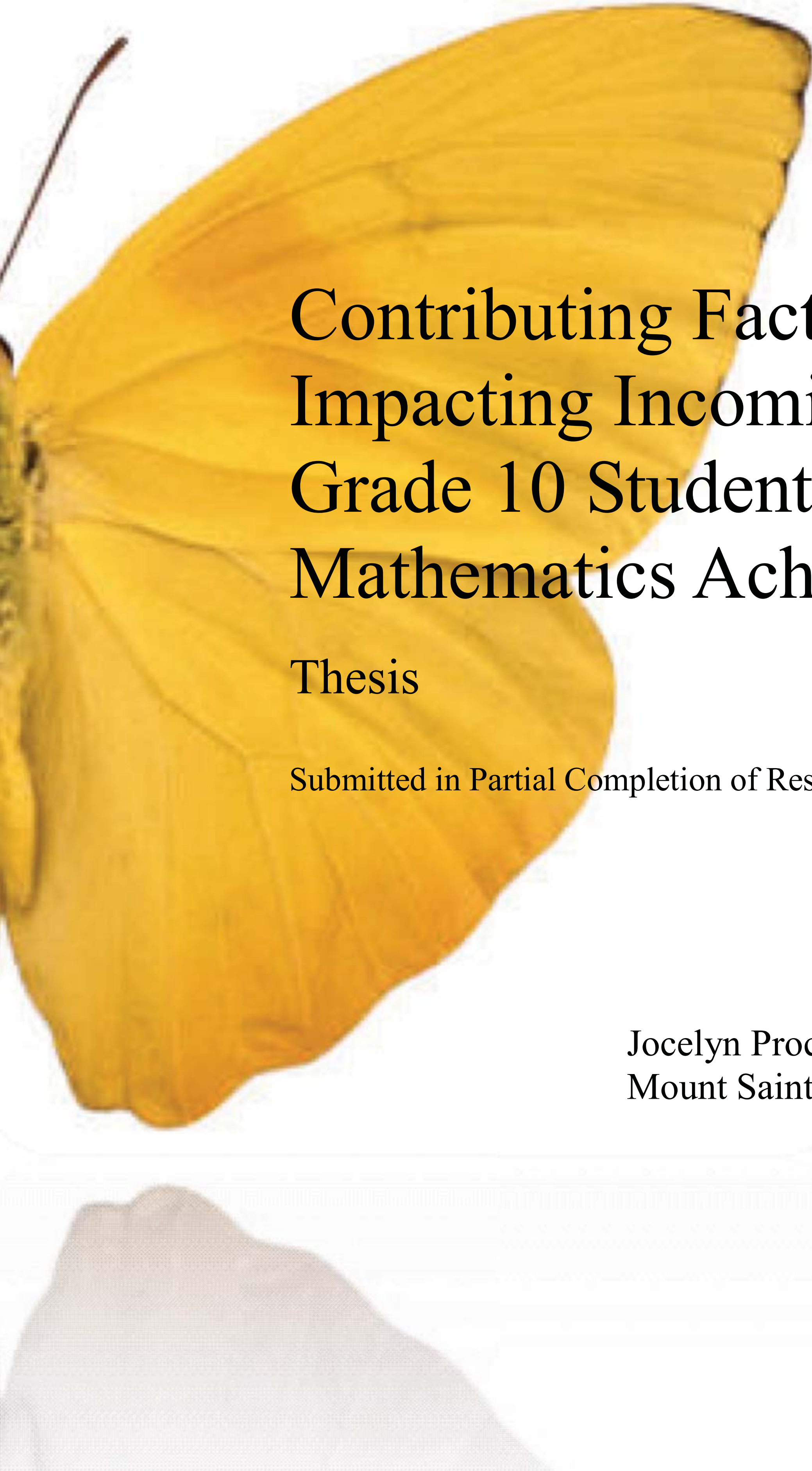
2011



Contributing Factors Impacting Incoming Grade 10 Students' Mathematics Achievement

Thesis

Submitted in Partial Completion of Research Masters of Arts Degree

Jocelyn Procopio
Mount Saint Vincent University

Acknowledgements

This research would not have been conceivable without the supervision and assistance of several individuals who in one way or another contributed and extended their valuable support in preparation and completion of this study.

" The teacher who is indeed wise does not bid you to enter the house of his wisdom but rather leads you to the threshold of your mind. " Khalil Gibran (1883-1931)

First and foremost, my utmost gratitude to my supervising professor Dr. Geneviève Boulet for her wise guidance, overwhelming encouragement, infinite patience, and unfailing energy. It is no small feat to undertake turning a 'math person' into a writer. The journey was challenging and at times gruelling, yet I enjoyed every minute. It is wonderful to be pushed outside of your comfort zone and learning was inevitable. Geneviève, thank you for pushing *just* the *right* amount.

A lot of learning can be the result of a good set of questions, so thank you Dr. Andrea English for asking them. I am truly appreciative of the time and effort exerted on my behalf.

To Dr. Donovan Plumb thank you for pointing out the past and encouraging me to question the future. Your input and insight kept me grounded and looking up.

I would also like to thank my brother, Jonathan, for asking the right questions and offering words of encouragement as only a brother can.

To my friend, and colleague, Maureen MacInnis for listening and helping me iron out what I really wanted to say. Given copious amounts of coffee we could conquer the world.

Eileen Brennan, I appreciate your wisdom and thank you for the *Pick a face* recommendation.

Table of Contents

Figures

Appendix

Introduction

"I only attempt to provide the conditions in which they can learn." Albert Einstein (1879-1955)

In my role as the Head of the Mathematics Department in a large urban high school, I have devoted countless hours "attempting to provide the conditions" that offer the best support to our newest, and thus most vulnerable learners, the incoming grade 10 students. These incoming grade 10 students are challenged with multiple hurdles to overcome. First, they are experiencing adolescence, a time when their bodies are undergoing rapid and often confusing changes. Second, they usually have moved to a new school, changing their status from being the oldest to now being the youngest members of the school. They are introduced to different social and academic settings. They are contending with a newfound independence. Added to these abundant changes are feelings of anxiety, both socially and academically; anxious feelings that may be affecting students' self-perception. Yet, during this time of transient upheaval, it is expected of these students that they make a decision concerning the selection of mathematics courses - a decision that impacts their future in a disconcertingly important way. Is it any wonder then that I wish to explore "the conditions in which they can learn" better during such a significant yet troublesome time? In our departmental meetings, the question that often arises is "what can we do to help support our grade 10s in mathematics?" I want to have an answer. More specifically, I want to be able to draw on current knowledge of how grade 10 students learn, what their perceived anxieties are, what their real anxieties turn out to be, and what has already been done to support them. I plan on reviewing, analysing and synthesizing the relevant literature in order to provide a profile of the main contributing factors in students' achievement in mathematics along with a number of recommendations for improving the mathematics learning experience for a very singular class of learners, the grade 10 mathematics students.

In this research proposal, I delineate in some detail why I am choosing to investigate and to analyse factors impacting incoming grade 10 mathematics students. In conducting a review across the collection of current and past literature centered on contributing factors of impact, I have gained insight into these students' issues. From this improved understanding of the range and depth of the factors that impact student achievement in mathematics, I then present and defend my methodological choices. Specifically, I describe how I plan on taking the literature review and turning it into recommendations for improved student learning and maximized support.

Chapter 1: Statement of the Problem

In the changing world, those who understand and can do mathematics have significant opportunities and options for shaping their future. (National Council of Teachers of Mathematics [NCTM], 2000, p. 5)

In life, transitions can be difficult for anyone in any circumstance. If that person is a teenager, transitions take on greater proportions because teenagers' bodies are changing, their friends are changing, their emotions are changing, and their knowledge and thought processes are all undergoing multiple types of transformations. Then added to this, often 15 to 16-year olds entering grade 10 have to switch schools; schools in which the pedagogy, the curriculum, the assessment, the social setting, the expectations, the teachers, and the responsibilities are all very different from the junior high experience. This transition to high school is a critical time for students, and as such, it requires the awareness and support of the students' learning community. Students' decisions regarding possible mathematics routes and their success in mathematics are influenced, not only by transitioning, but also by other factors, such as self-efficacy, prior performance, attitude, motivation, teachers, and many more. I plan on understanding better why this grade 10 year is so important in students' academic lives by examining major contributing factors affecting their achievement in mathematics and, in light of these, determining means that would ease their transition to high school.

This chapter explores the problem that arises when students enter grade 10 mathematics. From there, I offer the reasons why the problem is of interest to me, and why I desire to explore and address the problem. Like all studies dealing with the complexity of humanity there will be limitations and they are discussed before concluding the chapter.

For the purpose of this study, it should be noted that success or failure, although necessitating much deeper consideration, is defined here in terms of our current education system's as a passing grade. In addition, when talking about the contributing factors impacting grade 10 students I am referring to the grade 10 students' achievement in mathematics. I use the word *achievement* as it is measurable in terms of success or failure unlike the word *ability* which is much more difficult to measure.

The Problem Entering Grade 10 Mathematics

Students entering Grade 10 Mathematics are faced with deciding their mathematical future. Students leave a single Grade 9 Mathematics course, where no choice was available. Students entering a senior high mathematics program have a number of options with regards to courses in mathematics to choose from (Atlantic Canada Mathematics Curriculum: Mathematics 10, 2004). Students can choose either Mathematics 10 Essentials, Mathematics 10 Foundations, Mathematics 10 Academic, or Pre Diploma (IB) Mathematics 10. Students can limit their future options with the choices they make in Grade 10, as they do not have the opportunity to change routes at a later date. For example, a student who chooses Mathematics 10 Essentials cannot then take Mathematics 11 Foundations, since routes are designed in accordance with prerequisites. Students typically choose their Grade 10 Mathematics course based on their Grade 9 Mathematics performance. This also can be very restricting; if a student chooses to take Essentials but really is capable of Academic, he or she has limited his or her acceptance to a university or to other post-secondary institutions and has closed the door to a number of employment opportunities (for example nursing at the University of New Brunswick requires a minimum mark of 70% in grade 11 and 12 academic math, www.unb.ca). The chart below shows students' options in Grade 10 mathematics and the allowable pathways from then on. (See Figure 1)

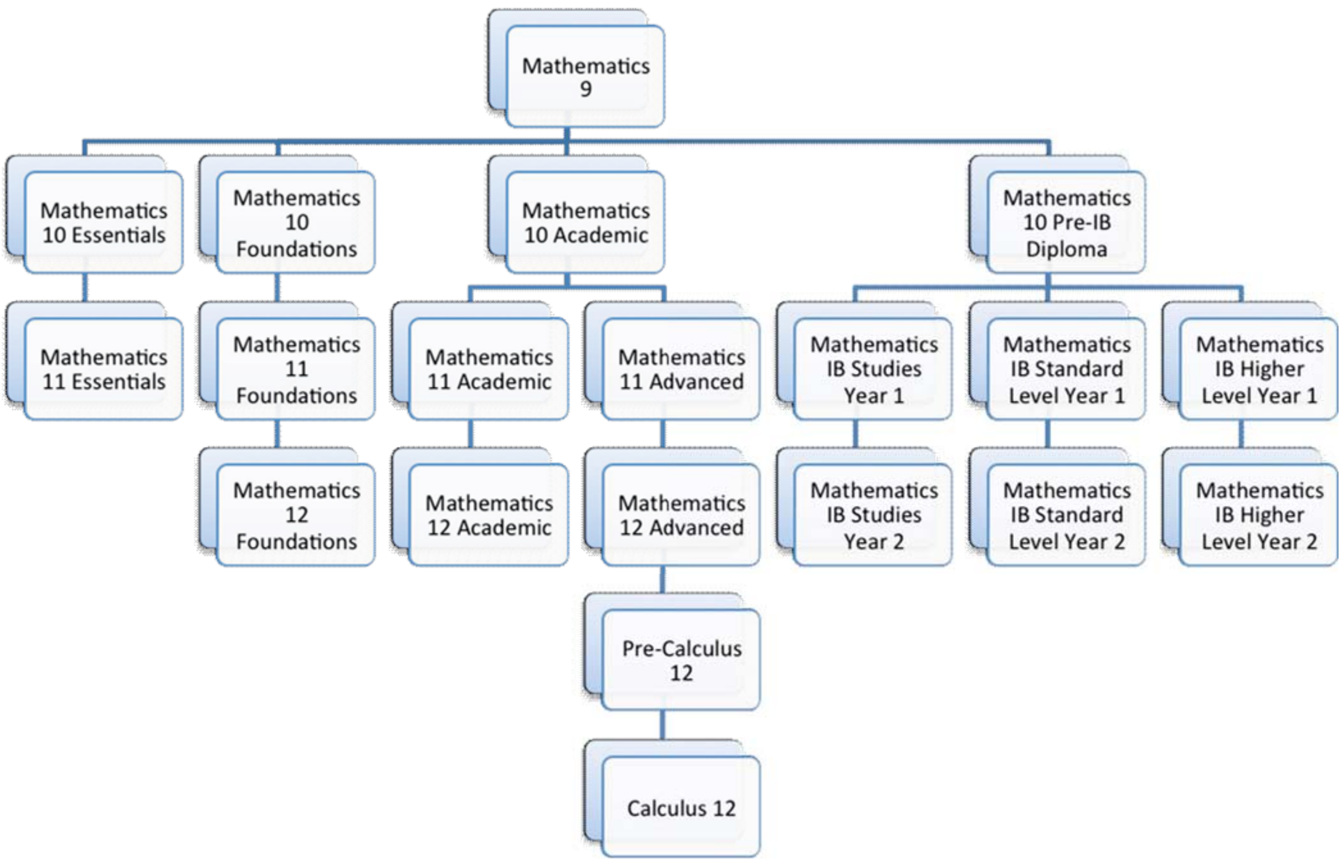


Figure 1. High school mathematics options in the province of Nova Scotia.

For students, this long-reaching decision occurs during a transitional time, a time when streaming (students being placed in classes according to mathematical ability) begins, when self-efficacy (the belief in one's competence), and prior achievement are all weighing in. Students must make this decision at a time in their lives when they have more change and uncertainty than ever before, and they have not yet reached adulthood with the experience and maturity it brings. It is a problem that cannot be ignored.

Purpose of the Study

The first goal of my study is to gain a better understanding of the contributing factors that impact incoming grade 10 mathematics students. Once I have clarity on the issues, I then plan to create a profile of the major factors. Finally, this profile will serve to make informed recommendations for change. In her poem, "There's a Hole in my Sidewalk" Portia Nelson illustrates a realistic portrayal of what we encounter before making a change for improvement:

Chapter 1.

I walk down the street.
There is a deep hole in the sidewalk.
I fall in.
I am lost…
I am helpless.
It isn't my fault.
It takes forever to find a way out.

Chapter 2.

I walk down the same street.
There is a deep hole in the sidewalk.
I pretend I don't see it.
I fall in again.
I cant believe I am in this same place.
But it isn't my fault.
It still takes a long time to get out.

Chapter 3.

I walk down the same street.
There is a deep hole in the sidewalk.
I see it is there.
I still fall in… its a habit.
But, my eyes are open.
I know where I am.
It is my fault.
I get out immediately.

Chapter 4.

I walk down the same street.
There is a deep hole in the sidewalk.
I walk around it.

Chapter 5.

I walk down another street.

The purpose of this study is to examine "other streets." When I first began teaching, I was not aware of the "holes in the sidewalk" that our incoming high school mathematics students were falling into. I found it troublesome that these students were making decisions upon entering high school that would affect the rest of their lives; I also knew that the mathematics courses they chose would directly affect the future courses in higher education they would be eligible to take, and that in turn would affect their post-secondary options. Some students happened to choose the right courses for themselves; ones that fit their learning styles and were sufficiently challenging yet not daunting. However, I observed that many students struggled in the courses they chose. The problem was that students were making these critical decisions without the right tools and the necessary guidance to help them understand the reasons for and the consequences of their choices. Since I have become more cognizant of this recurring, problematic situation as the Head of the Mathematics Department, I want to gain better insight into the issues involved in order to be able to support more effectively the students who are beginning their high school mathematics experience. The literature currently available on this subject is based on studies that typically focus on one or two contributing factors impacting students' achievement in mathematics. I plan to examine more closely such studies in order to create a profile of the major contributing factors. This profile will then serve to make comprehensive recommendations for improvement. In conducting this study, I aim to find an alternate "street" for these students to travel on; a street without a "hole in the sidewalk."

Limitations

This study is not without its limitations, as one would expect when dealing with the complexity of human interactions and the many influencing factors involved in each action. Most of the studies examining contributing factors that impact student success were conducted in Australia and in the United States. School systems, teacher training, budgets, and policies all differ from country to country, thus limiting but not restricting the applicability of the studies to Canadian schools. Not all schools transition students from grade 9 to high school; some make the transition from grade 8 to high school. As a result, it is difficult to determine whether or not age is an influencing factor. The topic of contributing factors is vast and I have to limit the scope of my investigation. I choose to focus on studies in areas that will help me make recommendations within the scope of my position and set of responsibilities in the educational system so that the recommendations for change may be implemented. As a result of this, although it would be more beneficial to go back to grade 9 when they make the decision for grade 10 course selection, this is outside of my focus. I am committed to making recommendations in the area where I am most likely to see them put into actions, which is when they are already in grade 10. Finally, as I am a teacher in the school system, I am not an unbiased observer when exploring the studies. Although being in the education system can be a strong point in that it is a huge motivator for finding answers, it is also a limitation. It is a limitation in that it is difficult to read the studies objectively and without seeing them through the lens of experience. I have attempted to read with an open mind and to seek new understanding. In other words, I did not read with the intent of confirming what I already believe. I feel it is important to place myself within the study and acknowledge that it is a struggle to remain objective and open.

Conclusion

In the majority of Nova Scotia schools, Grade 10 is the pivotal year for setting the mathematical routes students will follow. This grade level is critical, since the routes determine post-secondary options; a student may be choosing a pathway that leads to multiple opportunities or to limited opportunities. As educators, we want to provide students with the best and the most opportunities possible. Therefore, the study I propose seeks to shed light on the influence of various factors on this grade 10 year with the aim of making recommendations for change, support, and improvement.

Chapter 2: Literature Review

Introduction

In this chapter, I examine three of the many contributing factors impacting incoming grade 10 students' achievement in mathematics. The three factors I choose to focus on are transitioning, self-efficacy, and prior achievement. Transitioning refers to the many changes associated with moving from Grade 9 to Grade 10. These changes include both physical and psychological development in adolescence, as well as social changes due to moving from junior high school to high school. Self-efficacy refers to the belief in one's competence within a specific context (Bandura, 1994). In this review, I am specifically interested in students' belief in their mathematical competence. Prior achievement refers to the levels of success the students have demonstrated before entering grade 10. Prior achievement does not necessarily indicate prior ability. What the student is capable of may not be reflected in the demonstrated achievement results.

I selected these three factors as my focus for several reasons. First, it was quickly evident in the literature that transitions, self-efficacy, and prior achievement were major contenders. Not to consider transitioning would be to ignore the elephant in the room. Students entering Grade 10 Mathematics (with the exception of schools transitioning at different grade levels) undergo a major transition to high school from middle school. That this time of change plays a part in students' studies seems obvious and therefore should be explored. Next, I choose to focus on self-efficacy, because it seems logical that thought will result in action and therefore thought should be examined in order to pre-empt the possible actions. Marcus Aurelius (121-180) wisely said, "The universe is change; our life is what our thoughts make it." Since students will make decisions based on what they are thinking, I want to learn what has been studied thus far that reveals how students' thoughts about their own mathematical competence affect their Grade 10 course choices and subsequent success or failure. I focus on prior achievement as a factor of student success in Grade 10 Mathematics because this factor is intriguing, as it seems cyclic: does prior achievement indicate future achievement or dictate it? How a student has performed in mathematics in the past can be an indicator of how he or she will do in the future; or it may determine how he or she will do in the future because he or she will be streamed according to that prior achievement. Also, as a student is choosing courses in Grade 10 it is often done with the recommendation from teachers and guidance counsellors based on his or her previous achievement. This makes prior success, or lack thereof, a major contributor in determining a student's mathematical route at the high school level.

My second reason for my selection of factors is that I want to examine those that would lead me to make feasible recommendations for improving the support now offered to incoming grade 10 mathematics students. Of course there are additional factors that contribute to students' success in grade 10 mathematics, but a closer examination of them indicates that they would play a much smaller role in effecting change. For example, some studies (Bingolbali, 2011; Spier, 2010; Dick, & Rallis, 1991) reveal that better teachers, new curricula, or improved parental support all increase student success. However, such factors are out of reach and thus do not allow me to make recommendations to teachers on how best to support their students.

The third reason I choose to focus on examining these three particular factors, transitions, self-efficacy, and prior achievement, is that they overlap. Indeed, they are closely linked and are cyclic. For example, if a student's prior achievement in mathematics was low, then this would typically result in low self-efficacy (Bandura, 1994) and add to the concerns associated with transitioning.

This chapter is organised into three main sections, each treating of one of the three factors: transitioning, self-efficacy, and prior achievement. In my examination of transitioning, I am concerned with who is undergoing the transition, here the adolescent. In particular, I want to understand better what students perceive as fears and anxieties surrounding the change in schools before the transition, and then analyze the effects of the change on students after the transition. In my examination of self-efficacy, I am concerned with the impact that students' perception on their own competence in mathematics has on their achievement in mathematics. Lastly, in my examination of prior achievement, I am particularly interested in studies that explore what it is to succeed in mathematics, what mathematical literacy means and how prior achievement affects future achievement.

Transitioning

Life is pleasant. Death is peaceful. It's the transition that's troublesome. (Isaac Asimov, 1920-1992)

For the purpose of this review, the transition that I am interested in is the movement of students from grade 9, typically in a junior high school, to grade 10, the first year of high school. As this is not the defining grade at which all schools transition students, there is a limitation to my review in that I will have to parallel what occurs at different grade levels to what could happen at the grade level I am interested in.

In my examination of studies conducted on transitions, I first consider the students themselves: what are the characteristics of the group of students making the transition? In other words, *who* is making the transition? Then, I consider *what* it is that the students themselves are worried about when making the transition. Finally, I discuss what the studies show are the marked effects on students who are making the transition. These effects might or might not correspond with what the students are worried about.

Who is Transitioning?

Young adolescents contend with a multitude of changes including rapid physical and emotional development (Caskey, 2010). With new technology, MRIs can now shed light into the physiological changes occurring inside an adolescent brain (Steinberg, 2010). Other than the first three years of human life, adolescents show the most changes in brain activity. Steinberg (2011) specifies two significant changes in the brain. The first is that the brain is still maturing (until the person reaches his or her mid-20s) in its sophisticated thinking abilities, such as planning and considering consequences. The second important change occurring in the adolescent brain is a higher amount of dopamine, which leads to the sensation of pleasure; this may explain why adolescents take higher risks than adults do. Also in this study, teenager brains' reward centres were triggered simply by the presence of peers; this phenomenon was not found to hold in the case of adult brains. This may make teenagers even more inclined to take risks with friends present, as the focus may be more on the reward than any dire consequences. The grade 10 students sitting in our classes are undergoing such brain development. In order to be able to support these students, the teaching community must have a better understanding of these brain changes.

Students' Feelings of Anxiety

"Students have many fears real and imagined. At no other time in development is a student likely to encounter such a diverse number of problems simultaneously" (Wiles, & Bondi 2001, p. 35, as cited by Letrello, & Miles, 2003). Students coping with physical changes, seeking more independence, and acquiring new ways of learning all add to the emotional issues for emerging adolescents. Students experience a transition in their physical environment in the move from one school to another, as well as different academic requirements, and new social interactions (Letrello, & Miles, 2003). What are students worried about when moving to a high school? Ashton (2008) found students to have mixed feelings of anxiety and excitement about the move. Students listed such concerns as fitting in, bullying, getting lost, homework, new teachers, and being treated like a grown-up. In advance of the move, students' top priorities were about making new relationships and planning the details of life at their new school, such as finding their classes, lockers and following a new schedule (Ashton, 2008).

When teenagers are transitioning, they are most worried about social issues. Consequently, they feel less anxious about school routines and curriculum than the social aspect (Ashton, 2008). Wormeli (2011) agreed with these findings stating that belonging was one of the primary concerns expressed by transitioning students. The need for social acceptance is particularly significant for teenagers. Being aware of this predominant need for social acceptance is essential in high school education. If students are preoccupied by their need for social acceptance, this becomes apparent in behavioural incidents. More specifically, the social anxiety students may experience during this transition time often results in more disruptive outbursts than during other times (Casky, Malaspina, & Rimm-Kaufman ,2008). Recognizing social anxiety as a possible source of behavioural problems allows teachers to intervene more effectively since they can then aid the students in reducing the levels of anxiety and in redirecting the focus to academic issues.

Spier (2010) examined the effectiveness of a group-art-therapy intervention with students who were at risk for experiencing a difficult transition to high school from Grade 8. The participants completed the questionnaire on coping behaviours, A-COPE, before and after the intervention, and scores were compared for individual students. The eight sessions with the students used art to help them identify stress and then explore ways to cope. Activities included drawing, making masks, and creating games. Spier (2010) found that this type of intervention did help students to identify anxieties. Indeed, there was a decline in behavioural referrals. Participants' scores demonstrated an improvement in coping skills. Parents described positive changes such as a decrease in frustration, increase in confidence, and a more positive attitude towards going to high school. In other words, the changes were observable at home as well as at school. Students showed an increase in score on the developing self-reliance part of the survey and a decrease in the score on investing in close friends part of the survey. Together, the increase and decrease might suggest that an increase in self-reliance would result in a decrease in peer pressure.

Spier's (2010) study reveals that students who can identify areas of stress are then better able to explore ways to cope; with awareness comes a clearer strategy for coping. The improvement in attitude and behaviour suggests that students who are being disruptive do so as a result of frustration and a lack of ability to seek support. Indeed, Wormeli (2011) argues that academic grades should only reflect what is actually a curriculum outcome and not be reflective of other things such as behaviour. He claims that when teachers are able to separate adolescent behaviours from academic achievement, there is hope for the students.

Effects of Transitioning

Despite young adolescents' fears and anxieties about entering high school, once they make the transition, they may find their initial fears unfounded and that different challenges than what they anticipated arise (Mizelle, & Irvin, 2000). What then do studies indicate are the challenges faced once students have transitioned?

Grolnick, Kurowski, Dunlap, and Hevey (2000) studied the effects on academic achievement of students changing schools, from sixth to seventh grade. The most prominent negative effects were the students' low grades in both reading and mathematics. Grolnick *et al.* (2000) contribute this negative effect on grades to a change in grading practices rather than students' actual achievement. As a result of the lower grades, there was a significant decline in what students believed they could do.

Alspaugh, (1998) examined different transition practices on student achievement. The students attending middle schools, meaning they had already transitioned once, experienced a greater achievement loss in the transition to high school than did the students making the transition from a K-8 elementary school. In other words, the experience of making a previous school level transition did not moderate the achievement loss during the transition to high school. Rather, Alspaugh (1998) found that it implied that the students were encountering a compounded loss in achievement; a loss during the first transition and then an added loss during the second transition. This indicates a compelling case for the need of support during transitioning, as it is so influential on student achievement.

Wormeli (2011) questions "if high school success, navigating the larger world, and discovering the direction we want our lives to take all have roots in young adolescence, why would anyone leave the transition into this impressionable phase to chance?"(p. 49). The answer is, we would not. Teachers need to be as informed as possible, so that they may move forward with the best plan of action.

Self-efficacy

According to Bandura (2006), "self-efficacy is concerned with people's beliefs in their capabilities to produce given attainments"(p. 307). He also argues that self-efficacy is specific to a particular realm of functioning and is focused on *can do* rather than *will do*. This is because *can do* is a judgment rather than the *will do* which is an intent. Bandura (2006) also differentiates between self-efficacy and self-esteem; the first is a judgment of capability while the latter is a conception of worth. In light of this important distinction, reference to students' self-efficacy is not to be confused with their self-esteem. In particular, I will be referring to the student's belief in his or her mathematical competence; it is not a reference to students' overall feelings of self-worth.

What students believe they are capable of doing often becomes a self-fulfilling prophecy (Hemmings & Kay, 2010). Following will be a discussion of studies that examine the relationship, if any, between self-efficacy and achievement in mathematics. Carmichael, Callingham, Hay, and Watson, (2010) reveal that self-efficacy affects attitude, which in turn affects effort, which then affects performance. Between belief in one's competence and one's performance lies many stages. Therefore, it is difficult to attribute performance level to the single variable of self-efficacy. Indeed, the belief in one's competence triggers other factors that impact success. In other words, self-efficacy might be a direct or an indirect contributor on achievement. The reader should keep this in mind when the factors appear to be interacting with other factors, such as those of attitude or interest. In fact, it is difficult to separate them and the studies often link together self-efficacy with attitude and interest (Hemmings & Kay, 2010; Forgasz, 2010).

Bandura (1994) provides four sources for the development of high self-efficacy (see Figure 2). The principal source is the experiences of mastery. If a student is successful at a task, he or she will then believe that they will be successful at similar tasks in the future. The converse of this is also true; continued failure at a task is the biggest influence in undermining self-belief. If a student fails at a task, this leads him or her to believe that he or she will not be successful at a similar task in the future. While some challenges and setbacks can make people stronger, repeated failure is detrimental. The second most important way of fortifying belief in one's competence is through vicarious experiences. When people observe others similar to themselves meet with success on a task, it is easier for them to believe they will also succeed on the task. Again, observing failure will have an analogous effect in that when people see peers fail, they tend to believe that they too will fail. Social persuasion also strengthens the belief in one's competence. In other words, if people are told they will succeed and are expected to succeed, then, as a result, they are more likely to believe that they will. On the flip side, Bandura (1994) cautions that social persuasion may be more powerful at undermining self-efficacy than strengthening it. Social persuasion has the potential to act as a catalyst for retaliatory behaviour out of frustration or embarrassment at being unable to meet expectations (Bandura, 1994). The fourth source for the development of self-efficacy is people's own emotional state; people often interpret stress, fatigue, and mood as indicators of competence. For example, if a person is very stressed completing a writing assignment, he or she may interpret that stress to be an indicator of his or her weak writing capabilities; in other words, an individual may use the stress factor to support his or her belief of incompetence.

Figure 2. Bandura's four contributing factors of self-efficacy.

Taking into account Bandura's (1994) contributing factors of self-efficacy, he seems to be cautioning that teachers may (without realizing it) create experiences, which affect perceptions of efficacy in mathematics. For example, students could be in situations in which they face repeated failure, which leads to reduced levels of motivation and disengagement. Students with high self-efficacy could also be given better opportunities by teachers, because a student who has a strong perception of his or her own mathematical competence typically demonstrates more perseverance in tackling challenging problems.

According to Bandura (1994):

> Successful efficacy builders do more than convey positive appraisals. In addition to raising people's beliefs in their capabilities, they structure situations for them in ways that bring success and avoid placing people in situations prematurely where they are likely to fail often. They measure success in terms of self-improvement rather than by triumphs over others. (p.3)

It is important to be aware of the sources for the development of self-efficacy because then, teachers may help create situations which will foster a higher level of perception of mathematical competence and in turn help students to take bigger risks more confidently.

Carmichael *et al.* (2010) found that self-efficacy correlates with student interest in a quadratic way. It was quadratic in that junior high students with low self-efficacy in mathematics showed the same low interest as those who believed they could easily complete the mathematical task; the latter group of students simply had no interest in trying something they felt certain they could do. However, students who had mid-levels of self-efficacy were the most interested. The idea that actions are pre-shaped in thought and that people anticipate optimistic or pessimistic possibilities based on what they believe, is important in thinking about how students learn. It is important because students need to be engaged and motivated. They should not give up because they do not believe they are capable or because they are sure they are capable (Carmichael *et al.,* 2010).

Hackett, & Betz, (1989) found in a group of undergraduate students that self-efficacy in mathematics played a major role in choosing a mathematics-related career. In particular, the study reveals that mathematics-related self-efficacy expectations are stronger predictors of mathematics-related educational and career choices than actual mathematics performance or prior achievement. Dick and Rallis (1991) also found that students who choose careers that are mathematically-based do so with the prime motivator being interest rather than salary. The strong drive that self-efficacy showed in career choice, Hackett and Betz (1989) felt indicates the need for mathematics teachers to pay an equal amount of attention to students' self-evaluations as to actual performance.

In an Australian longitudinal study, Yates (2002) found that optimism or pessimism plays a role in students' achievement in mathematics. In fact, not only did Yates (2002) find that optimism and pessimism play a role in students' current achievement level, it was found to be associated with their achievement levels three years later. In particular, students' negativity toward elementary school mathematics influenced their achievement in later years. The relationship between negativity or pessimism and lower achievement is an important one for mathematics teachers to be aware of; it is significant because it requires early intervention. Yates (2002) found that the pessimism displayed by students early on became a reality three years later. This makes the early years of mathematics learning a very impressionable and influential time.

Tanner and Jones (2003) found in their study that many students find themselves caught in a unfavourable loop in which low self-efficacy leads to a failure to apply effective learning strategies or appropriate thought processes. This in turn leads both the student and the teacher to believe the student is unable to succeed. For example, a student who has a low perception of his or her capability to perform a certain task begins the task with negativity and pessimism. In believing he or she cannot complete the task, the person is likely to apply less effort, experience anxiety that they interpret as another piece of evidence of being unable to complete the task (Bandura, 1994), and lose motivation to continue. What the teacher sees, is a lack of effort and an uncompleted task, and thus concludes the student is *unable* to complete the task. This failure may then in turn lead to even lower perception (Bandura, 1994) and the unfavourable cycle continues in a downward spiral. The flipside of the unfavourable loop is an upward, successful loop. Students with higher levels of self-efficacy see themselves as having the potential to be successful. This in turn leads them to achieve more, work harder, and not quit when met with challenges (Wolters and Rosenthal, 2000). Therefore, it is important for mathematics teachers to be cognizant of how students think and feel about their learning processes, as it is such an influential factor in their overall achievement. By what means can teachers determine how students feel about their own competence in mathematics? There are some tests that have been designed to help measure self-efficacy in mathematics. Betz and Hackett (1983) designed the Mathematics Self-Efficacy Scale (MSES), consisting of three subscales and a total of 52 items. Richardson and

Suinn (1972) designed an 18-item Mathematics Anxiety Rating Scale to measure student confidence in the capability to perform everyday mathematical tasks. If teachers were more accurately informed about students' anxious feelings, they may be better equipped to help minimize fears with appropriate activities. Similarly, for those students who feel confident about performing mathematical tasks, the informed teacher could introduce higher-level problem-solving tasks. In addition, the results from such testing could facilitate the seeking of counseling or give rise to the needed dialogue between the student and teacher for developing constructive strategies. Results to such tests help students become more aware of the impact that their feelings have on their learning of mathematics. This, in turn, helps them self-regulate their own thoughts and feelings when facing mathematical tasks.

If students' perceptions of their competence in mathematics plays such an important role in how they actually achieve in mathematics, then teachers should pay attention to it. The importance of self-efficacy is emphasized by Branden (1994):

> Of all the judgments we pass in life, none is more important than the judgment we pass on ourselves. That judgment impacts every moment and every aspect of our existence. Our self-evaluation is the basic context in which we act and react, choose our values, set our goals, meet the challenges that confront us. (p. 1)

Students' judgement of their competence in mathematics becomes a self-fulfilling prophecy. It influences the goals, the perseverance, and ultimately the career choices they make (Hackett, & Betz, 1989; Dick, & Rallis, 1991).

Prior Achievement

In examining prior achievement as a contributing factor to future success, it is imperative to determine what exactly is being considered as prior achievement in mathematics. When measuring mathematical achievement, the definition of mathematical proficiency lurks in the background. What then is mathematical proficiency? Is it mastering a set of skills, or is it being a creative thinker, or is it about mastering the mathematical language itself? Only after getting an idea of how proficiency is being measured, can we establish which students might have fallen into the "hole in the sidewalk" or "found another street." Essentially, we will examine the effects that prior achievement has on future achievement, negatively or positively.

Mathematical Proficiency

Lavine & Milgram (2006) claim that mathematical achievement involves two components: an academic part and a creative part. They designed a series of questions with each academic question requiring typical logic-based questions that had one path to reach one solution. For example, one of the items was "How many distinct three-digit numbers can one build out of three arbitrary digits (from 1 to 9), e.g., 2, 5 and 9? A digit may repeat itself inside the number" (p. 202). The creative questions were nonstandard and had more than one way to reach more than one solution. For example, an item in this category was:

> Try to arrive at the number 4, using precisely four times (not two times) the digit 4, which is an integer multiplication of the digit 2. Try to make the largest possible

> number of solutions that overall include all of the following arithmetic operations: addition, subtraction, multiplication, division, square root, factorial, and so on. In every solution separately, one need not use all the operations." (Lavine, 2006, p. 202).

Lavine and Milgram (2006) conducted a series of pre-tests assessing students' creative thinking and their IQ. The pre-testing on creative thinking predicted creative, but not academic competence in mathematics. The IQ testing predicted academic, but not creative thinking in mathematics. They found the creative thinking to be a stronger predictor of creative mathematical achievement than the IQ of academic mathematical competence. These findings are particularly significant for schools using testing as a means of measuring achievement for placement. If schools are not defining mathematical achievement as including a creative component, they may be overlooking a number of gifted mathematics students. In the consideration of a students' competence in applying mathematics in diverse contexts, creative thinking is essential. Applications of mathematics to design, engineering, environmental or even social complex problems do not fit with a definite right or wrong answer approach to mathematics. According to Lavine and Milgram (2006),

> unrecognized talent in mathematics is the failure of an adult to realize the potential mathematical abilities that he or she demonstrated in youth. With the rapid development of the mathematical and scientific challenges of the 21st century, the problem of unrecognized talent in mathematics has become intolerable both for the individual and the society. (p. 204)

This suggests that the creative aspects of mathematics are often overlooked in favour of the procedural aspects. What Lavine and Milgram (2006) recognize is that this creative thinking, which is often ignored, is the key ingredient to solve the complex problems in our modern world. While this may not pertain to a student pursuing an academic or professional mathematical career, it may apply to the majority of students who will study subjects that require the competence to apply mathematics. This clearly is seen in fields such as medicine, engineering, science, research, but just as important in fields such as those of social sciences, environmental sciences, and business.

Boaler's (1997) study reveals similar findings. The study involved examining two schools with similar populations of students (socioeconomic, cultural, and size) but with a marked difference in what the teachers at those schools consider constitutes mathematical competence; students in one school think of competence in mathematics as the mastery of recalling and using procedures, while the students in the other school view competence in mathematics as a creative, problem-solving capability. The students viewing mathematics as a series of algorithms were unable to answer questions they had not seen before with any success. The students who took the more creative approach were much more successful at solving new problems. Once more, schools need to be cautious when considering prior achievement as indicating future achievement. For example, a student that might well score high on an academic-based test by recalling pre-practiced problems may struggle to apply the very same concepts to a context-based problem. On the other hand, a student who may not place well on the academic-based test might have the competence to understand the very same mathematical principles and apply them to a problem in another field. The competence to use mathematics creatively is more practical in everyday life and the development of that competence will support students in their academic pursuits as well as in their careers later on. In fact, the National Council of Teachers of Mathematics (2004) called on the educational system to enable students "to compute fluently and to solve problems *creatively* and resourcefully" (p. 1).

Jones, Hopper, and Franz (2008) liken the learning of mathematics to the learning of a second language. They describe the frustration and anxiety about one's capability to do mathematics as the same as that evoked when learning to speak in a foreign language. Jones *et al.* (2008) continue to argue if learning mathematics is defined as being immersed into a foreign language than different instructional methods will result from this definition of mathematics. Looking at the learning of mathematics through the lens of ESL instructional methods links mathematics and literacy techniques in ways worth exploring.

The Program for International Student Assessment (PISA) defines mathematical literacy as:

> an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned, and reflective citizen (OECD 2006, p. 72).

The OECD (2006) argues that the development of mathematical literacy involves using mathematical knowledge in meaningful situations. The OECD (2006) stresses that literacy in the linguistic context involves the learning of vocabulary, alphabet, grammar, and phonetics, and that it takes humans to combine and to synthesise these various components into creative expressions in order to communicate in real world situations. In the same way, mathematics requires but cannot be reduced to algebra, symbols, terminology, numbers, and algorithms; it must be creatively synthesized in real world situations. McCrone, Dossey, & Lindquist (2008) organize PISA's assessment of literacy into the following six categories of competencies: reasoning and argumentation, communication, modeling, problem solving, presentation, and symbols and formalism (See Figure 3). These are the skills students need in order to turn a contextual problem into one that can be solved using mathematics.

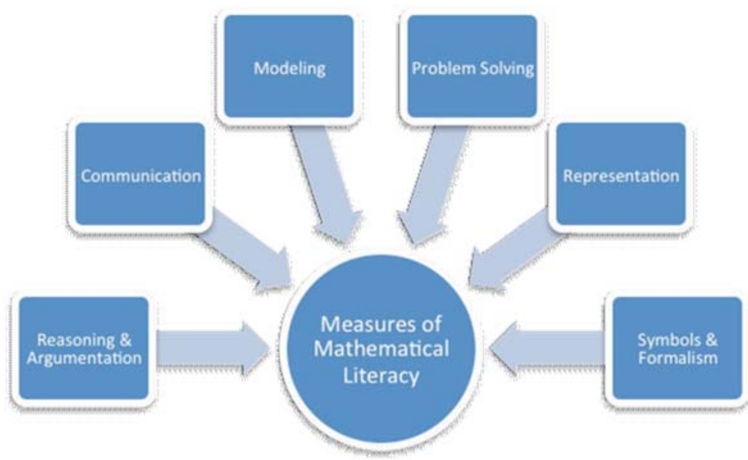


Figure 3. PISA's six assessments of mathematical literacy.

Effects of Prior Achievement

Prior achievement can indicate potential future achievement in a course, or it can also determine what course a student is placed in. Yates, (2002), as a result of a longitudinal study that collected data over a three-year period, found prior achievement to be a strong indicator of future achievement in mathematics. Therefore, the mathematical success in the past can be a predictor for future success. Furthermore, prior achievement can be the determinant of the course a student takes and the level at which they can achieve. For example, a student might be placed in an enriched or foundational class based on how he or she did in the past, and this confines him or her to a specific route in mathematical studies. In a certain sense, prior achievement can indicate or dictate success.

It is not just prior achievement but also interest that influences students' selection of mathematical routes. Köller, Baumert, and Schnabel (2001) found that there is no significant effect of interest on achievement, but that interest did impact course selection. Students with high interest were more likely to choose advanced courses, but within the course, higher interest did not result in higher achievement. However, students who were higher achievers did show higher interest and were more likely to self-regulate their own learning. Therefore, indirectly prior achievement in turn affects interest, which ultimately effects choice.

In Australia, educators use the terms *streaming* and *ability grouping* interchangeably, (Forgasz, 2010) indicating the constraint imposed by prior achievement and leaving little room for progress. Forgasz (2010) questions the justice of streaming or grouping students by ability. He wonders if this allows each student a second chance? Hemmings and Kay (2010) found that for year 10 mathematics students, it was mostly a case of *fait accompli*. There was a strong relationship in the achievement in mathematics in year 7 and the achievement in year 10 Mathematics. Prior achievement was found to be the strongest indicator, over interest and attitude, of future success. This emphasizes Forgasz's (2010) point of how the education system is not providing students with opportunities to improve on their past achievement level.

Husen (1960), during a Swedish education reform movement, examined the issue of lost talent. He noticed that students with a low socio-economic background or other challenges outside of school often displayed success later than other students. As some schools select students based on testing such as IQ tests, students who did not show signs of ability until later on were cut. Husen (1960) called this a "waste of talent through selection" (p.72). Essentially, the placement tests become a social selection rather than an achievement selection.

Prior achievement is a contributing factor towards future achievement in mathematics, whether positively or negatively. However, underlying this contributing factor is the subtle influence of the variations in defining of mathematical proficiency. If you define mathematics as a skill set then your measurement of proficiency is tied to the simple recall of mathematical facts. If you define mathematics as creative expression than you will measure competency in problem solving. If you define mathematics as a language than fluency is your indicator.

Conclusion

In this chapter, I presented an initial review of the factors that relevant experts and researchers have found to impact the achievement of incoming grade 10 mathematics students. While the range of factors is wide, I chose to focus on the effects of transitioning, self-efficacy, and prior achievement on students' accomplishment in mathematics. Students, as adolescents are undergoing many confusing and rapid changes and then are expected to adapt skilfully to the change in schools. Students are most anxious and concerned about social issues in their anticipation of the change of schools; yet, the reality is that after the transition to high school, the biggest areas of concerns become academic in nature. Critical to achieving mathematical success is self-efficacy, or the belief in one's competence. Helen Keller (1880-1968), who with her determination and achievement against overwhelming odds corroborates the results of the studies on the importance of self-efficacy: “No pessimist ever discovered the secrets of the stars, or sailed to an uncharted land, or opened a new heaven to the human spirit.” In examining prior achievement as a contributing factor, studies reveal that it is a strong indicator, and even can pre-determine the level of achievement a student can attain in school. The measurement of achievement levels is often dependent on the definition of mathematical proficiency, which studies claim vary. Students entering grade 10 mathematic face many challenges. However, with an increased awareness of their issues, the right tools, and focused strategies, teachers could help them more effectively in overcoming the obstacles.

Chapter 3: Methodology

Introduction

In the previous chapter, I presented an initial review of the literature on transitions, self-efficacy, and prior achievement as contributing factors that impact incoming grade 10 mathematics students. In particular, I examined these factors in light of the fact that the student is an adolescent experiencing anxieties and struggles during a period of transitioning. The studies provide reasons for the difficulties ranging from students' own belief in their competence to teachers' understanding of mathematical achievement. In this chapter, I describe the strategy I plan to follow in order to create a profile of the factors that will then allow me to make recommendations for change. As mentioned earlier, studies typically focus on one or two factors. For my study, I plan on providing a more comprehensive portrait of the issues, which will in turn provide more wide-ranging recommendations for improvement.

In what follows, I describe and explain the methodological choices I have made to achieve my research goals.

Research Strategy

John Locke (1632-1704), known for his influence on epistemology, said, "Reading furnishes the mind only with materials of knowledge; it is thinking that makes what we read ours." I choose to conduct secondary research in order to gather information offering diverse perspectives into students' experience. The insights provided by the results of the different studies will be valuable in constructing a profile of contributing factors that impact grade 10 students' achievement in mathematics. Having started this process with my initial review of the literature, I have *furnished the mind*, but now I need to *think* to make it *ours*. I use the word *ours* because I am endeavouring to make recommendations first to my family of schools, *our* six feeder (junior high) schools and *our* high school to help *our* students.

Secondary research has its strengths and its weaknesses (Punch, 2006). There are several advantages to using secondary data in order to answer research questions. The data can be obtained quickly and thus used quickly. The data is often of higher quality since it is collected using wider-ranging expertise and resources than could be offered by a single researcher. However, the data might be difficult to interpret when taken out of context. It is also more difficult to appreciate the limitations of a study the researcher did not participate in. In addition, the secondary data may only in part be useful to answer the research question the researcher aims to answer. I argue that social research, in general, has similar limitations. In other words, studies involving humans and human interactions are complex and contextual, making generalizations and conjectures difficult to infer, whether or not the research is primary or secondary. We do not, however, forsake knowledge because it is not perfect; we move forward with the hope of being enlightened.

I am going to frame my results in the form a thematic thread from a fairy tale. Plews, Breckenridge, Cambre (2010) found echoes of two fairy tales in their study of Mexican English teachers' experiences in Canada. Plews *et al.* (2010) portray teachers' experiences in the frame of *Cinderella* and *The Princess and the Pea*, paralleling the Mexican English teachers' stories to common folk tales. This is such powerful way to communicate, to relate the theme to that of a common story or tale. Polkinghorne (1995) on narrative configuration argues that narrative descriptions portray human activity as meaningful interactions in the world. He uses the word "narrative" to refer to texts that are thematically organized by a plot. Polkinghorne (1995) makes a compelling argument that the organized whole is greater than the sum of its parts; putting data together in a plot of storied segments may be superior to a list of generalizations. My desire to frame my findings in the form of a fairy tale is so that I can draw on the underlying message and parallel it with the emerging themes that I find in the literature review. By framing my recommendations within the message or the moral emphasized in common fairy tale, I am hypothesizing that it will have a greater impact on my reader. We live storied lives and can appreciate the power of a story; I plan on taking advantage of this to present the profile of the contributing factors and to make recommendations for improvement.

Procedure

I plan on extending the review of relevant literature on the three main contributing factors, transitions, self-efficacy, and prior achievement. I will first organize the extended literature review in the form of an annotated bibliography; this will constitute my data collection. The annotated bibliography (see figure 4) will include an analysis of the studies' manner of addressing the contributing factor impacting student achievement, the information about the participants involved, and the results. The contributing factors under examination in the studies is important, as I am profiling the factors and thus searching for common themes and links that show cohesiveness. The reason for considering the information regarding the participants involved in the studies is that age, country, size of the school, gender, and any other relevant information will inform the relevance and scope of the studies' results. Finally, the studies' results will serve to inform my recommendations.

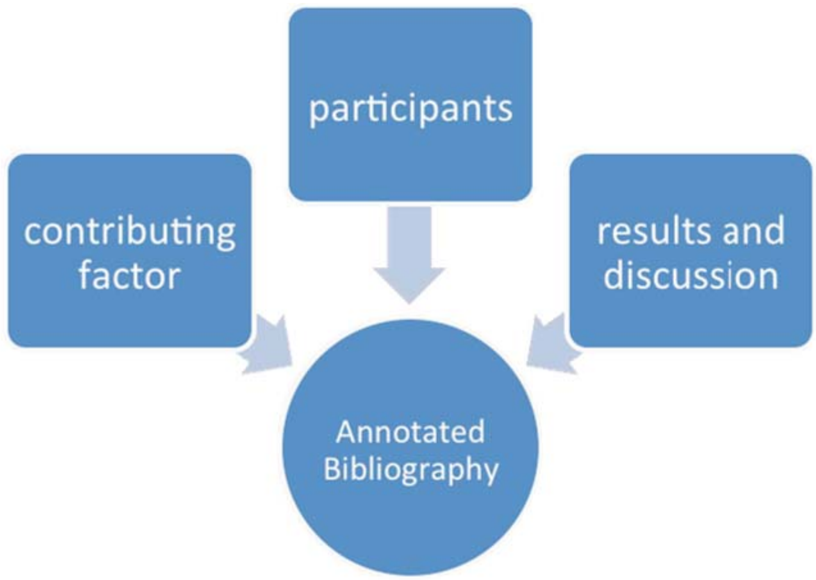


Figure 4. Annotated bibliography structure.

Once the annotated bibliography is completed, I will then be able to determine common themes that emerge regarding the contributing factors impacting the incoming grade 10 students' achievement in mathematics. The themes that emerge will serve to create a profile of factors. In creating the profile of factors, I will be aiming for comprehensiveness, coherence, clarity, and relevance. To engage my audience in applying my findings to their educational practices, I will present those findings within the framework of a classical fairy tale. I am choosing to channel the power of a fairy tale because as Zipes (2008) contends, "fairy tales are uncanny because they tell us what we need and they unsettle us by showing what we lack and how we might compensate for lack" (http://www. Artofstorytellingshow.com). The writer, in telling his tale leaves reality and invites the reader to do the same, in this make-believe, and therefore comfortable, world the reader can face a fundamental truth about himself without feeling threatened by the acknowledgment. Within the fantasy, the magic, struggle and conflict leads to enlightenment, resolution, and Utopia – the "happily ever after." The "once upon a time" anchors the fairy tale to reality by implying historicity and possible repeatability. Zipes (2008) echoes this in his reference to fantasies providing a "a conduit into social reality" (http://www. Artofstorytellingshow.com).

Finally, for each element of the profile, I will make recommendations that are specific and tangible. My goal is to enable the application of the recommendations by including such things as resources, examples, and possibly, teacher ready materials and tools. Teachers should be able to go through my profile of factors, identify recommendations that are relevant to their students and use the materials provided to implement the necessary changes. To recap, from my annotated bibliography I will frame emerging themes in the framework of a fairy tale to create a profile of factors with recommendations and resources where possible (See figure 5).

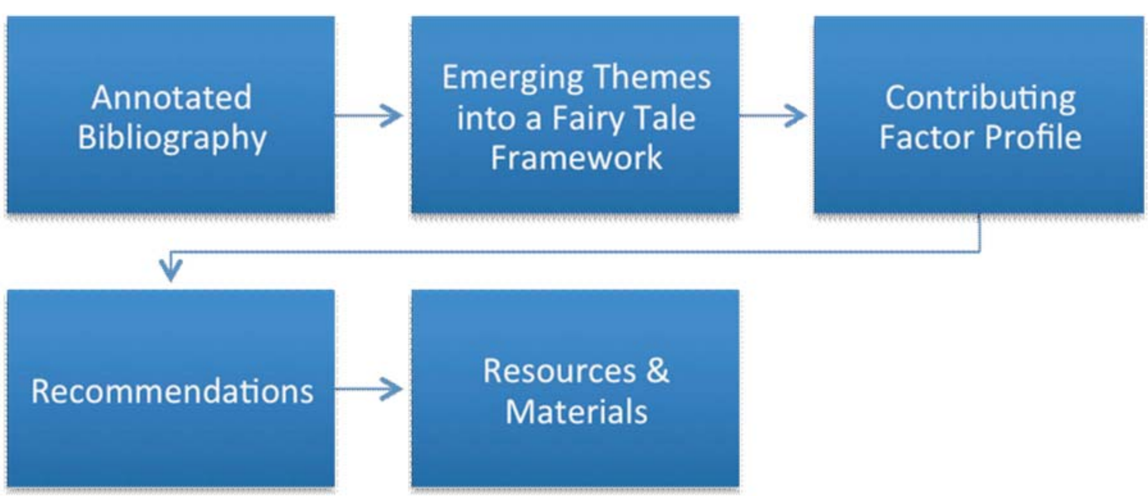


Figure 5. Methodology steps for proposed thesis.

Conclusion

The purpose of this chapter is to explain and defend my choice of secondary research to help answer my question - what are the factors impacting incoming grade 10 mathematics students? I want to answer this question in order to make recommendations for change.

Queenan (1987) in her paper about teachers as researchers warns:

> be forewarned: Being a teacher researcher will change you. You will listen to your students and teach a new curriculum: the one to which your listening leads you. At least that's what happened to me… (p.88)

My aim is that through the analysis of the broad array of research conducted regarding the factors that impact grade 10 students' achievement, I may organize and synthesize the studies in such a way as to make practical and useful recommendations, coupled with teacher resource materials, to improve student learning. In changing my own practice and the practice of other teachers, it will consequently open the door to enriching opportunities for students. I hope to underline my message through the engaging quality of a fairy tale. Even Albert Einstein (1879-1955) with his logic and reason for applied sciences said, "If you want your children to be intelligent, read them fairy tales. If you want them to be more intelligent, read them more fairy tales." There is something magical about fantasy that allows us to escape and yet, strangely, connects us with reality. I hope this allows my audience to hear the recommendations in a way that compels changes. My study fills a need that is lacking in the literature. Specifically, I plan on combining the various elements that play a role in the choices students make regarding their mathematical routes. By examining the relevant studies and compiling them in such a way as to provide a profile of the factors that serve to make recommendations, my study contributes to the understanding of student learning in high school mathematics.

Chapter 4: Data

Introduction

This chapter's purpose is to present the findings in the secondary data and to discuss them in accordance with a common theme. This chapter is not intended to be a literature review; rather it is an analysis of the literature with regards to a recurring, key theme as it pertains to the factors impacting incoming grade 10 mathematics students. As the data has already been collected and displayed in the primary sources, I am here analyzing and organising them in such a way as to provide support for the recommendations that will stem from my findings.

I focused on two main types of sources for the literature to support this thesis. First, I investigated contextual information in books and articles that help me support and defend the purpose as well as the methodology chosen for this study. Second, I examined peer-reviewed studies that covered a broad spectrum of relevant areas, populations, and research designs. I collected the secondary data in the form of an annotated bibliography in which I was primarily concerned with the *who*, the *what*, and the *where* of each study (see Figure 6). This annotated bibliography was then used as my "raw data" from which I created a table that organizes the sources in accordance with the contributing factor or with other relevant types of sources (see Figure 7).

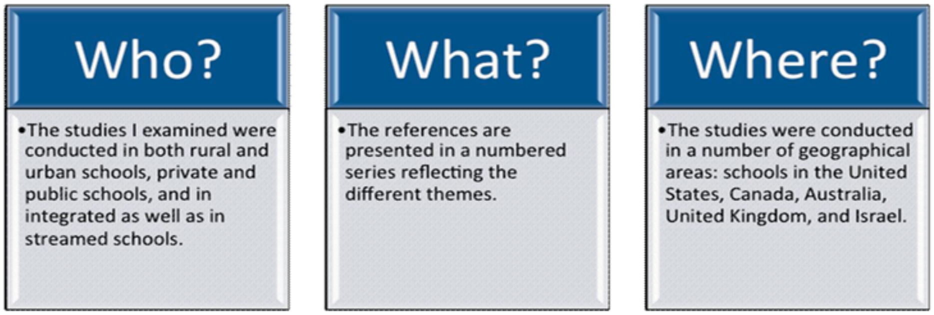


Figure 6. The *who*, *what* and *where* of the collected studies.

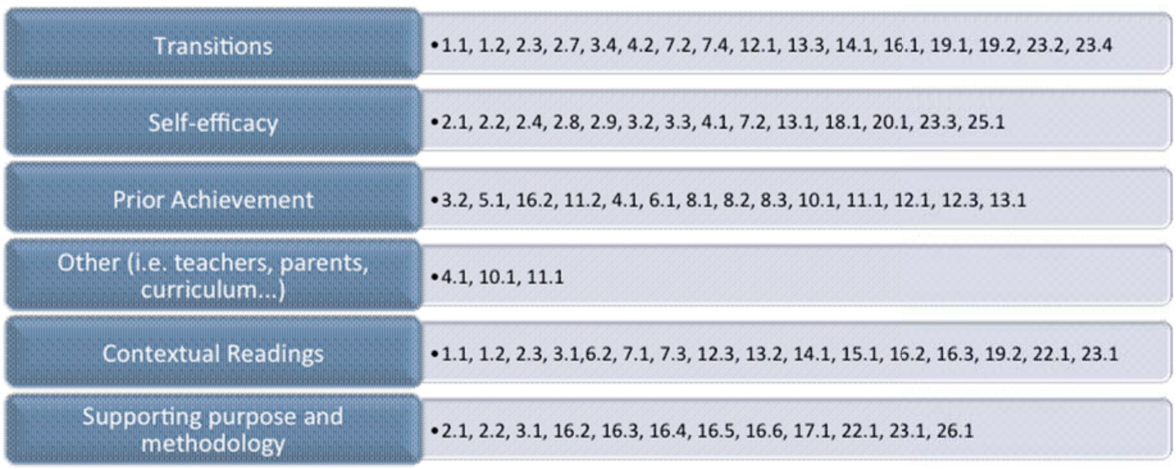


Figure 7. Organization of the studies and readings.

The chart in Figure 7 is organized in accordance with the contributing factors, which is how I organized the literature review. As explained in Chapter 3, the reason for choosing the three contributing factors impacting incoming grade 10 mathematics students--transitions, prior achievement, and self-efficacy--is primarily due to the feasibility of intervening effectively to redress their impact on students' learning.

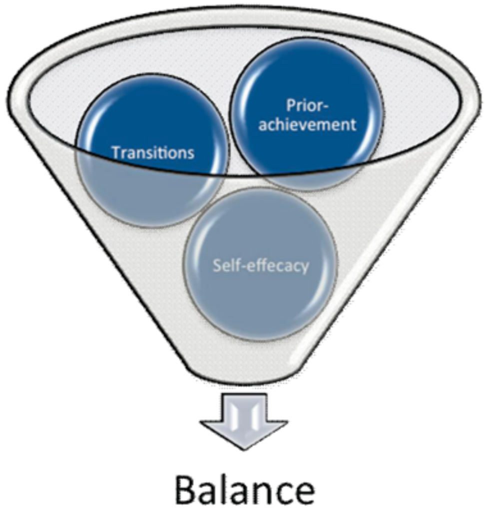


Figure 8. Emerging theme of Balance.

In analyzing the "data", it became evident that there is a shared theme of "balance" that emerges from the studies on the contributing factors (see Figure 8). It is worthy to note that some of the results of the emerging message are applicable to education in general and not confined only to mathematics.

Balance

"I called the New World into existence, to redress the balance of the Old." (George Canning, 1770-1827)

In the studies on the three main factors that I chose to focus on, there is a recurring underlying message of balance. It is this striving for balance, equilibrium, stability, or 'rightness' that became an apparent goal in the various studies. Consequently, it is "balance" that will serve as the connecting thread for the concluding recommendations I make for improving students' mathematical journey during a time when life and career altering decisions are made. In the next paragraphs, I explain the role of "balance" has with respect to each contributing factor.

Transitions & Balance

When students are transitioning to high school from junior high, it is a question of striking a balance between addressing the students' perceived social anxieties (Ashton, 2008) and the reality of their academic apprehension (Mizelle & Irvin, 2000). Ashton's (2008) study reveal that students making the move to high school are anxious about friends, fitting in, bullying, getting lost, and having new teachers; in other words, they are preoccupied with the social aspects of school. In particular, Wormeli (2011) stresses that the sense of belonging is one of the primary concerns for transitioning students. Mizelle and Irvin (2000) argue that while there is a need to provide adolescents with social supports, there is also a need to prepare them academically. Thus, striking a balance between the student's social and academic needs, not just focusing on one or the other, is essential during a time of transition.

During a transition, it is also important to be cognisant of the balance required between a healthy amount of change, which can result in personal growth, maturity, and confidence, and too much change, which can result in derailing a student in an unrecoverable way. Wormeli (2011) asks, "Where in our transition programs do we respond to these needs and strengths?" (p. 52). It is normal to want to focus on alleviating students' anxieties. However, in so doing, we neglect to challenge the students in such a way as to continue and further their education. Steinberg (2011), in exploring the adolescent brain, outlines that teenagers are primed for taking risks and indeed experience a "dopamine squirt" or a sensation of pleasure while doing so. In an effort to coddle them during a time of transition, it becomes easy to disregard an important part of a being a teenager – the enjoyment and pleasure of being challenged. Wormeli (2011) also argues that "without hope, a child will throw down the ball and go home" (p. 52). Thus, it is important that as we challenge them, we do not create a situation in which the student 'throws down the ball' in defeat; no learning will occur in absentia, either physically or mentally.

Self-efficacy & Balance

Branden (1994) claims that "historically, this is a new phenomenon, and so in a very real sense, self-efficacy is an idea whose time has come" (p.1). With regards to self-efficacy, there is a fine line between making the work sufficiently challenging so as to engage and to further learning and not making the work so challenging that the student loses the belief in his or her ability to accomplish the tasks. Bandura (2006) argues that there is no one-size-fits-all when it comes to self-efficacy; rather how self-efficacy is developed and experienced is varied and unique (note: this also makes it difficult to measure and to use as a predictor). Bandura reminds us that self-efficacy is concerned with "perceived" capacity not "actual" capacity. In order to reinforce a person's perceived capacity effectively, there is a need to do so with the awareness that there exists a fine line between the right level of support and the right level of challenge. Margolis and McCabe (2006) emphasize this need for balance recommending that teachers give students moderately challenging materials and tasks, which increase in difficulty with progress. Students who are gradually and appropriately challenged while experiencing success tend to develop a firm belief in their abilities.

Prior-achievement & Balance

In the case of prior achievement, the balance comes down to an issue of fairness. How do you help place students where they will be mathematically successful based on their previous achievement without limiting their opportunities? This is an area in mathematics education that perhaps most needs balance, as it is a question of equity and justice. Our education system often places students in mathematical courses based largely on their previous performance or achievement on standardized tests.

Throughout the studies, one cannot help but realize the existence of a glaring inconsistency in the conceptions of what exactly learning mathematics is all about. The definitions of mathematical achievement and assessment seem to be varied from one study to the next. This may be the result of the lack of consensus regarding the nature of mathematics itself. Gilfeather and del Regato (1999) highlight that mathematics is defined in many ways. Some define mathematics as the study of numbers and arithmetical operations, others as a collection of skills to answer the question *how many?* or *how much?* Others still think of mathematics as a specialized language dealing with shape and quantity. In addition to the dispute regarding the nature of mathematics, there has been a long-lasting debate about whether or not mathematics is invented or discovered (Livio, 2011) and this impacts the conception of how its learning is achieved. In ancient philosophy, there was a belief that learning was simply a process of recollection. Plato, in his Meno (n.d) shares a conversation between Meno and Socrates on mathematics in which they argue about how mathematics learning occurs:

SOCRATES: And that is the line which the learned call the diagonal. And if this is the proper name, then you, Meno's slave, are prepared to affirm that the double space is the square of the diagonal?

BOY: Certainly, Socrates.

SOCRATES: What do you say of him, Meno? Were not all these answers given out of his own head?

MENO: Yes, they were all his own.

SOCRATES: And yet, as we were just now saying, he did not know?

MENO: True.

SOCRATES: But still he had in him those notions of his—had he not?

(http://www.gutenberg.org/files/1643/1643-h/1643-h.htm)

Plato argues here that mathematics is applied knowledge and already exists within the student and just needs to be drawn out through guidance. He implies that achievement is building on knowledge and that success is based on moving forward, through obstacles, such that even wrong answers are part of the process of learning. This is emphasised when Socrates says, "He [the boy] did not know at first, and he does not know now, what is the side of a figure of eight feet" (http://www.gutenberg.org/files/1643/1643-h/1643-h.htm) and Socrates goes on to say "but now he wants to know and will add to his knowledge by inquiry."

The different definitions of mathematics necessarily lead to different conceptions of mathematical achievement. The different conceptions of mathematical achievement weaken the validity of the studies I reviewed as this creates an undercurrent of uncertainty running through the studies. For example, Yates (2002), in attempting to show the link between prior achievement in mathematics and their optimistic or pessimistic results, measures the students' achievement in mathematics with a tool called the Progressive Achievement Tests in Mathematics (PATMaths). PATMaths is composed of three timed multiple choice tests. The three tests measure knowledge of number, computation, measurement, money, statistics, spatial relations, and graphs. Therefore, Yate's (2002) results regarding prior achievement are based on a conception of mathematics achievement as being a set of acquired skills, which the student demonstrates by providing final correct answers. Multiple-choice tests do not facilitate the measurement of problem solving strategies or of creativity. Consequently, one should tread cautiously when comparing the results of different studies. These may not be comparable when the range in the definition of mathematical achievement might be so vast.

Boaler's (1997) study examines two schools with a marked difference in what the teachers at those schools consider to constitute mathematical achievement; one defines achievement as the easy recollection of facts and the mastery of skills, while the other views achievement as the logical and creative approach to solving a problem. The students did not meet with success when they were assessed on items that required understanding that differed from their school's view of achievement. For example, a student from one school would score high on a mathematical skills test by recalling pre-practiced problems, but struggled to apply the very same skills to a context-based problem. The student from the other school would struggle with the recall of facts and procedures, but would demonstrate an ability to use resourceful mathematical thinking to solve a problem in context. Consequently, while it is important that mathematical achievement and assessment reflect a balance of both skills and application, thus allowing students to demonstrate their mastery of both, how the teacher views mathematics is a significant variable in their success.

This issue raises the question of how we can possibly teach and assess achievement in mathematics when we do not have a clear understanding of what achievement is in mathematics. Perhaps even more worrisome is that in Nova Scotia, we stream students based on previous achievement and thus run the risk of curtailing their future opportunities. At the very least, such a significant variable as that of the definition given to mathematical achievement and how this is reflected in its assessment should be acknowledged in the school system.

Conclusion

After collecting and organizing the studies pertaining to the impact on grade 10 students in mathematics, the three focused contributing factors-- transitioning, self-efficacy, and prior achievement--all had a strong goal of seeking balance. There is a demand for a balance between students' social and academic anxieties. There is a plea for a balance between making the work challenging enough to gain engagement but not so challenging as to destroy a students' belief that the work is possible. There is a petition to balance the definition of mathematics that is being assessed making sure it is a fair representation of skill, creativity, and language. It is also important to balance the assessment so that it is reflective of all three components. Euripides (480-406 BC) is quoted as saying, "the best and safest thing is to keep a balance in your life, acknowledge the great powers around us and in us. If you can do that, and live that way, you are really a wise man." I have no doubt that we desire to be wise in mathematics education, yet we continue to let the pendulum swing all the way left or all the way right. For example, we devote all our energies to the skill side of mathematics with skill drills and rote learning. Realizing that skills are not enough, we abandon them and (hear the swish of the pendulum?) turn to conducting only investigations and attempting problem solving without known skills. It can exhausting for teachers to keep up with the pendulum swings. There is merit in both the left and the right approaches. Therefore, as the studies implicitly suggest, I strongly support that we actively seek balance.

Chapter 5: Results

Introduction

In this chapter, I present the recommendations that I propose based on the studies that I have examined and analyzed with the purpose of seeking clarification on the contributing factors impacting incoming grade 10 students' achievement in mathematics. As previously stated, in order to help convey these recommendations, I draw on the power of a fairy tale. Harvard Professor Maria Tatar in her introduction to *The Annotated Classic Fairy Tales* articulates that

> Fairy tales are up close and personal, telling us about the quest for romance and riches, for power and privilege, and, most important, for a way out of the woods back to the safety and security of home. Bringing myths down to earth and inflecting them in human rather than heroic terms, fairy tales put a familiar spin on the stories in the archive of our collective imagination. (Tatar, 2002, p.11)

Fairy tales become part of the fabric of our lives and result in the communication and actions of our existence. Tatar (2002) dares to suggest that if Beauty had not ended up with the Beast, or Red Riding had not made her way to Grandma's house, our lives would not be the same. Tatar (2002) further argues:

> By entering the world of fantasy and imagination, children and adults secure for themselves a safe space where fears can be confronted, mastered, and banished.

> Beyond that, the real magic of the fairy tale lies in it is ability to extract pleasure from pain. (p.12)

By channelling the *real magic* of a fairy tale, I can create a safe venue for the recommendations in which my readers will learn and extract the essential elements to implement change. Tatar, (2002) conveys my desire to communicate with my reader effectively when she says, "our deepest desires as well as our most profound anxieties enter the folkloric bloodstream and remain in it through stories that find favour with a community of listeners or readers." (p. 2)

This chapter starts with my reasons, or rationale, for choosing the fairy tale of Goldilocks and the Three Bears. My rationale is followed by my recommendations framed within this fairy tale. The framing is explained and the recommendations are supported by the studies on the contributing factors impacting grade 10 students' achievement in mathematics that have been explored in the previous chapters. The organization of this chapter is outlined in figure 9.

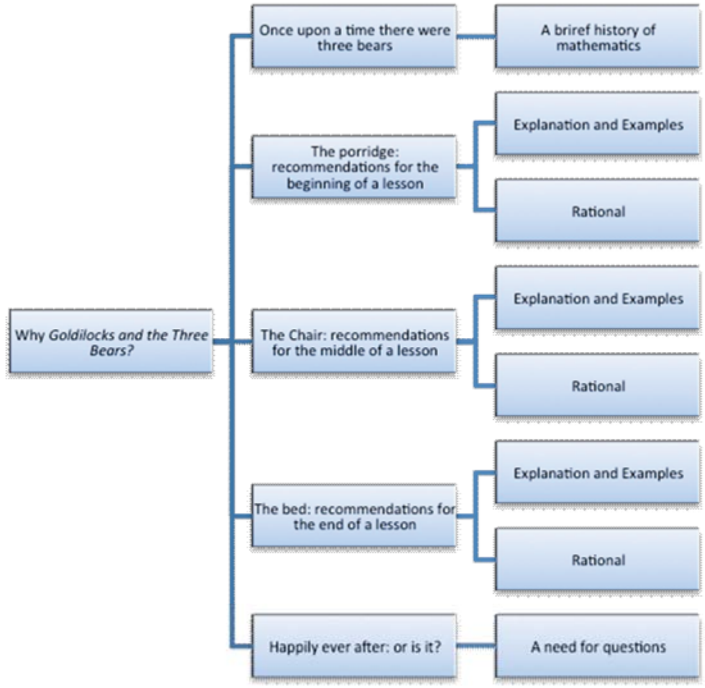


Figure 9. Chapter 5 outline

Fairy Tale: Goldilocks and the Three Bears

"In stories for children, we have come to desire and expect clear, positive moral direction, along with straightforward messages." (Tatar, 2002, p. 2)

I choose *Goldilocks and the Three Bears* as the story on which to hang my recommendations. This story was first narrated by the British poet Robert Southey (Tartar, 2002) and was first published in 1837 (see Appendix B for a version of "Goldilocks and the Three Bears"). My primary reason for choosing this fairy tale was the recurring message of "just right", or the need for balance that emerged from the studies on transitions, self-efficacy, and prior achievement in relation to grade 10 mathematics students. Although there is an interpretation of "Goldilocks as an intruder, a child unable to control herself when it comes to the possessions belonging to others" (Tatar, 2002, p. 251), it is more common to "frame the story today as a tale about finding what is "just right"" (Tatar, 2002 p. 251). In fact, *Goldilocks and the Three Bears* is so synonymous with "just right" that a situation in which a happy medium is reached is called the *Goldilocks Principle*. Goldilocks finds one bowl of porridge too hot, another too cold, and the third "just right", and people apply this tale to life situations in which this occurs. For example, astronomers sometimes apply the tale to a planet's capacity to withstand life, as we know it, with Venus being too hot and Mars being too cold, but Earth being just right. The *Goldilocks Principle* pertains to any situation in which only one particular range of conditions is agreeable. It is this repetitive "just right" or agreeable range of conditions that I aim to infuse in my recommendations.

A second reason for choosing the story of *Goldilocks and the Three Bears* is because Goldilocks herself may be representative of a typical student entering the high school mathematics' program. She is a stranger making the transition, the house is foreign to her, and she has to try things out in order to find her niche or perfect place. This is not unlike the student transitioning to high school, unsure of his or her place and needing time to adjust and to experiment. Also, Goldilocks does not enter the house and get her own bowl, chair, and bed; everything has already been used and tried, not one is new. This is the same in the mathematics program. Although the student needs to find his or her "just right", other students have gone before them. It is unfortunate that students do not fully appreciate or value that the porridge, chair, and bed is available for them in all the different sizes.

The porridge, chair, and bed take me to my third reason for choosing this fairy tale. I use these images as metaphors to represent the three parts of a mathematics lesson: before, during, and after. Tatar (2002) says:

> Whether we are aware of it or not, fairy tales have modeled behavioural codes and developmental paths, even as they provide us with terms for thinking about what happens in our world. Part of the power of these stories derives not just from the words but also from the images that accompany them. (Tatar, 2002, p. 11)

In framing my recommendations, I not only want to use the message of the fairy tale, but also all of the images that accompany it. The porridge is the food, or the partaking of material. The teacher prepares the porridge, or lesson, but the student must actively consume it or it will not have any benefit. The teacher wants to make the porridge appetizing yet sufficiently nutritious so that the student will have a desire to eat it and be nourished. The chair is the student's working through the lesson. This is "seat work" or the students taking what they have learned and practising and applying it. The bed represents the end of the lesson; to borrow from Shakespeare, "perchance to dream." The student has the chance to rest on what they have learned and move forward with it. They can build on this, in the same way that rest prepares you for the morrow.

Finally, I choose this fairy tale because it has no happily-ever-after; it just ends. We do not know what Goldilocks' fate is. As educators we may relate to this ending, as we do our best to prepare students and rarely hear of the happily-ever-after. Yet, as educators, this may not be the ending we wish to have; the organisation of our present education system leaves a question mark after graduation. Maybe it is time to begin writing a better ending.

Perhaps that will occur if we look at the once-upon-a-time and follow the magic of the "just right" and we can re-evaluate and question our ending. Let us begin.

After collecting my secondary data relevant to the three main factors--transitions, self-efficacy, and prior achievement--a strong message of the need for balance or "just right" emerged. My recommendations address the concerns raised with regards to the three main factors under each of the three parts of a lesson: before, during, and after (see figure 10).

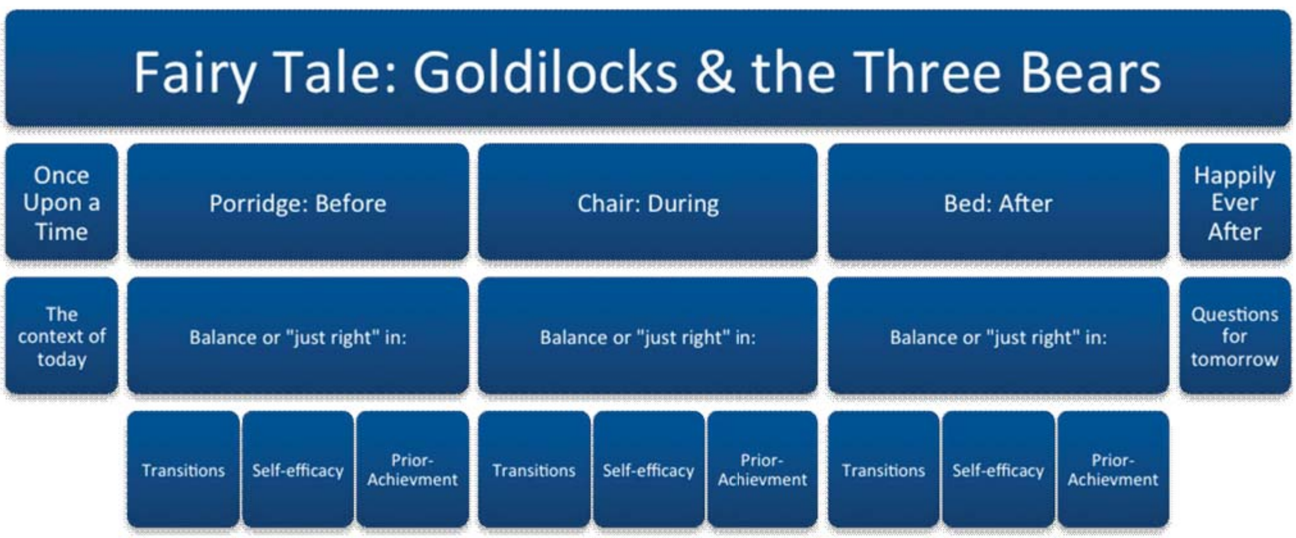


Figure 10. Presentation of recommendations

Once upon a time there were Three Bears

"I am sure that no subject loses more than mathematics by any attempt to dissociate it from its history." – J. W. L. Glaisher (1848-1928)

The education system is already in motion. My aim is not to rearrange the three bears' house or furniture; rather I aim to help Goldilocks, the student, find the perfect fit for her in an already established system. What does the inside of the house look like? Education in mathematics has changed throughout history and continues to evolve. It has gone from being tossed about by the philosophers such as Plato and Aristotle to being the foundation of the fathers of invention and innovation such as Albert Einstein. The history of mathematics is peppered with colourful anecdotes. There are wonderful tidbits and narratives about Pythagoras and Galois and Archimedes, and we could, if we desired, even indulge in a little gossip. The issue of mathematical achievement can be traced back to the ancient Orient where the emphasis was on the practical skills of arithmetic, measurement, and geometry. There is little trace of step-by-step solutions recorded in the ancient Orient. Mathematics was used punctually to solve real life problems, and thus there was no use for it to be recorded or preserved. However, the abacus, a calculating tool still used today, is thought to have originated in the Orient. The Babylonians, on the other hand, baked their records in clay, preserving their mathematical solutions to measurement problems. A Babylonian tablet, believed to be around 2300BC displays a table of squared numbers from 1to 60. There is also a preserved tablet showing the parts of the moons divided in 240 parts which demonstrates a geometric progression. We owe to the Babylonians our 24-hour day, divided into 60 minutes per hour, divided into 60 seconds per minute. No one can argue that the Egyptians, with their outstanding feat of building the pyramids, did not have a rudimental understanding of applied mathematics (Cajori, 1909). Indeed, Plato in *Phædrus* states that:

> At the Egyptian city of Naucratis there was a famous old god whose name was Theuth; the bird which is called the Ibis was sacred to him, and he was the inventor of many arts, such as arithmetic and calculation and geometry and astronomy and

draughts and dice, but his great discovery was the use of letters. (http://www.britannica.com/EBchecked/topic/454884/Phaedrus)

The Egyptians recorded their mathematical solutions on papyrus and thus demonstrated a basic understanding of fractions and a thorough mastery of geometry pertaining to farmland. The Egyptians lacked a comprehensive symbol system, which also stumped the Greeks. Around the seventh century BC, the Greeks and the Egyptians began to trade knowledge. Thales, Pythagoras, Plato, Democritus, all visited the land of the pyramids. Through this communication, the Greeks made significant progress in mathematics with Thales, Pythagoras and his followers articulating formal proofs and paving the way for Euclid and Archimedes. The Romans, on the other hand, differed greatly from the Greeks in that they showed very little interest in mathematics. They resorted to ancient, primitive mathematical methods when it was required, counting by pounding nails into a wall. The Roman numeral system was developed using this nailing technique. Then we enter the middle ages. During this period great advancements were made by the Hindus. The mathematics they developed differed from that of the Greeks in that their interest in mathematics was more arithmetical than geometrical. The Hindus' biggest contribution is the positional symbolism for representing numbers, which is referred to as the Hindu-Arabic notation. It was only sometime later that the Zero made its mark on the world with its essential and practical implications. Around the ninth century, mathematics progressed in India, with tables and instruments being perfected by astronomers (Cajori, 1909).

In the 9th century, the term "algorithm" and its implications emerge. During the next few centuries a lot of translation of the ancient math took it forward across Europe. In the early 1200's, Leonardo Fibonacci, a talented Italian mathematics arrives on the stage. At that time, the intellectual climate of Europe was changing. The Middle Ages were coming to a close and the dawning of the Modern World was on the horizon. Very exciting was the introduction of logarithms by John Napier in the early 17th century, greatly reducing laborious calculations. The seventeenth and eighteenth centuries laid the foundations of much of the mathematics as known today. The discovery of the analytic geometry by Descartes, the contributions to the theory of numbers by Fermat, to geometry and to mathematical physics by Pascal, and the discovery of the differential calculus by Newton and Leibniz, all contributed to make the seventeenth century a flurry of activity. Euler and the Bernoulli, d'Alembert, Lagrange, Laplace, Lambert bring us into the nineteenth century with the spread of mathematical knowledge, and the opening of extensive fields for applied mathematics. Today, especially influential has been the establishment of scientific schools and journals and university chairs in mathematics.

The history continues, evolves, regroups, and connects back as it goes. As educators, there is a need to recognize *the once upon a time* of mathematical achievements in order to continue the story with a respect for its evolution from its past to the future. The balance between pure and applied mathematics is very relevant in our time and it is essential that students be given the choice of what is *just right* for them.

In light of my findings regarding the factors that are impacting grade 10 students in mathematics, I am proposing the following recommendations. These recommendations are not meant to change the mathematical education system, or to be revolutionary in any way. Rather, they are small changes teachers can make that will put into practise what we know about transitioning, self-efficacy, and prior achievement in relation to what is *just right* for students. In making the recommendations, consideration was given to the busy schedule of teachers. They are thus intended to be strategies the teachers can smoothly integrate into their everyday practise without a considerable amount of preparation or disruption. The recommendations are sub-categorized in accordance with the three stages of a lesson--before, during, and after---which are represented by the porridge, chair, and bed. Each sub-category starts with a brief explanation of the relevance of the metaphor followed by the recommendations. Each recommendation begins with a description, followed by examples or resources where applicable and the rationale with respect to the contributing factors (refer to figure 10 for full details of the organisation).

Porridge: Introducing the lesson

"So first she tasted the porridge of the Great Huge Bear, and that was too hot. And then she tasted the porridge of the Middle-sized Bear, and that was too cold. And then she went to the porridge of the Little Small Wee Bear, and tasted that: and that was neither too hot nor too cold, but just right; and she liked it so well, that she ate it all up."

The Porridge is the *food for thought*, or the introduction to the lesson. Just as Goldilocks, when she found what was *just right* for her, "liked it so well, that she ate it all up" teachers want students to enjoy the mathematics and partake in it with enthusiasm. The recommendations that follow aim to facilitate the delivery of a mathematical lesson that may be the start of a new unit, or be a sub-unit. The three recommendations proposed for the beginning of a lesson involve: a *Skills survey*, taking of an inventory of what relevant skills students should have; an *opening kicker*, starting with a problem that connects students with what they know to what they will learn in an engaging and enlightening way; and, finally, *There is an app for that*, connecting the mathematical concepts and tools to relevant applications.

Skills survey: checking for tools

"The Universe is a grand book which cannot be read until one first learns to comprehend the language and become familiar with the characters in which it is composed. It is written in the language of mathematics." Galileo (1564-1642)

Before starting a lesson, it would be prudent to take an inventory of the skills required to participate in activities and to appreciate the mathematics that will be learned. A skills survey is exactly what the title suggests, a survey of the students' skills prior to the lesson. To help clarify this recommendation an example is provided. Prentice Hall's ExamView 6.2 Test Bank (2009) CD-ROM is a good resource for developing such a skills survey. For example, in this resource there are such questions as:

QUESTION: Find 10^2.

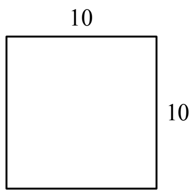
a. 12	c. 40
b. 100	d. 20

Work here:

ANSWER: b

Use a model.

Multiply the length by the width of a square.



$10^2 = 100$

	Feedback
A	To square a number, multiply the number by itself.
B	Correct!
C	To square a number, multiply the number by itself.
D	Use a model to help you.

Outcome addressed: power | square

While this tool does not respect a genuine balance between applied and pure mathematics, it does provide an opportunity to identify strengths and weaknesses in the students' skills. Developing such a skill survey must be used with the intent to help students, and not to be used as a placement or streaming tool. The students' achievement should be measured with the aim to provide students with an opportunity to identify areas of weakness that need improvement, and identify areas of strength that improve their self-efficacy about their skills. With the skills identified and measured, the groundwork is set to move forward and to use those skills in application. Lavine and Milgram (2006) argue that creative thinking, which is often overlooked, is essential in solving the problems in our modern world. Yet, it is difficult to approach a problem creatively without the necessary tools and skills. Such a skill survey should help the students and the teacher take an inventory of individual skills. The skills survey should be administered in such a way as to be as informative as possible.

The skills survey should be in multiple-choice format with instructions to show work. Multiple-choice format is favoured here so as not to overburden teachers. The multiple-choice questions should include the common errors students make as possible answers. A feedback key should also be provided to indicate the common errors connected with choosing an incorrect response. This is to facilitate conversation with the students after the skills survey and to prompt them to seek support when necessary. Students should be asked to show their work in addition to choosing a response so that more appropriate and focused feedback can be given.

The next recommendation for the porridge, or feeding the students the material, is to choose a problem that links what students know with what they will learn in an engaging and meaningful way.

An opening kicker: linking the past, the present, and the future

When beginning a lesson, the teacher should present a problem that uses some knowledge and experience that students have already acquired through an exploratory method of discovering. In reviewing the history of mathematics, mathematical discovery was often driven by necessities such as farming, construction, or business. In other words, mathematics was invented in order to solve practical problems or to understand better real-world phenomena. Consequently, an *opening kicker* should involve contexts that mirror this approach.

As an example of an *opening kicker*, consider the case of starting a lesson on number sequences and series. The teacher could start the lesson with the students making necklaces and bracelets. To the student, this is a hands-on activity that is both creative and concrete. The activity involves students in designing a pattern. The following website has instructions on the two types of knots, and how to add beads: *Make a Hemp Necklace or Jewelry* at http://www.beadage.net/hemp/index.shtml. Students must then match a number sequence to their design and write the instructions for constructing their necklace or bracelet. The discussion that ensues from sharing students' work and instructions allows to highlight types of number sequences and their mathematical implications.

Köller, Baumert, and Schnabel (2001) found that engagement in mathematics had a direct impact on course selection. Students with high interest and who were more engaged were more likely to choose advanced courses in mathematics. These students were also more likely to self-regulate their learning. Therefore, it is wise to begin a lesson by engaging the students' interest as it might result in better mathematics choices and more self-regulated learning. Mathematical problems are often more interesting when they combine the mathematics with other areas of learning. When students ask "when will I ever use this in my life?" it is most likely that they are not engaged in the activity and that they fail to see the relevance of the problem to solve. However, the reality is that educators cannot answer that question for every student since they do not know what their students' will or will not require down the road. Indeed, most students do not know themselves what mathematics their lives will necessitate. If the *opening kickers* demonstrate clear connections between mathematics and real-world contexts in authentic ways, then there is a better chance of engaging students. Indeed, by starting with a problem that involves areas of human experience and knowledge, students are more likely to get a glimpse of a future possibility of the uses for what they are about to learn.

The debate over how people learn dates back at least to the Greek philosophers. René Descartes (1596 – 1650) revived the Platonic concept of innate knowledge. Descartes believed that ideas existed within human beings prior to experience. John Locke (1632 - 1704) believed that education should arrange experiences for students and that discipline could be developed through the study of mathematics. Jean-Jacques Rousseau (1712 – 1778) was a pioneer in suggesting that education should be shaped to the child and that learners learn through lived experiences. Dewey extends this to say mistakes and difficulties are necessary for learning.[1] Piaget and others further developed the ideas of cognition and learning.

By starting with an engaging problem that ties foundational knowledge with new knowledge, the student is able to advance his or her learning. However, more importantly, by starting with a problem that the student can tackle because he or she is already familiar with parts of it helps build self-belief and thus motivates her or him to tackle the newer material. The goal is to strike a balance between the familiar and the unfamiliar in a way that is meaningful and interesting. To maintain this balance throughout an entire mathematics lesson is not always possible or requisite, since there are times when learning new concepts or skills take precedence. Nevertheless, to do so at the beginning of a lesson

---

[1] See for example:

Dewey, John. (2011). *Democracy and Education*. LaVergne, TN: Simon & Brown.

Locke, John, John W. Yolton, & Jean S. Yolton (1989). *Some Thoughts concerning Education*. Oxford: Clarendon.

Rousseau, Jean-Jacques, & Barbara Foxley. (1974). *Emile*. London: Dent.

with an *opening kicker* sets the tone and allows the possibility of balance. Starting lessons with a collection of appropriate opening problems is invaluable to promoting learning mathematics with confidence and contextual relevance.

The next recommendation attempts to put what students are about to learn into contextual relevancy. What better way to communicate to students the power of language than to use language that they are familiar with? In this age of technological availability, the popular expression *"there is an app for that"* reflects the current tendency to search for a downloadable application to help individuals solve all sorts of problems. That is the reason I chose this title for the next sub-section of the "Porridge" recommendations that addresses another approach to beginning a lesson in a meaningful way.

There is an app for that: download it

At the beginning of a lesson, teachers could hold a brainstorming session to examine why (the *application*) students might want to learn the mathematics they are about to *download*. This brainstorming session should continue throughout the lesson and be added to as students think of more *apps* to *download*. For example, consider the topic of trigonometry. The students might suggest a list of applications such as architecture, construction, acoustics, surveying, engineering, education, optometry, etc… After students have exhausted all the applications they can think of, the teacher may ask each of them to bring one more application the following day. Once students have suggested applications during the brainstorming discussion and added more the next day from their individual searches, the teacher should add a few more in order to demonstrate to the students that there are even more applications. In so doing, the teacher emphasizes to students that mathematical education offers opportunities to a world of possibilities of which we cannot even name them all. It is now time for the lesson or the downloading, having established that there *is an app for that*.

Dick & Rallis (1991), in examining students' career choices, observed that students who followed career paths that directly involved mathematics admitted receiving encouragement from teachers while in high school. In other words, teachers do have a direct or an indirect power over students' choices. Teachers who promote and open the window to the world of applications for mathematics play a more significant role in students' decisions to learn a subject that is powerful and impacting.

The three recommendations proposed for "porridge" are made in the context of the studies collected and explored. They are intended to put into practise what we know about the factors impacting student's mathematical achievement in order to help enrich the student's learning at the beginning of the lesson. The next three recommendations are intended to continue to support students during the lesson as they practise and explore mathematical concepts.

The Chair: During the lesson

"Then Goldilocks sat down in the chair of the Great Huge Bear, and that was too hard for her. And then she sat down in the chair of the Middle-sized Bear, and that was too soft for her. And then she sat down in the chair of the Little Small Wee Bear, and that was neither too hard nor too soft, but just right."

The chair is the learning that occurs during the lesson, or the seatwork. Just as

Goldilocks, when she found what was *just right* for her, not *too hard*, teachers should strive for students to be challenged while ascertaining that the material is at an appropriate level. The recommendations to follow are to facilitate the learning, or owning, of a mathematical lesson. There are three recommendations proposed: *big notes*, which encourages students to synthesize important information; *pair quizzes*, which facilitates assessment *for* learning; and *pick a face*, which is a method for letting students identify how they are feeling during the process of learning mathematics.

Big notes: displaying the key points

Once students have learned a new concept or method that is part of a whole unit, teachers could have the students make a *big note* in which they highlight key ideas, definitions, or examples on chart paper and display them on the wall in a coherent manner. Aside from the obvious benefits of synthesizing what the key parts of the lesson are, the display is a reminder that acts as a reference throughout the lesson.

Nordell (2009) found that students who transition from high school to university were found lacking the necessary skills to study effectively. Nordell's (2009) study reveals that students who attended a study skills workshop performed significantly better on the second exam than the students who did not. He acknowledges that this may have been in large part due to higher achievers also being students who chose to attend the sessions. However, even the high achievers did much better on the second exam than on their first exam. Students who did not attend the sessions did worse on the second exam than the first--indicating that it was not a natural progression to do better on the second exam. There is thus a clear need for teachers to help students learn how to study. The making of the *big* *notes* by the whole class models how to synthesize important information, an important study skill. The displaying of the *big notes* emphasises the importance of continual reviewing and revisiting in the learning of mathematics, another significant study skill.

The *big notes* activity also demonstrates how to take useful and worthwhile notes during a mathematics lesson. The next recommendation, *pair quizzes*, emphasizes and defends in more detail the need for scaffolding and learning with the help of others.

Pair Quizzes: learning happens together

Giving pairs of students the opportunity to work on quizzes together allows for genuine team work. How the pairs are chosen can be randomly or through purposeful selection. Allowing students to work together on a quiz does require a different structure and will improve with practise. For example, one approach might be to allow the students to formulate questions for their partners and then each work independently to respond. This approach involves student collaboration while still allowing the teacher to assess individual strengths and weaknesses.

People learn by building on prior knowledge. It is therefore important to design educational activities that call on students' prior knowledge. However, if students do not have useful prior knowledge, then there is a strong risk that they will build new knowledge on a shaky or faulty foundation. In other words, students are more likely to develop misconceptions if their prior knowledge is not sound. Consequently, scaffolding is important in assisting the process of mathematical creativity. To clarify my understanding of “scaffolding” I refer to Vygotsky’s (1978) concept of the zone of proximal development. According to Vygotsky (1978), learning occurs in this zone. In the leftmost zone, the child cannot complete a task, even with help. For example, a student may have great difficulty adding large numbers. In the zone of proximal development, the student can complete the task with support. For example, a teacher may provide Dienes blocks (base ten blocks) to help the student add large numbers. Finally, experiences in the zone of proximal development assists the student to move to the zone of independent performance–the student can add large numbers without supports. The zone of proximal development in the case of the pair quizzes can be seeking assistance from a peer. The collaboration is the middle stage which positions pair quizzes nicely in the stage during learning. In so doing, the assessment is now not just for evaluation but is a part of the learning process.

Working in groups, with a specific structure and distinct purpose, is a teacher’s way of providing a controlled social setting. Students in grade 10 are very anxious about the social aspects of school (Ashton, 2008). By providing a definite setting in which students can interact, teachers are assisting in appropriate social relations that support students’ academic needs (Vygotsky,1978).

It is important for teachers to lead students toward the outer zone in which they are able to work independently. Accomplishing such a feat is often scary and frustrating for students in mathematics. Teachers are not necessarily aware of how the student feels, as there is usually no outlet in a mathematics classroom for expressing such feelings. The next recommendation, *picking a face*, is offered in order to help provide a simple and quick way to allow students the chance to identify how they feel, while at the same time indicating to the teacher their anxieties or confidence.

Pick a face: turning the frown upside down

Picking a face to indicate how a student feels is a technique that is familiar to students since it is used in social media. For example, on Facebook an individual can indicate their like or dislike of a particular picture. They are able to send an instant message in smiley faces expressing how they feel without using words at all. As this is part of their world already, choosing a face that expresses how they feel--confident, bored, frustrated, or just okay--about a topic has several benefits. Spier (2010), using art-therapy, found that during transitioning times, those students who identified their anxieties were better able to cope with them. Students who named their anxieties not only employed coping mechanisms but also subsequently displayed less inappropriate behaviour and demonstrated an overall improvement in confidence. Therefore, in having students identify how they feel about a specific mathematical topic is the first step in devising a strategy for coping with the problem. If the student is feeling confident about a specific topic, then naming that confidence develops his or her self-efficacy, which in turn improves overall achievement (Tanner & Jones, 2003). By choosing a face that expresses how the student feels about a certain task, the student is also informing the teacher in a simple and brief manner how he or she is feeling. Knowing how the students feel provides clues to the teacher on how to proceed. As Bandura (1994) claims, a person who believes he or she cannot complete a task will consequently apply less effort and also experience a level of stress that will be interpreted as another indicator of inability. In other words, the negative perception on the student's part creates a vicious and unfavourable cycle, which the teacher should endeavour to break. In knowing how the student feels, the teacher may be less likely to interpret the lack of effort and the uncompleted task as the student's lack of ability; rather, the teacher may then understand that the student may simply be caught in a negative loop and thus intervene accordingly. For example, should several students indicate a feeling of frustration it would then be an indication to the teacher to provide alternate examples, extra assistance, or perhaps simply take break and try something else and then come back to the problem at hand. It might be that a student needs to be gently guided into identifying the problem. In the business world there is a technique called *The 5 Whys*, in which a person is asked "why?" continually until one gets at the root of the problem. This technique could be used with students who are facing challenges negatively. Wolters and Rosenthal (2000) discuss the flip side of this negative spiral, stating that higher levels of self-efficacy result in the student taking potential ability with increased work habits to actuality and meeting with success. The teacher should therefore double his or her efforts to turn the frown upside down to this end.

The three recommendations provided above are intended to alleviate mathematics anxiety and increase self-efficacy by building on prior knowledge, by attending to students' need for social interactions, and by smoothing the transition into learning mathematics. The next three recommendations are intended to enable and to promote preservation of learned material at the end of a lesson, represented by the bed in *Goldilocks and the Three Bears*, so students may take newly acquired knowledge and skills forward to the next level.

The Bed: After the lesson

"And first she lay down upon the bed of the Great Huge Bear; but that was too high at the head for her. And next she lay down upon the bed of the Middle-sized Bear, and that was too high at the foot for her. And then she lay down upon the bed of the Little Small Wee Bear; and that was neither too high at the head nor at the foot, but just right."

The bed is the resting, or the appreciation for the learning that occurred. It is the *perchance to dream* part of the lesson. This is a very important time of the lesson as it is this knowledge that will become previous knowledge for the new lesson. The link between previous knowledge and mathematical achievement has been explored in the previous chapters. The three recommendations I propose to help conclude a lesson are: the *wall of praise*, an activity in which students questions, work, and examples are displayed; the *party hats*, an approach to making final assessments a celebration of what students know and have accomplished; and, *I have, I want, I got*, an activity in which students can rehearse and practise newly acquired mathematical language.

Wall of praise: work, words, or wonderings

Displaying students' successes on a commemorating wall is a way to showcase achievement. For example, an interesting question a student has posed, a clever deduction of another student, or a clever solution yet another has found would be acknowledged and displayed on the wall along with the student's name. Creating a wall of praise demonstrates Bandura's (1994) four sources for the development of high self-efficacy. Banduras (1994) had identified four sources: experiences of mastery, vicarious experiences, social persuasion, and emotive state. Each of these sources has to be *just right* in order to improve a student's self-efficacy. First, the wall of praise shows mastery in that the student has a visual representation of previous success. Each time the student is praised for exemplary practices in mathematics there is a reminder on the wall. The absence of student names on the wall is not as powerful a reminder of failure since it is not blatantly apparent. Bandura (1994) cautions that should a student be successful, or not, at completing a task, he or she will then believe that to be, or not to be, successful in completing similar tasks in the future. In light of this, it is important for the teacher to emphasize the success without drawing attention to failure. In addition, when people observe others similar to themselves meet with success on a task, it is easier for them to believe they will also succeed on the task. Students, in seeing their peer's names along with their productions on the wall, are reminded that others, similar to them, have met with success, thus increasing their belief in their own success. Furthermore, the wall of praise reflects the teachers' confidence that exemplary work is possible, adding to the students' confidence in achieving success. Finally, since a person's own emotional state often dictates self-efficacy, people interpret stress and moods as levels of competency. The wall of praise is celebratory, and as such, promotes positive feelings.

The wall of praise also promotes a balanced concept of mathematics. It promotes creativity and mastery of skills. It is reflective of questioning and inquiry. While it commemorates the beauty and poetry that is mathematics, it also pays homage to skill and adroitness.

Party hats: Celebrating what you know

For a final assessment, whatever form the assessment may take, teachers should ensure that it is a celebration of acquired knowledge and understanding, not doomsday. This requires that the teacher acknowledge each student individually for what they have achieved, it is not a tool for comparisons among students. It is important then to talk about the approaching celebration positively and to prepare for a party. Then, in order to make it a true celebration, teachers should arrive at the assessment with party hats that say *celebrating what we know*! with balloons or treats. Assessments should be an occasion for students to shine--to be an opportunity to participate in a *show and tell,* if you will. The teacher can impact students' attitude towards assessment by approaching it with a festive air and thus help lower anxiety.

Yates (2002) claim that optimism and pessimism play a significant role in students' current achievement levels as well as in their achievement levels three years later. The major relationship between negativity or pessimism and lower achievement is an issue that mathematics teachers have to address. As the negativity from previous years carries forward, it becomes difficult for high school mathematics teachers to change students' attitudes this late in the game. Making end of unit assessments occasions for celebration is a simple and manageable way to improve the overall attitude to one that is positive and commending.

One of Bandura's (1994) four sources of high self-efficacy is social persuasion. When teachers plan for the assessment to be a time of rejoicing, they communicate to the student the message that they are anticipating success. The celebration of learning in effect could improve the students' belief in their own ability to do well.

For students, who have just left junior high and who are beginning high school, this celebration might also have a bridging effect between the child they were and the adult they are becoming. Benson (2009), in working with gifted students, found that although students do not ask for much do require much. In particular, his study revealed that when students are transitioning, "the 'pizza and party' are important as they provide a celebration for the previous year and help the students relax before asking the questions they are anxious about" (p. 33). The celebration is a social activity and thus provides a link that helps close the gap created by the transition from junior high to high school.

In mathematics, the concepts and skills students learn form the foundation for further success in mathematics. Prior achievement is thus a prominent indicator of future success. Therefore, it is important that teachers end a unit, or a lesson, or a topic in such a way as to provide students with the chance to own their new knowledge to take forward. The next recommendation *I have, I want: I got* aims to reach that goal.

I have, I want: I got!

"*Ideas cannot be given but in their minutely appropriate words.*" *William Blake (1757-1827)*

I have, I want, I got!, is a game with rules, definitions, and symbols. Ahead of time, the teacher highlights the new words, definitions, and symbols the students have been introduced to in the lesson and the teacher designs a loop of *I have and I want*. The *I have* and *I want* statements are written on slips of paper and put into a jar, so they are all mixed up. The students each draw a slip of paper and the game begins. It is important that it is a complete loop or the game will not include the whole class. For example, for a group of three students the teacher might create the following loop:

First student's paper:

I have the measurement of the radius. (This will be the *I want* of the final student.)

I want the name of the triangle that has three equal sides.

Second student's paper:

I have an equilateral triangle.

I want to know the name of the symbol used for the measure of an angle.

Third student's paper:

I have the angle theta.

I want to know the distance from the centre to the circumference of a circle.

The game can be replayed by putting the papers back into the jar and re-selecting. By playing *I have, I want* it reiterates what students have learned but more importantly it is acknowledging that mathematics is like learning a new language and requires rehearsal and review. Jones *et al.* (2008) argue that ESL instructional methods may be effective in the teaching of mathematics. In order for educators to achieve a balanced view of learning mathematics, it is important to acknowledge that learning mathematics and learning a language are quite similar. Therefore, students should be given ample opportunity to practise and to use mathematical language. The following example demonstrates the power of considering mathematical language as a significant component to learning mathematical concepts and skills:

> If a straight line be cut at random, the square on the whole is equal to the squares on the segments and twice the rectangle contained by the segments. (Euclid, *Elements*, II.4, 300 B.C.)

Or expressed in symbol notation and much easier to understand:

$(a + b)^2 = a^2 + b^2 + 2ab$

Teachers and students need to appreciate that there is a component to mathematics that involves literacy skills. Perhaps we should offer MSL, or mathematics as a second language course such as that offered by Professor Warren Esty at Montana University. He offers a core course for the mathematics program at Montana University and is called *The Language of Mathematics*. Professor Warren Esty has also written a text to go with the course and one of his students responded with the following recommendation, "I strongly believe that every math major and high-school student should have a copy of your text! I agree with your articles; Mathematics is a language on its own and it is essential that students understand the true meaning of the subject." (http://augustusmath.hypermart.net/)

The above three recommendations are intended to conclude a lesson in a celebratory way and to make the learning personal as well as a matter of pride. Altogether, the nine recommendations are proposed in order to help Goldilocks in the bear's house, or to help support the student in the current mathematics program. In *Goldilocks and the Three Bears*, Goldilocks runs off into the forest and we do not know what happens to her. It is the same with students; teachers rarely get to see how their lives unfold and whether or not they are okay. The next section of this chapter, *Happily-ever-after?* addresses some questions that have arisen in this thesis about the ending of high school students' mathematical journey. I make no attempt to answer the questions; rather I pose them in order to ascertain that they do not get dropped and to ensure that thinking of possible responses continues.

Happily-ever-after?

"A man may fulfill the object of his existence by asking a question he cannot answer, and attempting a task he cannot achieve." Oliver Wendell Holmes (1841-1935)

My purpose in this section is not to ask questions, although I pose a few, but to stress the *need* to ask questions. If we want to seek a *happily ever after* it will mean taking the risk and asking the questions--questions that might have political implications. It might mean asking questions that require change and work. It might mean asking questions that admit error and fault. It might mean getting out of the comfort zone and truly searching for what is *just right*. We will never find solutions to unasked questions; there would be no need.

In examining the mathematical education system, there is reason to raise questions--questions that are difficult to answer for diverse reasons. Some questions are difficult to answer because to answer them would require change, and change is uncomfortable. Other questions are difficult to answer because our ignorance is vast and our knowledge limited. Yet, still other questions remain difficult because we lack resources such as time and money to explore the answer. Regardless of the causes for not being able to answer the questions, it is important to pose them and to continue to search for plausible answers. For example, such questions as: What exactly is mathematics? How should mathematics be assessed? What really is assessment? What is achievement? Who measures or defines success? Should we be streaming students? Is our current curriculum serving society's needs? We need to push our thinking further and thus move towards the improvement in the teaching and learning of mathematics. Goldilocks disappears at the end of the story, and we do not know what happens to her. I wonder if anybody asked?

Conclusion

They say that *third time's a charm,* and I certainly hope that is as true as it is in the story of *Goldilocks and the Three Bears.* I have respected groupings of three throughout the thesis. In reviewing relevant literature, three contributing factors: transitions, self-efficacy, and prior achievement, were examined in the context of incoming grade 10 mathematics students. In an effort to promote best practises, I chose *Goldilocks and the Three Bears* to reveal the need for balance, getting it *just right*, in mathematics education. This led me to propose three recommendations for each of the three parts of a lesson (before, during, and after) for which a summary is represented in Figure 11.

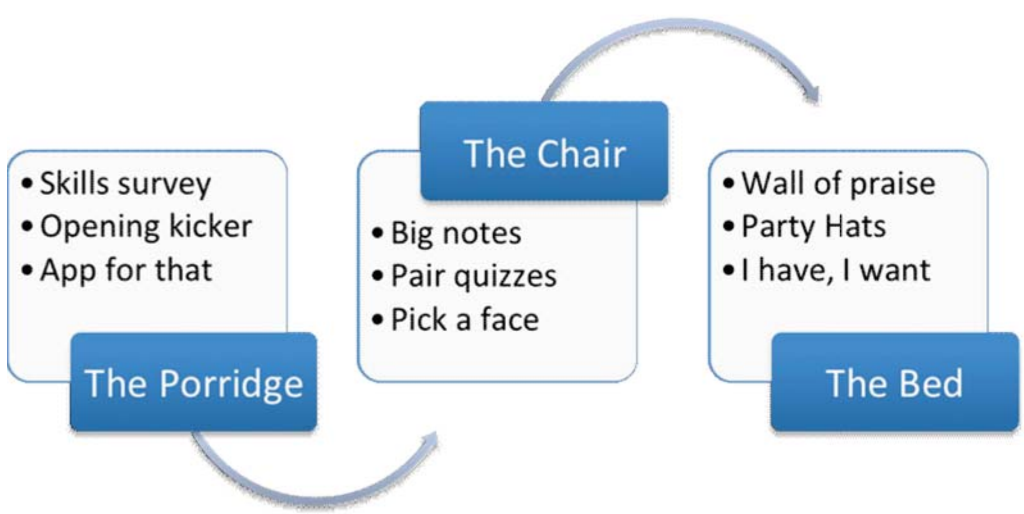


Figure 11. Summary of recommendations

The number three holds a significance that I intend in my study. First, the number three has a spiritual connotation in the trinity or triad, in body, mind, and spirit. This reiterates the need for balance when responsible for educating students, and serves as a reminder to remember the whole student. Second, "three" is representative of time periods: past, present, and future. It is important to balance a respect for the history of past mathematics developments with relevance to the present and anticipation for the future. Third, and here I stop, to complete my deference for the number three, we are reminded that there is often too much or too little and a perfect middle or "*just right*".

Conclusion to the Thesis

This study originated from a very real and pertinent need in the school system. Students are falling in the "hole in the sidewalk" in grade 10 mathematics. They make a decision, which has long-term effects on the rest of their lives and they do so at a time when they are faced with many challenges. My study aims to gain insight into *the contributing factors that impact incoming grade 10 students' achievement in mathematics.* What I discovered in my initial review of the literature is that studies limited their examination of the issue by focusing on a single contributing factor. Yet, there are numerous difficulties to face all at once, and these challenge grade 10 students during a time when they are expected to be planning their future; a future in which opportunities are dependent on their high school mathematical achievements. In particular, incoming grade 10 students are experiencing multiple transitions involving biological, social, and academic changes. Students' belief in their mathematical competence plays a major role in the decisions they make. Students' achievement in the past is also perceived as a strong indicator of future achievement. Each of these contributing factors involves underlying assumptions regarding the definition of proficiency in mathematics. Also underlying these contributing factors is the fact that these students are adolescents.

My aim at creating a profile of contributing factors through secondary research was to arrive at a common theme that could motivate recommendations on how to address the needs of the students who are affected. In examining studies on transitions, self-efficacy, and prior achievement as the factors impacting student success, there was an underlying theme of a need for balance in the education of mathematics that emerged. There is a need for balance in addressing students' anxieties and their academic needs while they transition to high school mathematics. There is a need to balance the difficulty of the work so as to challenge students yet not destroy their level self-efficacy in approaching mathematical tasks. There is a need for balance in how we assess and define mathematics, combining the literacy, creativity, and skill components of mathematics.

To accentuate the core message of balance or "*just right*" that is needed in mathematical education, the ensuing recommendations were encased in the common fairy tale: *Goldilocks and the Three Bears*. From Cinderella, Hansel and Gretel, to Snow White, for every hero's quest and slayed dragon in a fairy tale there is a story for everyone, narrating the problems encountered on the journey of life. We relate and identify to the common folklore's struggles and resolutions; we are given a reality of hope and promise in the pages of fantasy and make-believe. The ultimate goal is that my study provides grade 10 students improved support so that they may make the best choices possible for their future.

As Albert Einstein (1879-1955) is quoted as saying, "life is like riding a bicycle. To keep your balance you must keep moving." In mathematics education, it is not possible to put education on hold, reflect, and then restart the mathematics education once a perfect balance has been achieved. Like the bicycle, the momentum of current movement is what will help us adjust and find balance. Therefore, my recommendations are these adjustments that will help teachers so that educators may continue to move forward and to search for that smooth ride.

Goldilocks and the Three Bears was the vehicle used to drive home the message of balance in the mathematical education system. From the *once upon a time,* capturing the history of mathematics, to the *happily-ever-after*, questioning the future of mathematics as there is a need for getting mathematics education *just right* for students. To help with this intricate but very real need for balance, there were three recommendations made for the three parts of a lesson: before, during, and after, that is metaphorically represented by the porridge, the chair, and the bed.

The three recommendations for the “porridge” are: a *Skills survey*, taking an account of what pertinent skills students should have; an *Opening kicker*, beginning with a problem that joins what students know to what they will learn in an appealing and illuminating way; and, *There is an app for that*, connecting the mathematics to meaningful applications. The three recommendations for the “chair” are: *Big notes*, which helps students to synthesize important information; *Pair quizzes*, which supports assessment *for* learning; and *Pick a face*, which is a method for enabling students to identify how they are feeling about the mathematics they are learning. The three recommendations for the “bed” are: the *Wall of praise*, an activity in which students’ works are displayed; the *Party hats*, a tactic to make final assessments a celebration of what students know; and, *I have, I want,* an activity in which students can practise newly developed mathematical language.

Each one of the recommendations takes into account some aspect of what the studies revealed about grade 10 students and the effects of transitioning, their self-efficacy or belief in their mathematical ability, and prior achievement on their mathematical achievement. The recommendations are not laborious or time-consuming; rather they are meant to be seamlessly adapted by teachers in a mathematics classroom in order to bring out the best in students and increase their opportunity for learning and appreciating the beauty, the practicality, and the language that is mathematics.

The aim of this study was to use secondary research to build a more comprehensive profile of the factors impacting grade 10 mathematics students that could then lead to recommendations. This study is not without its limitations, as one would anticipate when dealing with the intricacy of human relations and the many shaping forces involved in each action. Most of the studies examining contributing factors that affect student success were conducted outside of Canada, thus limiting but not restricting the applicability of the studies to Canadian schools. Schools transition students at different times making it difficult to determine whether or not age is also an influencing factor. Yet, despite the variation of the studies, the message was clear and reflective in the recommendations made.

In undertaking the study in such a way as to gather data that combines more than one influence, it made the scope quite broad and at times it was difficult to stay focused and not follow the myriad of tangents that emerged. This is not to say that these tangents do not have value; rather, it was more a case of opening Pandora's box. However, I would be remiss not to mention a few of these tangents now for further exploration and consideration. Almost all of the studies I examined involved mathematical achievement, yet it was rare to find it defined. What exactly is mathematical achievement? What should it be? And how does one measure it? Such questions raise the more fundamental ones of what exactly is mathematics or assessment for that matter? I briefly overviewed the history of mathematics, and wonder if in the current educational system, we are truly respecting where we have come from and how mathematics has evolved and changed. I also referred to mathematics as a language and this, in itself, is a topic worth exploration as it has implications for the teaching and learning of mathematics. Throughout the thesis, I was careful to avoid the use of the word "ability" in relation to mathematics. There is a whole area of research devoted to mathematics ability and disability, but the current study focused on the typical incoming grade 10 student. In addressing "success" we take a very prosaic view of success as a passing grade or some benchmark set by a standardized test. Yet, is a grade of 50% proof of success? Or is success being able (there is that word able again) to appreciate or use mathematics? What really is success in relation to mathematics? I suggest that if we wish to move towards a *happily-ever-after* in mathematics education, we need to continue to ponder these questions further.

References

Alspaugh, J.W. (1998). Achievement loss associated with the transition to middle school and high school. *The Journal of Educational* Research*, 92(1),* 20-25.

Ashton, R. (2008). Improving the transfer to secondary school: How every child's voice can matter. *Support for Learning, 23(4),* 176-182.

Bandura, A. (1994). Self-efficacy. In V.S. Ramachaudran (Ed.), *Encyclopedia of human behavior 4,* 71-81.

Bandura, A. (2006). Self-efficacy beliefs of adolescents. *Information Age Publishing,* 307-337.

Benson, M. B. (2009). Gifted middle school students' transition to high school: how one teacher helped his students feel less anxious. *Gifted Child Today, 32(2),* 29-33.

Betz, N. E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Psychology, 23(3),* 329-345.

Bingolbali, E. (2011). Multiple solutions to problem in mathematics teaching: Do teachers really value them? *Australian Journal of Teacher Education, 36(1),* 18-31.

Boaler, J., (1997). Open and closed mathematics approaches: student experiences and understandings, *Journal for Research in Mathematics Education*, Vol. 29, No. 1, pp. 41-62

Branden, N. (1994, May 14). Our urgent need for self-esteem. *Nathaniel Branden.* May 19, 2011 from http://www.nathanielbranden.com/ess/ess12.html

Cajori, F. (1909). *A history of mathematics*. New York: The Macmillan Company, London: Macmillan &Co., Ltd.

Carmichael, C., Callingham, R., Hay, I., & Watson, J. (2010). Statistical literacy in the middle school: The relationship between interest, self-efficacy and prior mathematics achievement. *Australian Journal of Educational & Developmental Psychology, 10,* 83-93.

Casky, M.M. (2010) A longitudinal investigation of young adolescents' self-concepts in the middle grades. *Research in Middle Level Education, 33(10),* 1-13.

Casky, M.M, & Malaspina D., & Rimm-Kaufman S.E. (2008). Early predictors of school performance declines at school transition points. *Research in Middle Level Education, 31(9),* 1-16.

Dick, T.P., & Rallis, S.R. (1991). Factors and influences on high school students' career choices. *Journal for Research in Mathematics Education, 22 (4)*, 281- 292.

Esty, W.W. (2011, June 16). Language of mathematics. *Language of Mathematics*. Retried August 13, 2011 from http://augustusmath.hypermart.net/

Forgasz, H., (2010). Streaming for mathematics in years 7-1- in victoria: An issue of equity? *Mathematics Education Research Journal, 22(1),* 57-90.

Funderstanding (2008). *About learning.* Retrived August 8, 2011 from http://www.funderstanding.com/content/about-learning

Gascoigne, B. (2001). History of Mathematics. *HistoryWorld*. Retrieved August 3, 2011, from http://www.historyworld.net/wrldhis/PlainTextHistories.asp?historyid=aa50

Gilfeather, M, & del Regato, J. (1999). Mathematics defined. *Mathematics Experience-Based Approached Introduction*. July 29, 2011 from http://www.mathpentath.org

Grolnick, W.S., Kurowski, C.O., Dunlap, K.G., & Hevey, C. (2000). Parental resources and the transition to junior high. *Journal of Research on Adolescence, 10* (4), 465–488.

Hackett, G., & Betz, N.E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. *Journal for Research in Mathematics Education. 20(3),* 261-273.

Hemmings, B., & Kay, R. (2010). Prior achievement, effort, and mathematics attitude as predictors of current achievement. *The Australian Educational Researcher, 37(2),* 41-58.

Husen, T. (1960). Loss of talent in selective school systems: the case of Sweden. *Comparative Education Review, 4(10),* 70-74.

Jones, B.R., Hopper, P.F., & Franz, D. P. (2008). Mathematics: A second language. *Mathematics Teacher, 102(4),* 307-312.

Köller, O., & Baumert, J., & Schnabel, K. (2001). es interest matter? The relationship between academic interest and achievement in mathematics. *Journal for Research in Mathematics Education, 32(5)*, 448- 470.

Letrello, T.M., & Miles, D.D. (2003). The transition form middle school to high school: Students with and without learning disabilities. The Clearing House, 76 (4), 212-214.

Livine, N.L., Milgram, R.M. (2006) Academic versus creative abilities in mathematics: Two components of the same construct? *Creativity Research Journal, 18(2)*, 199-212.

Livio, M. (2011). Why math works. *Scientific American Magazine (33),* 80-85.

Mathematics (2011). In Wikipedia. Retrieved July 27, 2011, from http://en.wikipedia.org/wiki/Definitions_of_mathematics

Margolis, H., &McCabe, P.P. (2006). Improving sefl-efficacy and motivation: What to do, what to say. *Intervention in School and Clinic, 41(4),* 218-227.

McCrone, S.M., Dossey, J.A., & Lindquist, M. M. (2008). Learning about students' mathematical literacy from PISA 2003. *Mathematics Teacher, 102(1),* 34-39

Mizelle, N.B., & Irvin, J.L. (2000). Transition from middle school into high school. *Middle School Journal, 31(5),* 1-8.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

Nelson, P. (1993). There's a hole in my sidewalk. *Beyond Words Publishing, Inc, Hillsboro, Oregon.*

Nordell, S.E. (2009). Learning how to learn: A model for teaching students learning strategies. *Bioscene, 35(1),* 35-42.

Organization for Economic Cooperation and Development (OECD). *Assessing Scientific, Reading, and Mathematical Literacy A Framework for PISA 2006.*

Palmer, A., & Rodger, S. (2009). Mindfulness, stress, and coping among university students. *Canadian Journal of Counseling, 43(3),* 198-212.

Plato. (n.d.). Meno, by Plato . Project Gutenberg - free ebooks online download for iPad, Kindle, Nook, Android, iPhone, iPod Touch, Sony Reader. Retrieved June 25, 2011, from http://www.gutenberg.org/files/1643/1643-h/1643-h.htm

Plato (2011). Phaedrus. In *Encyclopædia Britannica*. Retrieved August 8, 2011 from http://www.britannica.com/EBchecked/topic/454884/Phaedrus

Plews, J.L, & Breckenridge, Y., & Cambre, M.C. (2010). Mexican English teachers' experiences of international professional development in Canada: A narrative analysis. *Electron Journal of Foreign Language Teachering, 7(1),* 5-20.

Polkinghorne, D. E. (1995). Narrative configuration in qualitative analysis. *Qualitative Studies in Education, 8(1),* 5-23.

Punch, K.F. (2006). Developing effective research proposals, second edition. *SAGE Publications Ltd, London.*

Queenan, M. (1987). Classroom inquiry: Teachers as researchers? *The English Journal, 76(4)*, 88-90.

Richardson, F. C. & Suinn, R. M. (1972). The mathematics anxiety rating scale: Psychometric data. *Journal of Counseling Psychology, 19(6),* 551-554.

Spier, E., (2010). Group art therapy with eighth-grade students transitioning to high school. *Art Therapy Journal of the American Art Therapy Association, 27(2),* 75-83.

Steinberg, L. (2011) Demystifying the adolescent brain. *Educational Leadership, 68(7)*, 42-46.

Tanner, H. & Jones, S. (2003). Self-efficacy in mathematics and students' use of self-regulated learning strategies during assessment events. In N.A. Pateman, B.J. Dougherty, & J.T. Zilliox, *Proceedings of the 27th Conference of the International Group for the Psychology of Mathematics Education* (PME27), pp. 275-82. Honolulu, HI.

Vygotsky, L. (1978). Interaction between learning and development. In Vygotsky, L. (1978), *Interaction between learning and development: Mind and society*. (pp 79-91). Cambridge, MA: Harvard University Press.

Walton, R. (2003, September 23). The story of the three bears. *Rickwalton.com.* July 21, 2011 from http://www. Rickwalton.com/folktale/bryant52.htm

Wolfram MathWorld (2011). Wolfram MathWorld. *Mathematics.* July 27, 2011 from http://mathworld.wolfram.com/Mathematics.html

Wolters, C. A. & Rosenthal, H. (2000). The relation between students' motivational beliefs and their use of motivational regulation strategies. *International Journal of Education Research, 33*(7-8), 801-820.

Wormeli, R. (2011) Movin' up to the middle. *Educational Leadership, 68(7),* 48-53.

Yates, S. M. (2002). The influence of optimism and pessimism on student achievement in mathematics. *Mathematics Education Research Journal 14*(1), 4-15.

Zipes, J. (2008, June 29). Are fairy tales still useful to children? *The Art of Storytelling Show.* May 23, 2011 from http://www. Artofstorytellingshow.com

Figures

Appendix A: List of Studies

This is a list of the studies and readings used as data or as context. The list was numbered with the first number being the letter of the alphabet and then the second number being the article number within the specific letter of the alphabet. The list was numbered this way so that adding a new article would require the minimum amount of changing numbers.

1.1	Alspaugh, J.W. (1998). Achievement loss associated with the transition to middle school and high school. *The Journal of Educational Research, 92(1),* 20-25.
1.2	Ashton, R. (2008). Improving the transfer to secondary school: How every child's voice can matter. *Support for Learning, 23(4),* 176-182.
2.1	Bandura, A. (1994). Self-efficacy. In V.S. Ramachaudran (Ed.), *Encyclopedia of human behaviour 4,* 71-81.
2.2	Bandura, A. (2006). Self-efficacy beliefs of adolescents. *Information Age Publishing,* 307-337.
2.3	Benson, M. B. (2009). Gifted middle school students' transition to high school: how one teacher helped his students feel less anxious. *Gifted Child Today, 32(2),* 29-33.
2.4	Betz, N. E., & Hackett, G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Psychology, 23(3),* 329-345.
2.5	Bingolbali, E. (2011). Multiple solutions to problem in mathematics teaching: Do teachers really value them? *Australian Journal of Teacher Education, 36(1),* 18-31.
2.6	Boaler, J., (1997). Open and closed mathematics approaches: student experiences and understandings, *Journal for Research in Mathematics Education*, Vol. 29, No. 1, pp. 41-62.
2.7	Brady, P., & Allingham, P. (2010). Pathways to university: The "victory lap" phenomenon in Ontario. Canadian Journal of Education Administration and Policy, 113, 1-26.
2.8	Branden, N. (1994, May 14). Our urgent need for self-esteem. *Nathaniel Branden.* May 19, 2011 from http://www.nathanielbranden.com/ess/ess12.html
3.1	Cajori, F. (1909). *A history of mathematics*. New York: The Macmillan Company, London: Macmillan &Co., Ltd.

3.2	Carmichael, C., Callingham, R., Hay, I., & Watson, J. (2010). Statistical literacy in the middle school: The relationship between interest, self-efficacy and prior mathematics achievement. *Australian Journal of Educational & Developmental Psychology, 10,* 83-93.
3.3	Casky, M.M. (2010) A longitudinal investigation of young adolescents' self-concepts in the middle grades. *Research in Middle Level Education, 33(10),* 1-13.
3.4	Casky, M.M, & Malaspina D., & Rimm-Kaufman S.E. (2008). Early predictors of school performance declines at school transition points. *Research in Middle Level Education, 31(9),* 1-16.
4.1	Dick, T.P., & Rallis, S.R. (1991). Factors and influences on high school students' career choices. *Journal for Research in Mathematics Education, 22 (4)*, 281- 292.
4.2	Donnison, S., Itter, D. (2010). Community service learning: A first year transition tool for teacher education. Australian Journal of Teacher Education, 35(3), 59-74.
5.1	Esty, W.W. (2011, June 16). Language of mathematics. *Language of Mathematics*. Retried August 13, 2011 from http://augustusmath.hypermart.net/
6.1	Forgasz, H., (2010).Streaming for mathematics in years 7-1- in victoria: An issue of equity? *Mathematics Education Research Journal, 22(1),* 57-90.
6.2	Funderstanding (2008). *About learning.* Retrived August 8, 2011 from http://www.funderstanding.com/content/about-learning
7.1	Gascoigne, B. (2001). History of Mathematics. *HistoryWorld*. Retrieved August 3, 2011, from http://www.historyworld.net/wrldhis/PlainTextHistories.asp?historyid=aa50
7.2	Giallo, R., & Treyvaud, K., & Matthews J., Kienhuis M. (2010). Making the transition to primary school: An evaluation of a transition program for parents. Australian Journal of Educational & Developmental Psychology, 10, 1-17.
7.3	Gilfeather, M, & del Regato, J. (1999). Mathematics defined. *Mathematics Experience-Based Approached Introduction*. July 29, 2011 from http://www.mathpentath.org
7.4	Grolnick, W.S., Kurowski, C.O., Dunlap, K.G., & Hevey, C. (2000). Parental resources and the transition to junior high. *Journal of Research on Adolescence, 10* (4), 465–488.
8.1	Hackett, G., & Betz, N.E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. *Journal for Research in Mathematics Education. 20(3),* 261-273.
8.2	Hemmings, B., & Kay, R. (2010). Prior achievement, effort, and mathematics attitude as predictors of current achievement. *The Australian Educational Researcher, 37(2),* 41-58.
8.3	Husen, T. (1960). Loss of talent in selective school systems: the case of Sweden. *Comparative Education Review, 4(10),* 70-74.
10.1	Jones, B.R., Hopper, P.F., & Franz, D. P. (2008). Mathematics: A second language. *Mathematics Teacher, 102(4),* 307-312.
11.1	Köller, O., & Baumert, J., & Schnabel, K. (2001). Does interest matter? The relationship between academic interest and achievement in mathematics. *Journal for Research in Mathematics Education, 32(5)*, 448- 470.

12.1	Letrello, T.M., & Miles, D.D. (2003). The transition form middle school to high school: Students with and without learning disabilities. The Clearing House, 76 (4), 212-214.
12.2	Livine, N.L., Milgram, R.M. (2006) Academic versus creative abilities in mathematics: Two components of the same construct? *Creativity Research Journal, 18(2),* 199-212.
12.3	Livio, M. (2011). Why math works. *Scientific American Magazine (33),* 80-85.
13.1	Margolis, H., &McCabe, P.P. (2006). Improving self-efficacy and motivation: What to do, what to say. *Intervention in School and Clinic, 41(4),* 218-227.
13.2	McCrone, S.M., Dossey, J.A., & Lindquist, M. M. (2008). Learning about students' mathematical literacy from PISA 2003. *Mathematics Teacher, 102(1),* 34-39.
13.3	Mizelle, N.B., & Irvin, J.L. (2000). Transition from middle school into high school. *Middle School Journal, 31(5),* 1-8.
14.1	National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.
14.1	Nordell, S.E. (2009). Learning how to learn: A model for teaching students learning strategies. *Bioscene, 35(1),* 35-42.
15.1	Organization for Economic Cooperation and Development (OECD). *Assessing Scientific, Reading, and Mathematical Literacy A Framework for PISA 2006.*
16.1	Palmer, A., & Rodger, S. (2009). Mindfulness, stress, and coping among university students. *Canadian Journal of Counseling, 43(3),* 198-212.
16.2	Plato. (n.d.). Meno, by Plato . Project Gutenberg - free ebooks online download for iPad, Kindle, Nook, Android, iPhone, iPod Touch, Sony Reader. Retrieved June 25, 2011, from http://www.gutenberg.org/files/1643/1643-h/1643-h.htm
16.3	Plato (2011). Phaedrus. In *Encyclopædia Britannica*. Retrieved August 8, 2011 from http://www.britannica.com/EBchecked/topic/454884/Phaedrus
16.4	Plews, J.L, & Breckenridge, Y., & Cambre, M.C. (2010). Mexican English teachers' experiences of international professional development in Canada: A narrative analysis. *Electron Journal of Foreign Language Teachering, 7(1),* 5-20.
16.5	Polkinghorne, D. E. (1995). Narrative configuration in qualitative analysis. *Qualitative Studies in Education, 8(1),* 5-23.
16.6	Punch, K.F. (2006). Developing effective research proposals, second edition. *SAGE Publications Ltd, London.*
17.1	Queenan, M. (1987). Classroom inquiry: Teachers as researchers? *The English Journal, 76(4)*, 88-90.

18.1	Richardson, F. C. & Suinn, R. M. (1972). The mathematics anxiety rating scale: Psychometric data. *Journal of Counseling Psychology, 19(6),* 551-554.
19.1	Spier, E., (2010). Group art therapy with eighth-grade students transitioning to high school. *Art Therapy Journal of the American Art Therapy Association, 27(2),* 75-83.
19.2	Steinberg, L. (2011) Demystifying the adolescent brain. *Educational Leadership, 68(7)*, 42-46.
20.1	Tanner, H. & Jones, S. (2003). Self-efficacy in mathematics and students' use of self-regulated learning strategies during assessment events. In N.A. Pateman, B.J. Dougherty, & J.T. Zilliox, *Proceedings of the 27th Conference of the International Group for the Psychology of Mathematics Education* (PME27), pp. 275-82. Honolulu, HI.
22.1	Vygotsky, L. (1978). Interaction between learning and development. In Vygotsky, L. (1978), *Interaction between learning and development: Mind and society.* (pp 79-91). Cambridge, MA: Harvard University Press.
23.1	Walton, R. (2003, September 23). The story of the three bears. *Rickwalton.com.* July 21, 2011 from http://www. Rickwalton.com/folktale/bryant52.htm
23.2	Whitley, J., & Lupart, J.L., & Beran, T. (2007). Differences in achievement between adolescents who remain in a K-8 school and those who transition to a junior high school. Canadian Journal of Education, 30(3), 649-669.
23.3	Wolters, C. A. & Rosenthal, H. (2000). The relation between students' motivational beliefs and their use of motivational regulation strategies. *International Journal of Education Research, 33*(7-8), 801-820.
23.4	Wormeli, R. (2011) Movin' up to the middle. *Educational Leadership, 68(7),* 48-53.
25.1	Yates, S. M. (2002). The influence of optimism and pessimism on student achievement in mathematics. *Mathematics Education Research Journal 14*(1), 4-15.
26.1	Zipes, J. (2008, June 29). Are fairy tales still useful to children? *The Art of Storytelling Show.* May 23, 2011 from http://www. Artofstorytellingshow.com

Appendix B:

Goldilocks and the Three Bears

Once upon a time there were Three Bears, who lived together in a house of their own, in a wood. One of them was a Little Small Wee Bear, and one was a Middle-sized Bear, and the other was a Great Huge Bear. They had each a pot for their porridge,--a little pot for the Little Small Wee Bear, and a middle-sized pot for the Middle-sized Bear, and a great pot for the Great Huge Bear. And they had each a chair to sit in,--a little chair for the Little Small Wee Bear, and a middle-sized chair for the Middle-sized Bear, and a great chair for the Great Huge Bear. And they had each a bed to sleep in,--a little bed for the Little Small Wee Bear, and a middle-sized bed for the Middle-sized Bear, and a great bed for the Great Huge Bear.

One day, after they had made the porridge for their breakfast, and poured it into their porridge-pots, they walked out into the wood while the porridge was cooling, that they might not burn their mouths, by beginning too soon to eat it. And while they were walking, a little girl named Goldilocks came to the house. She had never seen the little house before, and it was such a strange little house that she forgot all the things her mother had told her about being polite: first she looked in at the window, and then she peeped in at the keyhole; and seeing nobody in the house, she lifted the latch. The door was not fastened, because the Bears were good Bears, who did nobody any harm, and never suspected that anybody would harm them. So Goldilocks opened the door, and went in; and well pleased she was when she saw the porridge on the table. If Goldilocks had remembered what her mother had told her, she would have waited till the Bears came home, and then, perhaps, they would have asked her to breakfast; for they were good Bears--a little rough, as the manner of Bears is, but for all that very good-natured and hospitable. But Goldilocks forgot, and set about helping herself.

So first she tasted the porridge of the Great Huge Bear, and that was too hot. And then she tasted the porridge of the Middle-sized Bear, and that was too cold. And then she went to the porridge of the Little Small Wee Bear, and tasted that: and that was neither too hot nor too cold, but just right; and she liked it so well, that she ate it all up.

Then Goldilocks sat down in the chair of the Great Huge Bear, and that was too hard for her. And then she sat down in the chair of the Middle-sized Bear, and that was too soft for her. And then she sat down in the chair of the Little Small Wee Bear, and that was neither too hard nor too soft, but just right. So she seated herself in it, and there she sat till the bottom of the chair came out, and down she came, plump upon the ground.

Then Goldilocks went upstairs into the bed- chamber in which the Three Bears slept. And first she lay down upon the bed of the Great Huge Bear; but that was too high at the head for her. And next she lay down upon the bed of the Middle-sized Bear, and that was too high at the foot for her. And then she lay down upon the bed of the Little Small Wee Bear; and that was neither too high at the head nor at the foot, but just right. So she covered herself up comfortably, and lay there till she fell fast asleep.

By this time the Three Bears thought their porridge would be cool enough; so they came home to breakfast. Now Goldilocks had left the spoon of the Great Huge Bear standing in his porridge.

"SOMEBODY HAS BEEN AT MY PORRIDGE!" said the Great Huge Bear, in his great, rough, gruff voice. And when the Middle-sized Bear looked at his, he saw that the spoon was standing in it too.

"SOMEBODY HAS BEEN AT MY PORRIDGE!" said the Middle-sized Bear, in his middle-sized voice.

Then the Little Small Wee Bear looked at his, and there was the spoon in the porridge- pot, but the porridge was all gone.

"SOMEBODY HAS BEEN AT MY PORRIDGE, AND HAS EATEN IT ALL UP!" said the Little Small Wee Bear, in his little, small, wee voice.

Upon this, the Three Bears, seeing that someone had entered their house, and eaten up the Little Small Wee Bear's breakfast, began to look about them. Now Goldilocks had not put the hard cushion straight when she rose from the chair of the Great Huge Bear.

"SOMEBODY HAS BEEN SITTING IN MY CHAIR!" said the Great Huge Bear, in his great, rough, gruff voice.

And Goldilocks had crushed down the soft cushion of the Middle-sized Bear.

"SOMEBODY HAS BEEN SITTING IN MY CHAIR!" said the Middle-sized Bear, in his middle-sized voice.

And you know what Goldilocks had done to the third chair.

"SOMEBODY HAS BEEN SITTING IN MY CHAIR AND HAS SAT THE BOTTOM OUT OF IT!" said the Little Small Wee Bear, in his little, small, wee voice.

Then the Three Bears thought it necessary that they should make further search; so they went upstairs into their bed-chamber. Now Goldilocks had pulled the pillow of the Great Huge Bear out of its place.

"SOMEBODY HAS BEEN LYING IN MY BED!" said the Great Huge Bear, in his great, rough, gruff voice.

And Goldilocks had pulled the bolster of the Middle-sized Bear out of its place.

"SOMEBODY HAS BEEN LYING IN MY BED!" said the Middle-sized Bear, in his middle-sized voice.

And when the Little Small Wee Bear came to look at his bed, there was the bolster in its place; and the pillow in its place upon the bolster; and upon the pillow was the shining, yellow hair of little Goldilocks!

"SOMEBODY HAS BEEN LYING IN MY BED,-- AND HERE SHE IS!" said the Little Small Wee Bear, in his little, small, wee voice.

Goldilocks had heard in her sleep the great, rough, gruff voice of the Great Huge Bear; but she was so fast asleep that it was no more to her than the roaring of wind or the rumbling of thunder. And she had heard the middle-sized voice of the Middle-sized Bear, but it was only as if she had heard someone speaking in a dream. But when she heard the little, small, wee voice of the Little Small Wee Bear, it was so sharp, and so shrill, that it awakened her at once. Up she started, and when she saw the Three Bears on one side of the bed, she tumbled herself out at the other, and ran to the window. Now the window was open, because the Bears, like good, tidy Bears as they were, always opened their bed-chamber window when they got up in the morning.

Out little Goldilocks jumped, and ran away home to her mother, as fast as ever she could.