do you get from students who are not used to learning math in this way?

15. How do you assess student work in a play-based mathematics approach?

16. Can you give me an example of a math lesson that you have designed and taught that used a play-based approach?
   a. What grade were you teaching?
   b. What were your learning goals?
   c. What instructional strategies did you use? What opportunities for learning did you create? What were students intended to do and why?
   d. How did your students respond? What outcomes did you observe?
   e. What, if any, challenges did students experience? How did you respond?
   f. How did you assess this lesson? What were you looking for evidence of?

Section 4: Influencing Factors

17. How have your own experiences with math shaped the way you teach math?

18. What resources do you have access to in order to support your play-based approach to teaching and learning math? (BE AS SPECIFIC AS POSSIBLE; programs, books, manipulatives, funding, space)

19. What challenges or obstacles have you faced when teaching math with this model?
20. How do you respond to these challenges?
21. How might the education system further support you in meeting these challenges?
22. Have you received any feedback from peers on this teaching method? From parents/ others? What feedback have you received?
23. How does feedback impact what you are doing?

Section 5: Next Steps
24. What advice do you have in terms of how to relieve students’ experience of math anxiety and/or disengagement?
25. What advice, if any, do you have for beginning teaching who are invested in enacting play-based models for teaching math?
26. Is there anything else you would like to add?

Thank you for your time and participation!