July 2018

# Exploring Math Education in China and Ontario

Tian Lan
lan4@uwindsor.ca

# Exploring Math Education in China and Ontario

By

**Tian Lan**

A Major Research Paper
Submitted to the Faculty of Graduate Studies
through the Faculty of Education
in Partial Fulfillment of the Requirements for
The Degree of Master of Education
at the University of Windsor

Windsor, Ontario, Canada

2018

Exploring Math Education in China and Ontario

by

Tian Lan

APPROVED BY:

_____

A. Allen
Faculty of Education

_____

C. Greig, Advisor
Faculty of Education

May 10, 2018

## DECLARATION OF ORIGINALITY

I hereby certify that I am the sole author of this paper and that no part of this paper has been published or submitted for publication.

I certify that, to the best of my knowledge, my paper does not infringe upon anyone's copyright nor violate any proprietary rights and that any ideas, techniques, quotations, or any other material from the work of other people included in my thesis, published or otherwise, are fully acknowledged in accordance with the standard referencing practices. Furthermore, to the extent that I have included copyrighted material that surpasses the bounds of fair dealing within the meaning of the Canada Copyright Act, I certify that I have obtained a written permission from the copyright owner(s) to include such material(s) in my paper and have included copies of such copyright clearances to my appendix.

I declare that this is a true copy of my paper, including any final revisions, as approved by my paper committee and the Graduate Studies office, and that this thesis has not been submitted for a higher degree to any other University or Institution.

## ABSTRACT

As math education is one of the most vital subjects required in school and society in the 21st century (European Commission, 2011), the student's math competence has the potential to influence the development of economic, political and social policies of their own country (Hanushek, Woessmann, Jamison, & Jamison, 2008). Students' engagement in math is influenced by many factors. Many studies show that the students' engagement in math may influenced by parents' attitude toward math and other studies show that the gender stereotype may influence students' engagement in math. In this paper, according to the expectancy-value theory, students' engagement with math are primarily influenced by the expectations from family, school and society. Among these three factors, students' math engagement is significantly influenced by the school's effect. However, this is not the only important factor. Parents play a critical role in the pre-education stage in terms of guiding a student's attitude towards math. Furthermore, the other factors such as gender and social class also influence students' academic experiences with math, and even their decisions on their future majors. The purpose of this paper is to explore math education broadly in Ontario and China. I will put forward the suggestions that may benefit these two regions so that they could learn from each other and improve student experiences with math.



*Keywords:* mathematics, influential factors, family, school, society, expectation, China, Ontario

## TABLE OF CONTENTS

## Chapter 1: Introduction

Given the move toward a global economy that is dependent on technology and technological innovation, it is becoming increasingly apparent that in order to be competitive in future job markets, students will need to possess strong math skills upon entering the workforce. In order to help students develop these critical math skills, it is essential that teachers and schools employ effective pedagogies to help students develop the necessary math skills and knowledge that will help them become more engaged citizens; however, a variety of approaches are currently being used in different contexts and regions. For example, China employs a teacher-centered and exam-orientated approach to instill students with the math skills they need. In contrast, Canada, as demonstrated by the pedagogies employed in provinces such as Ontario, embraces a student-centered and multi-assessment approach. A thorough exploration of these two academic contexts provides insights into factors that influence students' motivation, performance, and achievement with regard to math. Moreover, a comparison of the two pedagogical approaches suggests that in order to maximize students' outcomes, a hybrid of the two approaches should be considered.

### Background

In Ontario, math is the foundation of other subjects, such as science, engineering and technology (Lancaster, 2006). According to the Student Achievement Division (2011), early success in math plays an important role in students' future studies. Thus, primary education in Ontario is essential to constructing students' math foundation. According to the *Ontario curriculum Grade 1-8: Mathematics* (2005), there are five particular strands in the math curriculum: "number sense and numeration, measurement, geometry and spatial sense, patterning and algebra, and data management and probability" (p. 8). The math curriculum requires students

to understand what they have learned and what math skills they should master when they complete this period study. For example, grade-three students should be able to represent and order numbers up to 1000, measure distance, tell "time to the nearest 5 minutes… identify right angles and to compare angles with a right angle", create and extend "growing and shrinking patterns", organize "objects into categories using two or more attributes," and collect and organize "categorical and discrete data" (The Ontario Curriculum Grade 1-8: Mathematics, 2005, p. 53). All government-mandated expectations and skills that the students need to master are clearly laid out requirements in each of strands found in the Ontario math curriculum.

Fueled by the shift to standardized testing in the late 1990s, which also placed significance on literacy and math as core subjects in elementary school, the Government of Ontario made efforts to re-shape students' math education and performance by promoting science, technology, engineering, and math (STEM) courses. Schools in Ontario started to carry out standardized numeracy testing for the grades three, six, and nine; this testing was organized and governed by Ontario's Education Quality and Accountability Office (EQAO). The EQAO primarily tests, assesses, and evaluates students' literacy and numeracy skills and their scores in the EQAO test (Neill, 2008). Given the increased political significance of the EQAO math test scores in elementary schools, the government of Ontario devotes approximately 60 million dollars to math training for teachers annually. Worried over student performance on the standardized math tests, the Ontario government also increased the mandated time spent on math education (Csanady, 2016). Despite a significant amount of resources allocated by the Ontario government toward more math education, only half of Grade 6 students met the standard provincial math score in 2017. More interestingly, the percentage of the students who met the provincial standards in Grade 3 but failed in Grade 6 is also increasing (Alphonso, 2017). This

seems to suggest that even if students perform well in math in primary school, they may not be able to maintain that level of competency throughout their academic studies.

**A Brief Sketch of Math Education in China**

In China, math is an essential subject and constitutes a large percentage of the annual high stakes Middle School Entrance Exam (MSEE) and High School Entrance Exam (HSEE) in China. Although these exams do little to establish a lifelong interest and passion for math in an individual, they are critical as they determine students' academic options and career trajectory. The significance of math education in relation to high stakes testing to a student's life course in China, then, cannot be understated. Not only does success in school-based math play a significant role in shaping students' future in terms of their professional careers, but it also influences the future of the state as China. In this sense, China's aspirations to be a global leader requires a work force that excels in math and science in order to be competitive in the increasingly globalized tech-based economy.

In China, math education builds on and through progressive and spiraling stages. According to the *National mathematics curriculum standards for nine-year compulsory education* (2000), the content of Chinese primary math is "numbers and algebra; space and geometric figures; statistics and probability; relationships and synthesis" (p. 9). According to Zhao (2016), math content can be divided into three stages. The first is grades one to three, which focuses on the basics including numbers up to 10,000, basic images of simple geometric shapes, and basic exploration of statistics. This stage establishes a math foundation while also focusing on developing practical connections between math and daily life (Zhao, 2016). The second stage is grades four to six: this stage focuses on numbers up to 100,000,000, basic equations and negative numbers, the exploration of properties, various geometric shapes and

usage, and statistics with data. This stage seeks to help students develop a deeper understanding of how to use math (Zhao, 2016). The third stage is grades seven to nine which aims to solve practical problems in life by math strategy (Zhao, 2016). Each stage focuses on specified content. Thus, curriculum is arranged to become increasingly more difficult as students' progress from one stage to the next.

In China, success in math brings with it increased social status/social capital as peers are more likely to socialize and play with these students, and parents will often be more likely to display feelings of pride in them (Yang & Chen, 2006). This social currency and praise are also likely to motivate students to apply themselves to their math studies. Early success in math education, then, will likely stimulate students' motivation to get higher scores in the future for a variety of complex reasons, including future professional and personal status. For example, according to Yang and Chen (2006), students who perform well in math in their early school years often get more praise and academic support from teachers. This positive reinforcement encourages students to maintain their high levels of math performance. Hence, if the students have a strong foundation in math in China during primary school, then they tend to be more motivated to apply themselves to their math studies in middle or high school (Student Achievement Division, 2011).

Faced with a highly competitive labour market, Chinese parents and teachers often pay close attention to students' preschool math education. This is not surprising given the importance of math marks with respect to securing a spot in the highly competitive context of higher education in China. The students who are in Beijing or Hong Kong are educated in math before they enter primary school. In fact, most Chinese students are counting and writing by the time they are 2-3 years old (Ni, Chiu, & Cheng, 2012). Therefore, given the highly competitive nature

of the Chinese education system and its close connection to the labour market, students who do not have a solid foundation often struggle with math and may find it difficult to enter prestigious universities or secure high-status work. This is why many Chinese parents view the primary school period as an essential time for students to find success in math.

Chinese classrooms are teacher-centered and rely heavily on rote learning; therefore, Chinese math teachers usually prefer to teach students with a traditional method known as the 'banking model' of education (Freire, 2005; Li & Kaiser, 2011). In this approach, teachers adopt, knowingly or not, a conceptual view of students as 'empty vessels' that are in need of being filled with school based knowledge. Teachers fill students with the prescribed content, and students memorize what the teacher tells them (Alam, 2013). Teachers also write lesson content on the blackboard while students sit in their chairs and write the content in their note books. During this process, the whole class is required to be silent (Ni, Chiu & Cheng, 2012). There is no dialogue or discussion between and among students, or between and among the teacher and students.

Of course, there are some problems with this pedagogical approach. First and foremost, the assumption that students are simply 'empty vessels' waiting to be filled is no longer a tenable position to hold. Students construct and make meaning based in part on their own lived experiences. Moreover, this approach fails to allow students an opportunity to develop their critical thinking skills because they are required to accept the knowledge provided by the teacher (Alam, 2013). Power and power relations also play a role in the active pursuit of silence in the classroom. This may make students feel uneasy about expressing their thoughts, questions, and ideas about math if silence is the norm. Consequently, not only is the power and authority of the teacher left unsettled, but students may "leave the classroom without having their questions

answered and unable to understand the true meaning of the mathematics theory" (Peng, 2002, p. 13).

China's traditional math education, as mentioned, primarily depends on rote learning. Teachers teach the government mandated content; students memorize it. For instance, Chinese students memorize the multiplication table, which is viewed as essential in math learning (Spagnolo & Paola, 2010). When the students learn multiplication, the first thing they do is memorize is the multiplication table, which is also a way to exercise and develop students' sense of number, but perhaps to only a limited degree. When students calculate eight multiples of nine, they can get seventy-two directly based on rote multiplication, while, the others who do not have this sense of numbers may use eight multiples ten and subtract eight then get seventy-two (Rohaidi, 2016). However, rote learning is inconsistent with conceptual learning and fails to detect whether or not a student understands the content in any sophisticated way. Memorization does not necessarily equate to understanding.

China's history and culture are also a critical element in shaping people's attitudes towards math. Historically, China has been an agricultural country. Out of this tradition came the belief that increased efforts can increase gains. Based on the influence of this Confucian thinking, Chinese people have adopted the belief that as long as people give their best, difficult problems will be solved (Hall & Ames, 1947). Therefore, parents cultivate a reverence for a strong work ethic in their children. When established early, this encourages students to work diligently if they want to achieve their goals. This particular value system works itself out in many ways when it comes to education, including the number of days students spend in schools. Hence, the school year in China is approximately 245 days long, whereas the school year in Ontario is 195 days long (Ministry of Education, n.d.). Clearly, Chinese students spend much

more time in school than their Ontario counter-parts, which may give some of them a distinct advantage with regard to their math performance. So, the longer a student is in school, the more things they learn.

**A Brief Sketch of Math Education in Ontario**

Ontario's curriculum is based on a student-centered, constructivist philosophy of teaching and learning. A pedagogical approach that is based on constructivism rejects the idea that knowledge is transmitted or meant to be absorbed. Rather, constructivism accepts the idea that knowledge is developed and constructed by the student. Thus, knowledge is not passively transmitted by the teacher. In addition, the constructivism approach rejects the idea that there exists an absolute 'truth' and instead embraces the notion that there are various and individual interpretations of the world. Finally, a key idea from this perspective is that learning is a social process that is grounded in meaningful dialogue. This pedagogical approach stands in stark contrast to 'silent' classrooms as it encourages meaningful 'talk' between and among students.

Theorists such as Jean Piaget helped develop this understanding of teaching and learning. Piaget believed that "knowledge construction takes place when new knowledge is actively assimilated and accommodated into existing knowledge" (as cited in Jones & Brader-Araje, 2002, p. 3), and people's understanding of the reality changes through time. This view suggests that students construct and 'make meaning' based on their own lived experiences. Another key theorist that helped develop this particular theoretical foundation was Lev Vygotsky. Vygotsky formed "the foundation of social constructivism in educational settings" (as cited in Jones & Brader-Araje, 2002, p. 5). He "stressed that the mind and body of the subject are joined, and that this connection is further expressed between the subject and objects in his environment" (as cited in Jaramillo, 1996, p. 134). Ontario teachers use constructivism theory connect the knowledge

with students' lives so that they can learn a new knowledge based on their previous knowledge structure. This allows students to learn the practical functions of math in real-world situations. In this way, math education is different in Ontario than it is in China. To understand the benefits and limitations of both approaches, the current study's analysis of each math system will consider their own context.

Teachers who adopt a constructivist approach to teaching and learning reject the idea that the teacher is the ultimate authority. Rather they see their role as a guide and aid for students as they explore ideas and create concepts in the context of math education. Through guided questions and discussion, the teacher helps the students focus on the task at hand. Of course, this approach requires much more of a teacher than the transmission approach as it demands that the teacher be skilled at questioning in a way that helps students scaffold their knowledge while also being deeply skilled at developing and establishing an intellectual climate and culture that helps students develop a love of math. The math teachers who adopt a constructivist approach to teaching and learning have to take into careful consideration a number of complex factors, including the lives of the children in front of them in order to make the learning relevant.

Ontario teachers often use a student-centered approach to teaching and learning, which enables students to express their thoughts freely and solve real-world math problems (Student Achievement Division, 2012). Ontario teachers can design class activities based on the students' different lived experiences, comprehension, and skill levels, as well as employ classroom discussion and stimulate students' motivations according to their own situation (Ontario College of Teachers, 2016). Finally, it is important to note that Ontario elementary teachers are responsible for covering all subjects (except Music and French). They are not required to have a degree in math (Ontario College of Teachers, 2016), (Mendaglio, 2014). As a result, some

teachers who do not have a strong math background may come to doubt whether they are competent enough to teach math; their thoughts and behaviors can easily negatively impact students' attitudes toward math. Thus, in Ontario, math anxiety is found in both teachers and students alike.

Based on the brief introductions of China and Ontario math situations, there are many differences in math curriculum, teaching methods and national conditions. The current study explores and compares the factors that influence students' engagement, specifically family, school, and sociocultural aspects with expectancy-value theory in China and Ontario.

## Chapter 2: Literature Review

A thorough understanding of this subject requires a review of the literature on the key factors that influence math education in China and Ontario. The most significant factors include family, school, and sociological contexts.

### Influential Factors from Family

With respect to family, two factors significantly contribute to students' math performance: expectations and involvement.

**Parents' expectation.** Ma (2011) claims that parents' high expectations of children have a positive impact on children's academic performance. Whether in Ontario or China, parents have similar expectations when it comes to their children's performance: they want their children to succeed in school. Parents' high expectations of students' academic performances help stimulate a child's motivation to study and may also eliminate the negative influence of teachers who have low expectations (Yamamoto & Holloway, 2010). Maternal expectations are the most influential, though its impact on girls is more obvious with respect to math; however, it is important to note that maternal expectations can be negative or positive. For example, Casad, Hale, and Wachs (2015) state that mothers usually transfer their math-gender stereotype to their daughters intentionally or unintentionally, which may predict their daughters' math performance and increase their daughters' math anxiety. Consequently, mothers may want to comfort their daughters when they do not perform well in mathematics. In some ways then, the reproduction of the stereotype might be perpetuated. Thus, when girls grow mature and eventually become mothers themselves, they may pass this gender stereotype from generation to generation. In addition, mothers' experience also influences girls' math performance. If mothers have high levels of math anxiety, their daughters may also have high levels of math anxiety.

Parents' expectation should seek to improve children's development according to their abilities; however, parents' aspiration could set goals for children that do not consider children's abilities (Murayama et al., 2016). For example, Murayama, Suzuki, Pekrun, Marsh, and Lichtenfeld (2016) state that some parents may place excessive expectations on children and establish goals that are beyond their child's abilities. When parents have excessively high aspirations for their children, children may overestimate their abilities. Whether it is the children or parents who have a high expectation, unexpectedly low-test scores may damage children's confidence and may even result in children developing an aversion to their academic studies.

**Parents' involvement in students' study.** In order to help their children to meet the expectations they have of them, parents must be involved in their children's education. Parental involvement is a factor in students' academic performance and can booster their achievement (Underwood, 2010). Parents' involvement refers to support they offer with regard to students' homework, communication, and school activities (Hoover-Dempsey et al., 2005). Some parental involvement is pervasive, which is common among Chinese parents (Zhong, 2011). For example, Chinese parents like to be involved in students' academic study, provide a study environment conducive to learning, and communicate with teachers about students' school behaviors positively without asking students. Some Chinese parents arrange extracurricular academic activities to support their children's studies, like having a tutorial class and arranging their study time.

In Ontario, many parents have a strong sense of being involved in school life. Many policies stress the importance of parental engagement in students' school life because "positive parental aspirations and expectations for their children's educational achievement have a strong relationship with children's actual achievement" (Ontario Ministry of Education, 2010c).

Therefore, the government has some strategies to encourage parents to participate in students' school lives. For example, "the Parent Engagement Office was established by the Ministry of Education to underscore the importance of parental involvement in children's school life" (Underwood, 2010, p. 18).

Though the Ontario government encourages parental involvement in students' school life, this involvement is different from Chinese parents' involvement. It is recommended that Ontario parents should "encourage, listen to, praise, guide, monitor, and discuss schoolwork with their children, and not whether or how they teach school subjects" (Ontario Ministry of Education, 2010c). Ontario parents' involvement aims to help schools build the well-being of students (Ontario Ministry of Education, 2010c), while Chinese parents' involvement target is to prompt students' math scores and get enrollment from high-quality schools.

**Influential Factors from School**

Because children spend most of their time at school, schools' influence on students' academic performance should also be considered. Within this context, there are six critical factors: teacher quality, teacher behaviors, textbook, assessment, students' self-efficacy, and peers' expectations and responses.

**Teachers' quality.** Teachers' expertise is also critical to students' success in math (Yang, 2014) and is perhaps the most important factor. In China, if people want to be a primary teacher, their majors usually need to be in related with courses in addition to having a teaching certificate and completing an examination that for teachers. In Ontario, one must only finish a teacher education program and then get a teaching certificate (Ontario Ministry of Education, 2010a). In order to ensure a teacher can support students according to their needs and ability in China for essential courses such as math, students will have one teacher dedicated to that subject, and that

same teacher will instruct them over the course of several years. Primary/junior Ontario teachers are usually responsible for the all subjects and need to have a broader scope of knowledge (Ontario College of Teachers, 2016). Thus, they do not have to be an expert in a particular subject in primary school, which can help students develop a general knowledge of the world during the primary stage.

**Teachers' behaviors.** Teachers' influence also plays an essential role in children's academic performance, whether in Ontario or China. Teachers are responsible for providing students with instructions on the content of academic curriculum, constructing their behaviors, and cultivating their various abilities, which can prepare for their future careers. Ma (2011) states that if the teachers create a comfortable environment for students, give them positive feedback, provide them with prompt replies to their questions, and build a friendly relationship with students, they could play a positive role in students' academic performance. In the process of studying, people will meet different kinds of teachers, and these teachers will impact students' lives to varying degrees. Some teachers are committed and educate students as if they are teaching their own children. They consequently devote most of their time and energy to students. With teachers' help, the students who have poor performance can improve, and these students may appreciate the teachers' support. They know that without the teachers' help, they would not have a chance to improve themselves and their lives. Therefore, teachers' behaviors and speeches can potentially influence students' attitudes on the study.

In contrast, some teachers believe using insults as negative reinforcement motivates students to study harder; however, studies show that this will result in negative outcomes and teacher-led bullying. When students engage in inappropriate behaviors or cannot answer a question correctly, some teachers insult students under the pretense that it stimulates students'

desire to study. When teachers manage and intervene in peers' bully, their attitudes can influence students (Kochenderfer-Ladd & Pelletier, 2008). Once the teacher displays impatience or annoyance with these students, the other students, who may be too young to discern between appropriate and inappropriate behavior, will be aware that the teacher does not like these students. The students will then imitate the teacher's behavior and isolate the student: this is called school teacher-led bullying. Therefore, negative reinforcement can be counterproductive, and though it may stimulate people's motivation, it is just as or perhaps more likely negatively impact students.

**Textbook influences.** According to Wang and Yang's (2016) comparative study of five countries' primary schools mathematics curriculum, the content and quality of math textbooks affects students' math performances. Likewise, Sly (2016) states that math textbooks are a "background guide in curriculum" that are essential for students' further math performance (p. 1). Thus, because China's education goals prioritize problem solving skills (Cai & Nie, 2007), Chinese textbooks pay more attention to solving problem; however, they neglect the practicality of math and often fail to interest students (Xu, 2016). This causes students to lose interest in studying math. To address this issue, it is critical that China needs to develop math textbooks that demonstrate the value of math in practical settings and engage students' interests. This will motivate students to study.

In Ontario, the focus of academics is different. For example, the books aim to engage students first. Thus, the grade one students' textbooks are designed to be colorful and feature many pictures (Algebra basics, 2009). In addition, these books are also designed to be practical and accessible because the pictures depict animals and plants that child often see in their daily lives. From the grade three to grade six, there is a transition that eliminates colors and moves to

more practical presentations. By grade seven, the textbook depicts small pictures that feature "career opportunities: architects, electricians and plumbers, use it to do important calculations" (Algebra basics, 2009). This enables students to identify the relative requirements of different careers that encourage them to consider their future careers.

The Ontario textbooks have other considerations as well, such as accessibility and social contexts. In order to improve accessibility, Ontario textbooks are available in print or electronically (Ontario Ministry of Education, 2008). In addition, as Ontario is a multicultural province, the content of their textbooks is designed to reduce biases (Ontario Ministry of Education, 2008). Moreover, as Canada is a bilingual country, textbooks are available in English and French, which can benefit students' self-learning. In this way, the textbooks seek to address more than just academic concerns, but accessibility and social concerns as well.

**Assessments.** The style of assessments also influences students' math performance. Assessments can be divided into two categories: formal assessments, which are associated with high-stake testing; and informal assessments, which are associated with low-stake testing.

***Formal assessments***. With regard to formal assessments, teachers design exams and tests for students and give students a fixed time to finish them. China is the first country to establish a national examination system (Zhao, 2016). In China's large-scale classrooms, exams are considered a fair and efficient way to test students' academic abilities. Thus, teachers rely on tests to determine whether students have developed a solid understanding of course content. Designing assessment is inevitably a factor in teachers' work, and it is an efficient way to determine what students need to improve and what they have already mastered. However, it is challenging for teachers to design a test that not only evaluates students' degree of mastering knowledge, but also considers the degree of difficulty of the test. Therefore, teachers need to

design different assessments for students with different purposes. For example, high-stake tests can be used to select qualified candidates to enter institutions that require specialists in certain areas, such as a scientific research institution.

In Ontario, EQAO as a "provincial large-scale assessment program is a formal assessment" (Koch & DeLuca, 2012, p. 110) that is also designed by the curriculum. EQAO is used to

> scores student responses, analyzes the scores, and reports the results in ways that meet standards for educational testing; provides trustworthy and useful information for the Ontario educational system; and helps and encourages school officials to work with the results for their school board and schools to enhance student learning (Rogers, 2013, p. 5).

Thus, EQAO scores can help teachers understand students' study progress and enable teachers improvement.

***Informal assessments***. Informal quizzes are often used in China, especially for the primary school students. Low-stake tests allow students to make mistakes and do not have a role in deciding students' academic future (Penk & Schipolowski, 2015), which can protect and even improve students' confidence. Warnock (2013) also claims that low-stakes testing can stimulate students' motivation and that students are more willing to take such quizzes. As the low-stakes tests do not require students to provide the right answer for every question and do not count the results into their academic scores (Wiliam, 2010), students feel less pressure than they would for high-stakes tests. For example, in a math classes, teachers can utilize the first ten minutes to test the students' understanding with a small quiz, which is also a way to consolidate and review the

knowledge they learned in previous classes. Thus, with a small quiz, the teacher can get feedback promptly, and students can assess their abilities in a relaxed and informal setting.

Though informal assessments can also take the form of class discussions, this approach is not common in China. Li (2003) states that Chinese students are required to be quiet when teachers are speaking. This is reinforced by Confucius' thinking, which has socialized students to be respectful of teachers to the point where they cannot interpret teachers casually during a lesson (Li, 2003). Moreover, teachers are disinclined to use class discussions because there are a large number of students in class, which make it difficult to include all students. Moreover, teachers are also responsible for covering all the material in an intense curriculum and teaching syllabus. Likewise, in a Chinese context, students are socialized to feel ashamed if they make a mistake in public. As a result, the informal discussion usually occurs when the class is over and the students can take their questions to the teachers in private.

In contrast, the informal classroom discussion can encourage teachers "to be responsive to students' understandings and adjust instruction as well as deal with particular understandings with individual students" (Suurtamm, 2017, p. 1) and help students reconstruct their math thinking, which can prevent them from adopting a flawed interpretation of the lesson. The informal classroom discussion gives teachers the opportunity to get students' feedback in a timely fashion. Furthermore, through classroom discussion, students can reconstruct their understanding, which lets students identify where any potential misunderstanding occurred and what to do differently to correct any mistakes. Informal questions can also arouse the students' attention in class, so, when students are distracted in class, teachers can secure students' attention by asking a question. This also reminds students to stay focused in class so as to avoid being embarrassed when they cannot answer a simple question because they were not paying attention.

Thus, upon careful examination, it is clear that both assessments have their own merits depending on students and teachers' requirements.

**Students' self-efficacy.** Self-efficacy, which refers to people's belief in their abilities, can determine students math performance (Lindberg, Linkersdörfer, Ehm, Hasselhorn, & Lonnemann, 2013). Schulz (2005) also states that "Self-efficacy has often been measured through a rather general self-assessment of an individual's capacities to master a subject" (p. 1). So, when the students get a better performance in math, they may have a high self-efficacy in math. That is why students who have a high self-efficacy have a desire to demonstrate their best performance and behaviors in class (Shim, Cho & Wang, 2013).

**Peers' expectations and responses.** Another factor that influences math performance is the peers' expectations and responses. When teachers assign group work, students can develop their knowledge by sharing what they know with each other. In addition, when talking in a group, students who do not feel comfortable speaking to the teacher or in front of the class get an opportunity to reason out their logic and express their confusion in a more casual setting. In a small group, students can learn with each other and find a model to pursue (Kotsopoulos, 2010). Teachers in Ontario and China are similar as they allow students to express their thoughts freely and exercise their cooperation abilities in peer groups.

**Influences from Sociocultural Factors**

Students' academic achievements in school are closely linked with the needs of the state. A state, it is assumed, is likely to invest heavily in schools. For instance, at the end of the 1940s, China adopted the economic system found in the former Soviet Union, as well as its education system. The Soviet Union thought that the school system was the foundation upon which to build their country. This was at a time when Russia was industrializing and the coming of the Cold

War required students to study science and engineering (Luo, n.d.). Under the influence of this historical background, Chinese parents adopted a stereotype that the students who study science and engineering will have a bright future. A strong math foundation is crucial for learning science and technology. Thus, parents and teachers infuse children with the belief that math is important for their future.

Today, the state has an increased interest in emphasizing math in light of the digital age. Xie, Zhang, and Lai (2014) state that since 1978, economic reforms have helped the Chinese economy increase domestically and globally. The central reason is that the science technology has improved at a time when the job market requires students who excel at math. People who study science and engineering can find a job more easily than the students who study arts (Liao & Lu, 2005). Thus, studying science and engineering has become a significant trend in China. If there are some students who do not choose science or engineering as their future direction, they are, to some degree, looked down upon (Ma, 2016). That is why the math has traditionally been valued highly.

The Ontario public's attitude with regard to teaching student math addresses five concerns: levels of performance, problem solving, comprehension of concepts, the application of math procedures, and communication of the required knowledge. This has been affected by people's experiences with learning math and mass media guidance ("The state of mathematics," 2003). When the media reports on low math performances, people tend to blame such failures on rote learning because they have the similar experience of rote learning. Though sometime the media convinces the public of the importance of mathematics, they do not report on pedagogical approaches that can facilitate math learning ("The state of mathematics," 2003). This means that the sociocultural functions are not being utilized to improve students' math engagement.

In China, quality in education means everyone has the opportunity to go to school and learn the knowledge required to satisfy their basic life needs. However, in China, in addition to quality education, people are also concerned with equitable education. Equity in education means that, regardless of the background, nationality, gender, and social status, every student is accepted by a school (Mu et al., 2013). Despite efforts to achieve equity, an economic gap exists in the country (Lee, Yu, Huang, & Law, 2016). In China, the economic gap exists between eastern and western China. When it comes to education, the western mountain area lacks necessary facilities and struggles with a lack of teachers. Most parents in this region are illiterate, and the government does not pay much attention to education (Lee, Yu, Huang & Law, 2016); consequently, their children do have a strong academic foundation.

Ontario is Canada's most ethnically diverse province (Ontario Ministry of Education, 2009). As such, the government tries to pay attention to ethnic and cultural issues, especially with respect to education. Legislation has been passed to guarantee the quality and equity of Ontario education, such as Ontario Human Rights Code and the Federal Canadian Charter of Rights and Freedoms (Ontario Ministry of Education, 2009). Apart from policy support from government, each school board requires teachers and schools to address issues of diversity, and provide equity education including addressing issues around gender stereotypes (Ayalon & Livneh, 2013).

# Chapter 3: Theoretical Framework

## Definition and Function of Expectancy-value Theory

Expectancy-value theory will be used for this paper. To understand its value, it is important to first define the theory and explore how it functions.

**Definition.** Expectancy-value theory was developed in the 1950s by John Atkinson in an effort to better understand individuals' motivation (Wigfield, 1994). Theorists who adopt this perspective accept the idea that motivation is inspired by an individual's goals. According to Wigfield and Eccles (2000), expectancy has a long-term influence on motivation. Guo et al. (2015) claim that modern expectancy-value theory explains students' self-conception of success as it relates to their evaluation of themselves and their competency in a particular academic area.

The expectancy-value model of achievement is related to four components: intrinsic, utility, attainment, and cost. According to this theory, these components are essential to students' academic participation and choices. The intrinsic value refers to the enjoyment derived from students' inherent interest in activities that they are willing to do. The utility value means the practical usage in the domains that they are interested in academically, personally, or professionally. This means that they understand the utility or practicality of the work with respect to future endeavors. The attainment value refers to the students' sense of fulfillment (Zhou, 2014) and is characterized by the satisfaction they feel when they set a goal and overcome challenges to achieve it. According to Ibrahim, Aulls, and Shore (2017), attainment value can directly influence individuals' choices, performance, and engagement, ultimately dictating whether they achieve their goals. Cost, according to Zhou (2014), is a negative element involved in a task and includes "stress, fear of failure, and the lost opportunities that result from making one choice over another" (p. 179). Ma (2001) also states that expectancy-value theory

stresses the expectation of success on a task and their self-efficacy. This theory has a close relationship with students' self-concept and task value, which can influence students' math performance.

**Function.** As far as function, Eccles et al. developed an expectancy-value model of achievement choices to determine early adolescents' performance and choices in the math, and they found the expectation of success can shape students' perspectives of subsequent tasks and what they intend to do moving forward (as cited in Wigfield, 1994, p. 69). Expectancy has a close relationship with students' beliefs about being able to complete a task, self-conceptions, task level, and contributions (Barron & Hulleman, 2014). These can determine students' math success.

**Implication of Expectancy-Value Theory**

Students' engagement with math is shaped by a variety of stakeholder expectations, including family, school, and social expectations. These factors influence students' math performance to varying degrees. Thus, expectancy value theory can be used to understand math education and how it interacts with family, schools, and sociocultural factors.

**Family.** Parents play a vital role in a child's math achievement. For example, Thomas and Strunk (2017) state that parents' expectations have an effect on students' self-belief and is "linked with students' attitudes toward mathematics" (Prendergast & Zhang, 2016, p. 3). Parents' expectation of success will anticipate a child's achievement, and the task value can predict a child's persistence. If parents' have high expectations when it comes to their child and math, the child will be more likely to apply themselves to develop a deeper understanding of math and its concepts. It is also important to note that children will be inspired by their parents' own effort at math as they act as role models. Generally speaking, children will often adopt the passions and

enthusiasms of their parents in many cases. If this is the case with math, children will study math more diligently and participate in class activities, which can improve their motivation and engagement in math, which helps them become passionate and competent in the subject.

**School.** A teacher's influence has a significant impact of students' self-belief about their ability (Thomas & Struck, 2017). If teachers have a healthy and positive relationship with students, one that is grounded in mutual respect, students will likely have a passion for the subject that the teacher instructs. Likewise, if teachers have poor relationships with and low expectations of their students, the students are unlikely to try their best to develop in that particular subject. Unfortunately, these particular students may internalize negative stereotypes about themselves and come to believe that they are incapable of learning math (Rubie-Davies, 2006). Consequently, they may lose interest in studying math. Green (2002) found that teachers' words can stimulate students' motivation, especially in the class activities, and that teachers should offer timely encouragement. Specifically, Gniewosz and Watt (2017) state that positive responses and praise from teachers play a positive role in students' intrinsic task values. Thus, receiving praise from teachers may encourage students apply themselves and take an interest in a given subject.

**Sociocultural factors**. There are also a number of sociocultural factors that play a role in shaping students' attitudes toward math education. For instance, societal expectations can shape children's math experiences, most especially with respect to gender. It has long been recognized in China and in Ontario that "math and science have traditionally been masculine-stereotyped subjects, English has been a more feminine-stereotyped subject" (Leaper, Farkas, & Brown, 2012, p. 269). Boys are expected to be naturally good in math. Consequently, expectations for boys are generally higher. Thus, it is critical that all teachers, educators, and policy makers

consider the role gender and gender relations have in misshaping girls' attitudes and beliefs about themselves when it comes to math.

Student achievement is also shaped by other sociological factors, such as race and social class. For example, working poor and working-class students in Ontario and in other jurisdictions still typically do less well academically than their more affluent counterparts. As far as math is concerned, working poor and working-class students are more likely to find themselves in the applied math stream or the basic stream (Rushowy, 2015), which may limit post-secondary opportunities. While middle-class children are more likely to find themselves in the academic, university bound stream, which provides them with greater post-secondary opportunities. The academic stream tends to provide students with much more future possibilities that secure more economic, social and political benefits than those who emerge out of the applied/basic streams. Race and racism also play a powerful role in shaping student success. Research has shown non-white children, like working-poor children, often face various forms of discrimination in schools, including having low expectations placed on them by teachers (Kaufman & Rosenbaum, 1992). Administrators and teachers need to hold high aspirations and expectations for all students, including working-class and racialized students, both in and out of math class.

Therefore, expectations from family and school, as well as sociocultural factors, all influence students' performance. If students receive high expectations from parents, teachers and society, they often do their best to meet and achieve these expectations. In contrast, if the students receive the low-expectations from the various stakeholders, they will likely lose their motivation. This may result in believing they are 'naturally' incapable of doing well in math.

## Chapter 4: Discussion

Based on a survey of the current literature, there are three major issues in relation to math education: family, school, and sociocultural factors.

### Influential Factors that Shape Chinese Students' Math Engagement

In China, math sits atop of the school-subject hierarchy. In China, students who study science are typically perceived to be smarter than the people who study the arts and social sciences (Wali, 2013). Of course, the social status attached to subjects such as math and science is certainly greater than the arts whether China or in North America, so this is not necessarily unique to China, though the difference may be more extreme in China. Thus, it is not surprising that Chinese parents generally consider a student's math skills in an academic setting as one of the most significant factors that can determine his or her future career. Math matters to Chinese families. Parents and schools pay more attention to improving students' math performance, and often use other organizations who design various kinds of extracurricular math classes for students. Aa a result, Chinese parents, like some middle-class parents in Ontario, send their children to extracurricular classes to learn math concepts in advance and at the same time consolidate the math knowledge that they have learned in school. The trend toward increased time and money spent on private tutors has been escalating over time across the globe as competition for select spots in schools and in the labor market intensifies.

China is a country that takes family relationships, and their views and opinions, seriously. Like other regions of the world, Chinese people have many relatives and siblings, but they view these relationships in very interconnected, overlapping and intimate ways; therefore, when adults talk with each other, their topics often relate to their children. In China, there is a strong tendency among parents to want to compare the lives of their children. In particular, Chinese parents like

to compare their own children's math performance with other children's performance: this kind of competitive comparison not only happens with peers but also happens with siblings (Wang, et al., 2015). Though some children may feel tired of being compared with each other, the children's sense of filial piety for their parents makes them feel obligated to work diligently to do their best in school, as defined by high grades. In some ways, math education in China has less to do with grasping math concepts in any deep way and much more to do with securing a high grade on the high stakes exams. So much depends on it. This of course, is an outcome of an education system that uses high stakes testing to sort and sift children.

**The influential factors from family.** Influential factors that come from the family context that shape the students' math foundation include parents' authority and students' motivation.

***Parents' authority.*** Confucius is one of the most celebrated educators and philosophers in China. He proposed that hard study needs a hard effort because he thought children should have "filial piety to their parents and the relationship between parents and children should be interdependent" (Zhou, 2014, p.179; Leung, Graf & Lopez-Real, 2006). For Confucius, parents and children were tightly intertwined and their lives were deeply connected. In China, a parent's influence over their child's education is a very powerful factor. Chen (2016) states that as parents' authority is influenced by Confucius' thinking, parents plan a series of goals for students from primary school to university. Chinese parents privilege math as a subject over other subjects, in part because success in math is a major factor in helping to realize parents' wishes when it comes to labour market success and the fate of their children. Not surprisingly, parents often pay more attention to improving children's math performance than their performance in other school-subject areas.

The pressure to achieve high grades begins early in China. Parents of a grade one student, for example, will take many measures to guarantee the academic success of their child, including checking their children's homework (Hoover-Dempsey, Bassler, & Burow, 1995), or going to private tutors. This is why private tutoring has become big business in China. For Chinese parents, and to a lesser extent parents in Ontario, tutoring has become not just an educational supplement, but a necessity for their child's academic success. Parents believe that tutoring class is essential for students as it can enhance child's school success (Bray, 2006). Therefore, apart from learning in school, many Chinese parents, like some middle-class parents in Ontario, also send their children to after-school learning class, which they hope can improve and solidify students' academic knowledge and ensure entry into prestigious schools.

In China, high stakes examinations place enormous pressure on Chinese students and "play a pivotal role in student success" as defined by entrance into post-secondary education (Kirkpatrick & Zang, 2011, p. 38). Students have to face many kinds of examinations when they begin school in China, and they have to treat the high-stakes examinations, like *Gaokao*, seriously. For most of the students in China, the grades that they get in *Gaokao* will highly determine the quality of their college education, which in turn has a heavy impact on their future career. The scores, including in math, will decide their future. Thus, it is not difficult to understand that the tutoring class is essential in a students' learning. The extra work via tutoring can provide help and support that can improve math scores, although it is unclear whether or not it produces a deeper engagement with math. Furthermore, parents like making decisions without consulting their children when they face a choice. For instance, when students enter the second year of high school, they need to decide which area they will focus on: art or science. However, in many Chinese families, parents' authority is the supreme power that decide children's future

careers and lives. Thus, some parents choose science for their child because they think science will benefit their future, especially for boys. This situation often results in disproportionately high number of boys in sciences classes.

***Students' motivation.*** Students' motivation for studying math comes from societal pressure, but their motivation is also shaped by their intrinsic interests, attainment goals, and their understanding of the utility math.

*Intrinsic value.* Students' intrinsic value refers to students' "affective attitude towards a specific school subject, whereas effort refers to the effortful and diligent behavior that students show within the academic setting" (Dietrich, Dicke, Kracke, & Noack, 2015, p. 46). If teachers can make math meaningful and enjoyable, they can encourage students to develop an intrinsic appreciation for math, and students will in turn devote more time and energy to math and will find opportunities to exercise their math abilities. The extent to which Chinese teachers build math lessons with this goal in mind, however, is limited. Chinese teachers usually put only one question forward to arouse students' interest on the lesson. Thus, Chinese teachers do not devote much time to playing math games because of the limited time, large number of students, and the perception that 'games' are not meaningful.

*Goal attainment.* Attainment means doing well in a "given task" (Wigfield & Eccles, 2000, p. 72). When students recognize that understanding math can help them attain a goal that is important to them, they will be more likely to invest the time required to excel at the subject. For example, both Chinese parents and Chinese teachers emphasize the importance of learning math to find a secure, high-salary job in the future; therefore, students may try their best to learn math. However, Ontario teachers stimulate students' interest in different subject areas, and students take courses that may influence their future career choices based on their interests.

*Utility*. In order to motivate students to engage in math, it is also important for them to see the utility of math. According to Wigfield and Eccles (2000), "utility refers to how task fits into an individual's future plans" (p. 72). In part, this obligates teachers to ask questions and pose tasks to problems that relates to the lived realities of the students. However, unlike Ontario teachers, Chinese teachers often neglect the usefulness of math in life because they want to exercise students' proficiency of using various formulas. This approach is often disconnected from context or the material reality of life. In this sense, they will often design various questions with different situations for students to exercises until the students master the formula.

**The influential factors from school**. Schools can influence students' math performances with regard to math curriculum, math textbooks, teachers' qualification, and peer motivation.

***Math curriculum.*** Unlike education in Ontario, which is a provincial matter, the central government controls China's education system (Zhao, 2016). Because of this, the curriculum that is employed by the national schoolboard is also formulated and imposed by the relevant department of the Chinese central government. Students have to take math from grade one to grade nine, country wide, to complete a mandatory nine-year program (Wei, 2014). The Mathematics Curriculum requires that teachers should develop and cultivate students' math abilities and prepare them for lifelong learning instead of just transferring knowledge to students (Yang, 2014). Thus, the traditional teacher-centered math pedagogy should become students-centered (OCED, 2010). The new curriculum encourages teachers to teach math by connecting it to real life situations; however, this seems unlikely to have be fully implemented at this point in time (Yang, 2014). Through a series of changes to the math curriculum, the teaching methods and attitudes, as well as people's thinking of them, are likewise changing. These changes may influence students' learning patterns or customs with regard to math.

***Math textbooks.*** Math textbooks are designed according to the math syllabus, and primary teachers are mandated to teach their class based on the textbook (Zhao, 2016). Unlike Ontario teachers, Chinese teachers are not asked, nor obligated to consider children's individual learning needs. Chinese textbooks prominently feature problem-solving challenges in order to improve students' solving-problems abilities. They also include calculating questions and multiple-choice option, which can help students practice their abilities more efficiently (Zhu & Fan, 2006). In order to familiarize students with solutions, different scenarios that rely on the same solutions are included. Chinese textbooks also avoid mentioning unrelated information to clarify the lesson goals to students (Yang, 2014). The Chinese use of textbooks as central to the math classroom fits into the transmission model of teaching and learning.

However, there are several problems with this approach. First, a text-book-driven classroom that fails to take into consideration individual needs is likely to leave some children behind and fail to foster a passion for math in some students. A text-book-driven classroom, is also not a student-centered classroom; thus, it tends to reinforce a 'transmission' understanding of teaching and learning. As research has demonstrated, not all children learn in the same way. Moreover, if the textbook was designed to be too challenging, it may negatively impact a child's confidence. Likewise, if the text is not challenging enough, some students may get bored and feel less than motivated to succeed. Lastly, to make students fully understand the requirements of the questions and prevent students distract by other information, Fang, Gopinathan, Li, Stevenson, and Stigler said the "content in mathematics textbooks is very concise and coherent with few illustrations" (as cited in Yang, 2014, p. 76). Though, these questions may efficiently improve students' performance, it may make students feel bored and cause them to gradually lose interest in math.

In addition, exams are critical to student success and remain the most significant priority in China's education system (Kirkpatrick & Zang, 2011). Students have to write many kinds of exams, and if they hope to gain admission to prestigious schools, they have to treat the high-stakes exams seriously, particularly the Middle School Entrance Exam (MSEE), High School Entrance Exam (HSEE) and *Gaokao* (Feng & Li, 2016). Because students are studying in a highly competitive setting, students not only have to work diligently to earn an ideal math score in MSEE, HSEE and *Gaokao*, but they must also come to see failure as a potential reality. Of course, a strong focus on exams scores has the potential to prevent any deep learning, which require time and dialogue. Finally, under such pressure, students may easily have math anxiety when they take the examinations.

***Teacher's qualification.*** Teacher qualifications fall under three categories: teaching skill, administration skills, and attitudes.

*Teaching skills.* In China, most of qualified teacher candidates have graduated from official teacher colleges, where they are systematically trained in terms of teaching pedagogy and the orientation of the formal tests. In order to select a formal teacher in actual schools, teacher candidates have to be appraised on both professional teaching skills and ethical rules (Zhu, 2010, p. 377). In Chinese primary schools, teachers learn that the state-mandated textbook has absolute authority: "the student texts and teacher manuals are authoritative texts that many teachers feel they have to diligently consult in order to perfect their teaching skills and to achieve successful teaching" (Fan, 2004, p. 263). Thus, teachers have to learn the textbook knowledge to ensure they are current with the new curriculum plan, and they must also complete a recent paper to know what information is current and should be tested. Again, in the Chinese context, we see a strong emphasis between teaching and learning and exam scores. Nonetheless, teachers have

abundant experience as students on the examinations that they can bring to the classroom.

In most Chinese primary schools, a group meeting is held on a monthly basis with the purpose of giving math teachers a chance to exchange opinions on the teaching plans and students' feedback. Teachers will sit together, design the teaching plan, and share their teaching methods and experiences (Zhang, 2005). Some schools provide teachers opportunities for their professional development as well because the professional development is a lifelong process from the initiation of teaching until to the retirement (Zhu, 2010, p. 378). As Chinese people have been strongly influenced by Confucian philosophy, the most common teaching method is "didactic method and methodological choice for the disciplinary teaching" (Spagnolo & Paola, 2010, p. 37). Furthermore, the large number of students, the limited time, and the full content in one class compel teachers to adopt an inflexible teaching strategy.

*Teacher's administrative skills.* It is also necessary for teachers to be equipped with administrative competencies that allow them to manage a class's comprehensive issues. For example, when a math teacher in charge of being a head teacher of a class, it is more common for him or her to access and observe students' performances beyond the math class time. In such situations, the teacher is able to evaluate a student's academic strengths and weaknesses within an objective context, and in turn, utilize appropriate methods to address the student's issues with schoolwork and math specifically. Sigley and Wilkinson (2015) state that it is essential for teachers to learn how students function in a variety of situations as it allows teachers facilitate students' development based on their requirements. The classroom environment is the most influential factor that can affect children's motivation (Mata, Monteiro & Peixoto, 2012). Head teachers can arrange a good student to sit next to a student who is struggling with their math. Although this approach is limited in that it places an unfair burden to some degree on the

student-as-teacher, this approach may help facilitate an environment that promotes peer-to-peer studying. In the study group, the good students not only get a sense of achievement by helping others, but also get to review lesson content, which reinforces their learning and promotes higher levels of retention and recall. Additionally, head teachers also provide students who have a better performance in math with leadership opportunities in math learning groups, which can stimulate the students' motivation to study more.

As Confucius philosophy has heavily influenced education in China, it has reinforced the importance of "order, self-discipline, obedience and stability" (Ng & Rao, 2008, p. 160). Chinese teachers cultivate students' self-discipline and require that students keep quiet when they have class. This provides a precondition for a quiet learning environment where some students may learn best. Of course, it is important to note that not all students learn effectively under these conditions. That is why Chinese teachers use the teacher-oriented pedagogies to educate 45-50 students together within 45 minutes. In a traditional class, Chinese primary school teachers usually take the first ten minutes of a class to exercise students' working memory of numbers. This is because the memorization of numbers, calculation, and arithmetic rules are essential to students' future study, as well as their math processing (Lu et al., 2011). Then, the teacher educates students about the basic math concept through activities, which include group discussion, challenges, and individual or groups instructions (Li, 2007). When the math class is over, the teacher will give students homework every day based on what they have learned. Moreover, the teacher instructs students on math language and requires them to use math language orderly and clearly when they solve problems, as well as in examinations. In China, this is critical practice for the State-wide exams (Wei, 2014). In this way, a teacher-centered classroom climate and strict discipline may help cultivate some good study habits in some

students, which may include finishing their homework on time without teacher or parents' supervision, writing clearly, and listening to teacher and parents' instructions carefully and quietly in the class. All of these habits may provide some benefit to some students' in terms of their self-study. Of course, in a critical way, it is apparent that this type of teacher-centered classroom also produces a citizen who will make a 'good' worker on behalf of the State.

*Teacher's attitudes quality***.** Teachers' behaviors also affect students' attitudes towards math (Di Martino & Zan, 2010). Teacher's attitude toward math can be reflected in their teaching, and the methods they use when teaching math, which can influence students' thinking on math. If some teachers think mathematics is just a tool for supporting families and not dealing with math problems in real life, then students may see math as useless. This will not facilitate their learning. Therefore, it goes without saying that teachers' actions can influence students' attitude towards math, either positively or negatively.

***Peer motivation.*** In China, people have a tendency to adopt the maxim that 'birds of a feather flock together'; therefore, when children are young, parents prioritize who their children socialize with as this is a crucial period during which children form their personalities. Hughes, Dyer, Luo, and Kwok (2009) found children's academic performance may be influenced by their friends, and Morgenroth, Ryan, and Peters (2015) suggest that successful students can influence or inspire others in a group and be viewed as role models. Moreover, DeLay et al. (2016) also claims that when children first choose someone to be friends, they may consider peers' academic performance. That is why Chinese parents want their children to socialize with students who have a high academic achievement. In typical Chinese classrooms, the students who have high scores often become peer supervisors and they may be a model that encourages other students to study diligently. Teachers also use this philosophy for their seating arrangement, placing students

with high academic performance next to students who are struggling. This is done with the hope that the high-performing students will then take the responsibility of helping other students when they have difficulties in solving math problems. However, this approach is limited for a variety of reasons, not least because it assumes that there will be a healthy relationship between students, and also because it fails to question a funding model that does not provide enough classroom support.

**The influences from sociocultural factors.** With regard to sociocultural elements and for the purpose of this paper, there are three key influential factors: positive stereotypes, gender stereotypes, and social status.

***Positive stereotypes.*** Cvencek, O'Connor, Wischnia, Nasir, and Meltzoff (2014) state that Chinese students are often seen as model math students because they are diligent and are able to excel in academic performance with respect to math. Thus, there is a positive stereotype that Chinese students are good at math. Saad, Meyer, Dhindsa, and Zane (2015) found "subtle positive stereotype activation increases performance for more math identified participants (i.e., stereotype-consistent effect), whereas it decreases performance for less math identified participants" (p. 163). As an expectation from a sociocultural dimension, the positive stereotype is able to help many Chinese students to realize the necessity of displaying high-level math proficiency, which in turn motivates them to pursue greater success in math. Of course, this is not to say that not all Chinese students do well in math. Some Chinese students struggle in math, and some fail, like any group of young people coming from any population across the globe. However, some students aim to pursue external social achievements, like prizes of the advanced math or some competences of math. To fulfill expectations and earn prizes, many Chinese students devote their efforts to math studies (Shim, Cho, & Wang, 2013).

***Gender stereotypes.*** Math has historically been gendered male in a way that has disadvantaged girls. Gender prejudice, which is a negative stereotype of math education, potentially decides that the standard to evaluate a student's performance and achievement is based on the gender classification. Krkovica, Greiff, Kupiainenb, Vainikainenb, and Hautamäkib (2014) state that the more gender stereotypes are present in the school, the more gender stereotypes affect students. The threat of stereotypes exists everywhere, whether in school or society. That means girls socialized to accept, or at least consider, the stereotype that girls are not as good at math as boys. The stereotype threat on gender difference in math can be shown by examining peoples' assumptions that girls are not inclined to succeed in math, and if girls do not perform well in math class, it is because of the limitations of their gender and not due to a lack of effort or negative teacher/parent attitudes (Hastings, 2013). Therefore, from the gender perspective, many Chinese parents will accept poor math performance from their daughters, while the will simultaneously hold high expectations of their sons in this regard. As a result, female students easily lose motivation and confidence when they do not perform well on a math test, while male students are less likely to feel anxious when they face struggles in math.

***Social status.*** In China's educational context, social class, and the distribution of educational resources are also important factors that heavily impact students' math education. In some way, there is no bigger issue when it comes to securing a quality education than the urban-rural divide in China. Stout (2013) states that the students who live in urban areas will have more opportunities to go to university than the students who live in rural area. Schools in cities have abundant materials and tools for students, which facilitates students' learning and enriches their learning experience, thereby improving their creative abilities. These abilities are essential for students' math thinking. In addition, most high-quality teachers are in cities because the living

conditions in rural areas are more difficult and there is no opportunity for teachers to study and train. Thus, students in rural areas cannot access the advanced tools to aid their learning, nor can they enjoy useful learning methods. The labour pool for teachers in China is unbalanced as rural "teachers have not had any formal teacher education before entering the teaching profession" (Zhu, 2010, p. 375). This results in rural education lagging behind urban education. Moreover, students drop-out are higher in China's rural areas, where poverty rates are much greater than their urban counterparts. This remains true even though the education system in China has nine years of compulsory education (Luo, Frijters & Meng, 2012).

This creates a cycle of education disparity as the children of wealthy families can more easily secure high-quality education and then get high-paying jobs, which then secures more ideal education advantages for their children. While for the children from impoverished rural families cannot access high-quality education; thus, they struggle to secure high-paying positions and are less likely to be able to provide their children to access to quality education. This is a vicious circle in China and is the main reason that the imbalance in China's education system is perpetuated.

**Influential Factors that Shape Ontario Students' Math Engagement**

In Ontario, students' math understandings are shaped by three important elements: family, school, and sociocultural factors.

**The influential factors from family.** Research suggests that family context can impact students' math outcomes and that four core factors have the most influence: parents' belief, parents' expectations, cooperation between parents and teachers, and students' self-conception.

***Parents' belief.*** Children's attitudes and beliefs towards math are often and sometimes powerfully related to parents' beliefs (Prendergast & Zhang, 2016). Missall, Hojnoski, Caskie,

and Repasky (2015) argue that the students' performance in early kindergarten has a close relationship with grade one and grade two math performance. Cannon and Ginsburg (2008) also state that between 3-6 years old is a vital period for children to construct a foundation for future math learning. They also claim that the time the parents and children spend together is essential to furthering children's study. Thus, parents' beliefs about math plays an important role in forming students' conception of the math in their early childhood period. If parents can provide children with high-quality math education when they are young, then children will be able to engage in math in deeper and more meaningful ways in school. Thus, because the frequency of home activities can influence children's performance during children's early year (Missall et al. 2015), the home environment is crucial to cultivating students' math abilities and knowledge (Huntsinger, Jose, Larson, Krieg, & Shaligram, 2000). However, according to Musun-Miller and Blevins-Knabe (1998), parents think that social skills and general information are more important than the math skills in preschool child (p. 198). Moreover, one barrier to enhancing math education in Ontario is, as Galper, Wigfield, and Seefeldt found, that parents think the alphabet is more important than numbers for the primary students (as cited in Cannon & Ginsburg, 2008, p. 240). Therefore, some parents' belief that math is not really as important as subjects such as language arts may lead children to share this belief, which in turn negatively impacts their study motivation with respect to math.

***Parents' expectation.*** Soni and Kumari (2015) claim that parents' attitude influences children's involvement in class activities and the level of math because parents' assumption will decide their children's math engagement. If parents do not have a high expectation of students' math performance because they do not have relative experience when they are young, then children may not be willing to devote their efforts to improving their math. If young students do

not know what the intrinsic value, utility value, and cost value are, they only have the attainment value from parents' praise and encouragement. If parents do not care about their children's math performance, then children will not be motivated to apply themselves to their math studies.

***Cooperation between parents and teachers.*** Epstein (1986) states that schools and families share the responsibility of educating children and are encouraged to communicate and cooperate with each other. If parents are involved in their children' study, they can learn about their children's schooling experience and the teachers' teaching quality, which can help them understand their children's academic performance and their teachers' expectations (Epstein, 1986). This accordingly decreases conflicts between teacher and parents. Many parents think math should only be taught by the teachers because most parents do not have the confidence that they can teach children math (Tudge & Doucet, 2004). However, teachers believe that parents need to engage in students' activities to solidify the knowledge that students learn in school (Ontario Ministry of Education, 2010b). This situation leads to a decrease in students' math engagement. Furthermore, given the way schools in Ontario are structured to value white middle-class norms, if the parents are from a lower socioeconomic background, they may not feel that they have the educational background or necessary resources to adequately support their children's math studies (Delgado-Gaitan, 1991). Likewise, parents who are isolated from their native cultural environment may not come from a culture where parents are expected to participate in their children's study, or may lack the language skills to engage with the host culture's curriculum; thus, they are not likely to support their children's math studies (Delgado-Gaitan, 1991). When there is an impediment inhibiting cooperation between parents and teachers, the students who have an interest in math may miss an opportunity to construct a solid foundation for their math learning.

***Students' self-conception***. Students' self-concept will be influenced by a variety of complicated factors such as gender. As in China, math in Ontario has historically been gendered masculine, which has disadvantaged girls in Ontario (Mata, Monteiro, & Peixoto, 2012). Farood and Shan (2008) claim, in part, that gender difference is based on the students' self-perception and that girls believe math is boys' domain area. This belief leads many girls to lack self-confidence when they take an exam, which results in girls' struggling to reach their potential in math, as well as science. Thus, their scores are often not reflective of their real math abilities. In addition, Johnson (2004) states that in his study, when girls need help in math, they were often neglected by the teachers and peers because peers were busy with their work and teachers were helping boys. This makes girls feel as if they are abandoned by teachers and peers, which discourages them from expressing further interest in participating in class activities.

**The influential factors from school.** Several factors related to school also influence students' math engagement, including, but not limited to, the mathematics curriculum, text-books, the EQAO examination, teacher qualifications, teaching methods, and peers' influences.

***Math curriculum in Ontario.*** Ontario's math curriculum is designed using five 'strands': number sense and numeration, measurement, geometry and spatial sense, patterning and algebra, and data management and probability (Ontario Ministry of Education, 2005). The curriculum lists the content of each grade knowledge that students need to learn from the five strands, and there are specific and overall expectations that students are expected to master when they finish a period of study. These include aspects relating to problem solving, reasoning and proving, reflecting, selecting tools and computational strategies, connecting, and representing. When students take a standard exam in Grade 3 and Grade 6, and in Grade 9, they may find that the knowledge is too advanced for them as it is beyond their cognitive abilities (Alphonso &

Bocknek, 2017). This means the curriculum goals are do not correspond with their current situation. For example, according to Oldridge, the curriculum requires that students calculate the surface area and volume of a triangular prisms in grade six; however, the students still need more practice on area and volume and then continuing triangular prisms in grade seven (as cited in Alphonso & Bocknek, 2017, p. 1). Thus, even though the Ontario curriculum goals is clearly listed in the textbook, not everyone can reach the goals for a variety of complicated reasons.

***Ontario math textbooks***. Georgiou, Stavrinides, and Kalavana (2007) note that textbooks can also influence the students' performance. Math textbooks in Ontario often illustrate math problems with pictures, which can help students understand the questions more easily (Zhu & Fan, 2006). Xu (2016) found that researchers suggest that the teachers should not only use the math textbook but also use other printed materials, such as newspapers, picture books, and reading materials, along with hands-on math manipulatives. She suggests that these tools can improve students' reading abilities, which play an important role in solving math problems. In addition, because Ontario is a multiracial province that has a large international population (Expert Panel on Literacy and Numeracy, 2005), and because each province has its own unique students body and unique needs, there is a group of math teachers in Ontario who design the textbook and draw the questions independently based on Ontario situation to enhance students' interest in math (New Teacher Induction Program, 2011).

***Math examination of EQAO.*** Another influential factor in Ontario school context is the EQAO math examination. Pang and Rogers (2013) note that the EQAO "is an independent provincial agency founded by the Government of Ontario (p. 1). The EQAO focus on monitoring "students' achievement at key points in their learning as a way of assuring the public that all students were being assessed in the same way and according to an established set of standards"

(EQAO, 2013, p. 5). In addition, the EQAO is also able to suggest an instructive orientation to policymakers on the schoolboard, which contributes to making advanced teaching plans and pedagogies (Pang & Rogers, 2013). Gardener (2017) also states that the mathematics classes in Ontario have been overwhelmingly focused on teaching students test-taking skills and spending more time preparing for tests. As some parents take the EQAO scores as a measurement of choosing schools for their children, to attract more students, the schools pay more attention to testing and practicing rather than teaching (Neill, 2008). To improve students' mathematics performance and earn high EQAO scores, teachers give students more challenging math homework, and schools put much pressure on school administrators (Neill, 2008). This causes students to lose confidence and struggle with math (Pedro, 2014). This situation is inconsistent with the primary goals of education. Therefore, educators and parents should take an object attitude on the EQAO as to ensure that it fulfills its intended function with regard to children's performance.

Apart from the EQAO, there are also some examinations in school that focus on testing students' knowledge; however, some teachers would like to use low-stake test, which can stimulate students' motivation to study (Penk & Schipolowski, 2015). Because low-stake tests do not put too much pressure on students as would an exam, they reduce math anxiety when students take math examination (Jones, 2016).

***Teacher qualification.*** Primary teachers in Ontario are requires to complete four years of full-time study at a university to get a postsecondary degree and then four-semesters of postsecondary study to get a bachelor of education degree (Ontario College of Teachers, n.d.). Moreover, the Ministry of Education requires that teacher training last two years (Mendaglio, 2014). Based on these conditions, the Ontario primary school teacher must be a qualified teacher.

Because the qualified mathematics teacher can know to how to teach students mathematics with enjoyment and transform the theories into the effective strategies and skills for solving problems more professional (Ingvarson, Beavis, Bishop, Peck & Elsworth, 2004). Therefore, Ontario primary teacher's teaching qualification can be guaranteed.

***Teaching methods.*** In 1985, the Ontario government introduced the guidelines "that described approaches to teaching mathematics through inquiry, problem solving, and the use of technology" (Craven, 2003, p. 1). Teachers help students develop critical thinking when they face difficulties and the abilities to connect old knowledge with new knowledge, which are abilities they likely need in the future. Meyer states that the best way to teach math is to propose a question for students before they have class, but that the problem must arouse children's interest so that they explore the answer (as cited in The Canadian Press, 2015, p. 1). Therefore, the approaches of teaching mathematics through inquiry, problem solving, and the use of technology are widely used throughout Ontario.

Under the influence of these guidelines, teachers in Ontario focus more on teaching students how to solve problems independently instead of simply giving them answers of questions (Ontario Ministry of Education, n.d.b). Sometimes, teachers will use teaching tools as an aid for students to solve problems and help move students become independent. Teachers in Ontario are discouraged from using the drill-and-kill format to teach students, though some may still do this. Drill and kill simply means students learn by excessively repeating content without thinking. Honigsfeld and Dunn (2009) suggest, "drill-based activities that leads to the destruction of student joy in learning and motivation" (p. 220). Ontario teachers often like to encourage students to learn content through real-world applications and find answer by themselves. Ontario math teachers also prefer to be a helper for students, not an expert (Lawson, 2007). As a result,

Ontario classrooms are grounded in discussion, dialogue or, 'math talk', which reflects the constructivist philosophy that underpins the math curriculum. Because math talk can cultivate students' math thinking by talking with each other, which allows them to reconstruct their thinking and verify their answer through discussion (Sinay & Nahornick, 2016). Creating a safe environment for students is essential as it can to improve student confidence in math and stimulate their motivation to participate in the classroom activities (Sinay & Nahornick, 2016). In this environment, Ontario teachers use various strategies to engage students' in discussion and dialogue (Suurtamm, 2017). This approach may help students express their questions or clear up any confusions they may have while helping them express their opinions or questions. If the students do not have a correct answer, teachers will lead them to the correct directions.

Ontario teachers also ask practical questions that are meant to connect to a student's real-life experiences. They teach students the practical ways to solve math problems in a way that reflects the world around them. Golafshani (2013) claims that a good math teacher should be an affiliate for students and not simply transfer knowledge from textbooks to the blackboard, but work hard to make the lesson meaningful for the student. One of the ways teachers can do this is through the use of manipulatives, tools that help students visualize math concepts. Manipulatives can be divided into two categories; virtual manipulatives, and physical manipulatives (Kilgo & White, 2014). Virtual manipulatives can solve mathematics problems efficiently while the physical manipulatives enable students to do things with their hands, which can deepen students' memory about this knowledge. The virtual manipulatives may require teachers to master a certain knowledge and lead students directly, otherwise this approach may be too time consuming. Physical manipulatives exercise students' operational abilities but and follow the instruction of "learning by doing" (Kilgo & White, 2014). According to Golafshani (2013), the

best way to improve students' mathematics performance is to combine the virtual manipulatives and physical manipulatives because two methods can benefit both abstract and visual learners. Then, no matter which types of learner a student might be, all students can learn to improve their mathematics confidence and interest. Thus, teachers find manipulatives to be an effective way to help students to transform abstract knowledge to the practical knowledge. In addition, the manipulatives can positively affect students' learning attitudes and improve students' confidence in mathematics, which can reduce students' mathematics anxiety (Vinson, 2001). Therefore, the teaching method in Ontario is mainly focused on improving students' interest in learning mathematics with enjoyment and emphasis the utility function of mathematics in real life.

***Peers' influences.*** Kotsopoulos (2010) states that peers' potential influence will influence the formation of students' sense of mathematics. If some peers stay in a given social circle that has an interest in math and enjoys things related to math, then others in that group are more likely to adopt an interest in math, which shapes students' learning habits as they relate to math. Froiland and Davison (2016) found that peers will shape students' intrinsic motivation on mathematics because friends are easily influenced by each other. Carr, Barned, and Otumfuor (2016) also state that students usually evaluate their own abilities by looking their peers' performance. Then, peers can be positively influenced with each other if all of them are interested in mathematics. This influence can help develop a positive, competitive atmosphere in a classroom (DeLay et al., 2016).

**The influential factors from sociocultural aspects.** The government often improves students' mathematics performance through policy and finance.

***Government's policy support.*** In Canada, the Ontario English Catholic Teachers' Association (2016) states that parents are students' most important partners when they study

mathematics, and a warm environment is an essential factor to form the interest in mathematics learning. Thus, parents' involvement in children's learning period is critical. The Ontario government has been focusing on improving the quality of pre-education program, especially with regard to enlightening education on mathematics (Ontario Ministry of Education, 2016). Policymakers have made many relevant policies and have published guidebooks to make parents realize the importance of participating in children's pre-education period ("The new and improved math strategy," 2017), such as "Encouraging math learning at home: A guide for parents." (Ontario English Catholic Teachers' Association, 2016). This guide book is designed to teach parents about Ontario's math curriculum and encourage their involvement, which can cultivate students' understanding of mathematics through activities done in advance of class When students access mathematics in primary school, they will have confidence in studying mathematics because they have already learned in their daily activities (Ontario Ministry of Education, n.d.a). Therefore, with the help of positive and productive policies, citizens in Ontario have highlighted how pre-education can cultivates student's critical thinking patterns, problem solving abilities, and communication skills. These competences are essential to students' success in a sociocultural context (Ontario Ministry of Education, n.d.a).

***Government's financial support.*** Apart from the guidebook for parents about participating in students' daily life, Ontario also devote 60 million dollars in the Renewed Math Strategy, which can help students, teachers, educators, and districts to get better math results and improve collaboration among them (Ontario Ministry of Education, n.d.b). In order to help more students to improve their math performances (Ontario Ministry of Education, 2016), this strategy not only extends the math learning time, but also increase the number of lead teachers up to three in all elementary school (Ontario Ministry of Education, 2016). Ontario students will hopefully

be stimulated by the support and will try their best to improve their math performance.

**Similarities and Differences of Influential Factors**

This overview of current research will analyze some of the key similarities and differences between the influential factors that impacts mathematics education in China and Ontario with regard to family, schools, and society.

**Similarities in family.** Both Ontario parents and Chinese parents have high expectations for their children' math performance. Yet both contexts feature the stereotype that girls cannot perform as well as boys with respect to math. Gunderson, Ramirez, Levine, and Beilock (2012) claim that parents' gender-biased expectation negatively impacts girls, resulting in lower levels of achievement and self-efficacy for girls. In addition, mothers' experiences with and their attitudes towards mathematics will influence their children's math performance, especially with respect to their daughter because "educated mothers will have different aspirations and expectations when they are role modelling for their daughters" (Abuya, Oketch, Mutisya, Ngware & Ciera, 2013, p. 634).

**Similarities in school.** Under the strategies of teaching mathematics in Ontario and Confusion's education philosophy, both China and Ontario highlight the students' capacities of independent logical thinking and solving problems (Heng, 2013). Educators from China and Ontario operate based on a philosophy that adopts a constructivist teaching pedagogy, cultivating students to become "autonomous learners" (Abulnour, 2016, p. 6). Certainly, becoming an independent, thoughtful thinker is a primary goal in both contexts.

In addition to teaching and assessment methods, teachers' attitudes and expectations can affect children's mathematics performance. Teachers from both China and Ontario expect their students to be successful in math. Moreover, the teachers also use different ways to improve the

students' mathematics performance in their own context. Despite this, whether students are from China or Ontario, many of them have a degree of math anxiety, which can result from low exam and test scores, and in in turn drive students away from math and foster a dislike for the subject (Hill et al., 2016).

**Similarities in sociocultural aspect.** The gender stereotype on girls' mathematics still exist in Ontario and China and result in girls having lower levels of confidence in mathematics (Ganley & Lubienski, 2016). In addition, the gap between different social classes is also an issue and negatively impacts students from families with lower socioeconomic backgrounds. Some issues come down to 'Classism'. For example, along with facing other structural and systemic issues, students from working poor and working-class backgrounds face negative stereotypes in the classroom, whether from teachers and others. In addition, students from working poor and working-class background do not necessarily have the economic resources to pay for private tutors to help them develop their math skills. Finally, many working poor and working-class families do not have the luxury of having parents available to them for support given that many of them work longer hours.

**Differences in family.** In China, there is a saying that "all jobs are low in status, except study, which is highest" (Leung & Shek, 2011, p. 201). Thus, to study is a way for students to change their lives, especially for the students from families with lower socioeconomic backgrounds who have an opportunity to fulfill their parents' education goals by improving their economic standing (Hu & Hagedorn, 2014). Parents often give up their personal needs and provide their children with advantages in their studies by spending money on tutors, academic tools such as computers, and nourishing food (Leung & Shek, 2011), and even parents in families with lower socioeconomic backgrounds are not excluded from these practices. For

example, Chinese parents primarily focus on students' scores and invest more time and energy in children's study. To improve the academic scores, the parents of children with lower-grades will check their children's homework, while the parents of children with higher-grades will send their children to extra-curriculum classes. Therefore, students' mathematics performance cannot be separated from parents' support, and China is no exception (Lu, Weber, Spinath & Shi, 2011).

As Ontario parents stress people's inherent interest and personal development, parents generally do not force their children to study subjects that they are not interested in. Instead, they often encourage children to follow their nature, pursue studies they enjoy, and focus more on their creativity abilities (Heng, 2013). Even though children might not have a clear understanding of what they like, parents also encourage children to explore different academic options in order to discover their intrinsic interests. Therefore, parents in Ontario are generally more focused on students' instincts than Chinese parents, who instead focus on academic achievement. Ontario parents are also more likely to encourage a comprehensive development of their children than Chinese parents.

Apart from parents' influence, students' self-expectation of their mathematics performance also influences their math performance. Their self-expectations relate to their interests, achievements and usage of the subject. Chinese students' self-expectations are often shaped by external factors, such as parents and teachers' encouragement and the pressure of exams. Alternately, Ontario students' self-expectation come from their intrinsic interest because they have been trained to be independent thinkers and can thus pursue their goals.

**Differences in school.** Schools in China and Ontario also differ with respect to teachers' authority, curriculum design, classroom capacity and teaching pedagogy, and the orientation of math examinations and textbooks.

***Teachers' authority.*** In China, under the influence of Confucian thinking, students need to respect teachers, which makes teachers sacred to students (Ma, 2010). Students' respect for teachers' authority is already established when they first enter a school context. Similarly, Chinese teachers likewise have a sense of being a model for and authority to students and do not allow themselves to make mistakes or fail when they try to figure out problems in front of students (Cui, n.d.). Therefore, rightly or wrongly, teachers feel they must always be 'correct' when they are teaching, which means making mistakes is not allowed. No doubt, this puts enormous pressure on teachers, but it also sends the message to students that making a mistake is 'wrong.' This attitude does little to promote the idea that students need to take risks in the classroom. However, Ontario teachers are in the position where they are in a mutual-study process with their students. This is not to say that students are not required to respect teachers in Ontario; they most certainly are. However, there appears to be a greater sense of informality between teachers and students in the Ontario context. Nonetheless, the relationship between teachers and students in Ontario is built on the notion of being supportive and caring (Da, 2015). Therefore, the relationship between teachers and students is more equal when they are exploring a mathematics problem (Da, 2015).

***Curriculum design.*** The design of Chinese math textbooks focuses on addressing academic problems. Chinese math curriculum is divided into four strands: "number and algebra; space and geometric figures; statistics and probability; relationships and synthesis" (Zhao, 2016, p. 103). In order to cultivate students' abilities to solve practical mathematics problems, Ontario math curriculum is divided into five strands: "number sense and numeration, measurement, geometry and spatial sense, patterning and algebra, and data management and probability" (Ontario Ministry of Education, 2005, p. 8). Comparing these two different curriculums in

Ontario and China reveals a number of surface differences. For example, the Ontario grade one to grade three students need to study the number from 1-1000, while the Chinese students they study the number from 1-10,000. With regard to measurement, geometric figures, and statistics, Chinese students have a faster schedule than Ontario students, but there is little practical usage of math mentioned in Chinese curriculum. In contrast, Ontario's math curriculum specifies the practical usages of math for each grade and requires the teacher to impart this knowledge to students (Ontario Ministry of Education, 2005).

***Classroom capacity and teaching pedagogy.*** In China, based on the population, the capacity for a classroom is 55 or more in most of public schools (Heng, 2013). Consequently, the 'teacher-centered' classroom model has been dominating China's education patterns for decades, which makes the teacher an absolute authority. As a result, students are more likely to be passive listeners instead of active participants in the class (Shao & Tamashiro, 2013). Chinese teachers primarily cultivate students' sense of numbers and calculating abilities, which can increase some students' accuracy rates and success in standardized examinations. However, among many other issues, this way of teaching may make Chinese teachers neglect the role that math plays in real life.

In contrast, the Ontario classroom capacity is between 20-30 students. As a result, teachers in Ontario are able to give students more individualized attention to support their academic needs. Suurtamm, Koch, and Arden (2010) state that students in Ontario are expected to not only solve problems, but to know what the functions of math is in real-world contexts. Teachers often encourage students to express their opinions freely in class, whether right or wrong. Hence, under this free atmosphere, the relationship between teacher and student is more equal (Heng, 2013). Moreover, Ontario teachers seemed to make more efforts to cultivate

students' abilities to solve problems by themselves. In this way, teachers are the helpers, supporters, and guides for students in their own learning. During math class, teachers usually educate students by asking a question at the beginning of the class. They then encourage students to use multiple approaches to solve problems. Sometimes students may fail, but teachers still give students encouragement and try to help them to the correct answer. Therefore, the differences in class capacity and teaching method between Ontario and China are decided by their population and teaching goals.

***The orientation of math examinations and textbooks.*** Chinese students have to take high stakes exams, such as the MSEE and the HSEE, which will determine whether they can receive a high-quality education resource. Thus, Chinese students tend to be highly motivated to do well on tests and consequently spend more time preparing for tests than Ontario students (Feng & Li, 2016). Their future is directly linked to their exams scores. Furthermore, the frequent and high-stakes exams and their corresponding probabilities of failure place a much higher burden on Chinese students, who are more likely to suffer the feeling of failure earlier than Ontario students. The exams are clearly stressful for Chinese students and their families. While in Ontario, the scores of EQAO do not have direct influence to decide students' future study: it is just used to test students' degree of mastering knowledge. Consequently, students do not feel pressured to perform well on this examination. With this said, the standardized EQAO tests still generate some anxiety among students and their families, teachers, and others. For example, some parents in Ontario choose schools for their children according to the score ranking (EQAO, 2013); therefore, teachers and administrators might feel pressure to ensure their school has higher EQAO scores than other schools.

In contrast, Chinese math textbooks typically focus on solving 'what' not 'why' (Xu, 2016). Chinese math textbook consists of various steps that can exercise students' abilities to solve problems. Moreover, to improve students' solving-problems abilities, math textbooks add some challenging problems for students to try (Xu, 2016). However, Chinese math textbooks do not have multiple formations of questions, and the questions deviate from reality because there are about "15% problem-posing questions, and nearly 85% puzzle problems in the non-traditional problems types as identified in study" (Zhu & Fan, 2006, p. 618). In contrast, Xu (2016) states that Ontario students do not have a uniform math textbook. The Ontario math textbooks are designed based on students' situations and needs, which often stress the reality of life and the practicability of math.

**Differences in sociocultural aspect.** China and Ontario also differ with respect to expectation and social support on students' math performance.

***Expectation.*** Based on varying values, social expectations can encourage students to study math. Students who performed well in math are motivated by utility value and attainment value from society (Khattab, 2015). In China, most Chinese parents are excessively involved in students' academic growth (Hu & Hagedorn, 2014), which reduces the opportunities children have to exercise their autonomy and pursue their interests in school. Moreover, the Chinese job market has a high competency, which compels children have to study excessively. As a result, the promise of social and professional attainment motivates Chinese students to study math more diligently. "As Ontario's diversity is one of the province's greatest assets, schools need to be places where everyone can succeed in a culture of high expectations" (Student Success Implementation Branch, 2015). The expectation from society is not to develop the students to be the same person; rather, it embraces diversity. Neither do teachers require all students to study

math or literature; instead, they encourage students to study subjects they are interested in. Furthermore, many government documents encourage teacher to use diverse ways to teach students math in order to encourage students to intrinsically enjoy math and realize its utility. Consequently, most Ontario students who pursue math do so for these reasons.

***Social support.*** In China, with the pressure of the highly developing society, parents do not want their children to lag behind others, so they send their children to different tutoring classes to access more knowledge in case their children cannot keep up with others (Bray, 2006). Consequently, more institutions and extra-curriculum classes are sprouting up with various formats, like international camps. In Ontario, however, the government often encourages parents to become more involved in their child's schooling, and to this end, the government publishes guidebooks, policies, and strategies to cultivate parental involvement and children's interest in math (Ontario Ministry of Education, 2018)

# Chapter 5: Implications

## Implications for Family

Families play an important role in the academic success of their children, especially with respect to math. Parents should hold high expectations for their children in math and foster and nurture a love of math, not necessarily because success in math will help them in the labor market, but because exploring math concepts is intrinsically beneficial. However, parents' high expectation of students may result in student's loss of confidence or anxiety if they fail in an examination (Murayama, Suzuki, Pekrun, Marsh & Lichtenfeld, 2016). Regardless, establishing appropriate expectations for their children's math performance and enhancing communication with teachers is essential to improving students' math performance. Cannon and Ginsburg (2008) state the time that parents and children spend together is essential for children's further study, especially for the period of 3-6 years old. Thus, Chinese parents should realize the significance of participating in their children's lives rather than only being focused on children's math performances. In addition, Chinese parents should also study the pattern of Ontario families, who create an environment for children to learn things based on their intrinsic interest and not based on the prescriptions of external forces.

Ontario parents are encouraged to pay more attention to math and perhaps increase the amount of time spent playing math games at home because complex mathematics knowledge has a positive influence on children's performance (Missall, Hojnoski, Caskie & Repasky, 2015). This is necessary to enhancing the math levels of children, and game play is an effective approach because it establishes goal-winning and because children like to challenge themselves to reach their attainment value.

## Implications for School

Students' math performance can be improved by enhancing teacher's professional skills, adjusting math curriculum and textbook, and building students' confidence.

**Implications for teachers.** Chinese teachers suffer huge stress from "society, parents and students, the school teacher evaluation policy, heavy workload, economic situation, and a variety of exams that teachers themselves had to take" (Liu & Onwuegbuzie, 2012, p. 161). This pressure can be harmful to teachers' health. Therefore, Chinese schools should care for teachers' physical health and psychological health. In addition, it is necessary to provide more opportunities for teachers to enhance their professional skills, increase their salaries, and improve teachers' welfare. For the teaching method, teacher's aim should not be to simply teach children how to take an examination; rather it should be to teach students to love math and also understand how math skills can be practically useful, which cannot always be tested by examination (Neill, 2008). Hence, Chinese teachers need to create more math scenarios that relate to practical situations, design various formations of questions, pay more attention to the utility of math, and develop more interesting questions instead of surface level questions (Li & Ni, 2012). Chinese teachers should also encourage students to express their thoughts freely in class, which can help students develop a clear conception of mathematics knowledge. Teachers should likewise use their behaviors and attitudes to influence students' attitudes to math. If the students do not like math and think it is useless, the teachers can use different methods to introduce math from a practical and engaging perspective, which can help students discover math's utility and increase students' intrinsic interest in math. If students set high goals with respect to their math skills, teachers can help them to realize their abilities from an object point.

Ontario teachers, conversely, need to enhance the frequency of communicating with parents and work with parents to address students' barriers in studying math. Ontario teachers

also need to enlarge their math knowledge and pay more attention to improving students' memory regarding numbers, rules, and related math languages because working memory is also important in math learning (Lu et al., 2011). For the teaching method, Ontario teachers need to learn Chinese teachers' teaching pattern that teach students new knowledge based on the previous knowledge and create more examples for students to review the previous knowledge. Because using "prior knowledge not only helps students to review and reinforce the knowledge being taught but also helps them to picture mathematics as an integrated whole rather than as separate knowledge" (An, Kulm & Wu, 2004, p. 165). As a result, this teaching method can help students develop a deep connection between previous knowledge and new knowledge. Ontario teachers may likewise need to cultivate students' self-discipline, which can improve the efficiency of teaching and cultivate students' concentrations in math. Lastly, math language utilizes specific words or phrases, as well as common terms with specialized meanings in math (Uptegrove, 2015). Thus, teachers in both China and Ontario must build student's math vocabulary to help students develop a deeper understanding of and love for math.

**Implications for math curriculum and textbook.** The Chinese math curriculum needs to add the questions that are more closely related with real-world applications and reduce the tasks that primary school students have to finish. It would make much more sense if students engaged in tasks that were creative and exploratory in nature. Alternately, Ontario's education administrators may need to consider students' cognitive abilities with regard to math and increase the amount of time they spend on calculating exercises. There is an argument to be made to get rid of textbooks altogether classrooms. However, barring this, textbooks in both China and Ontario should consider and utilize methods that facilitate students' learning. Chinese textbook, for example, should add more questions or scenarios that explore practical

applications, which can help students learn how to solve problems if they meet similar difficulties in life. Additionally, textbooks should be designed to be interesting and useful for students, which may positively impact students' learning. In contrast, Ontario textbooks need to add some appropriate and challenging questions so as to ensure students comprehend the underlying concept of problem. For example, students may know that four and four make eight, but they may not be able to respond the question "How many ways can we find to arrange these eight gerbils in these two cages?" (Ontario Ministry of Education, n.d.b, p. 27). They should also incorporate more math language, which is an efficient way to learn math, especially for the students who are at the beginning of their math studies.

**Implications for building students' confidence.** Chinese schools should help students set appropriate future expectations for themselves and motivate students to fulfill their goals (Ma, 2001). The most fundamental way to eliminate students' math anxiety is to cultivate students' confidence when they are young, at which time teachers can make students familiar with math and then encourage them to develop this understanding. Building students' mathematics confidence is a step-by-step process (Ganley & Lubienski, 2016) that requires teachers to have patience. Meece, Wigfield, and Eccles (1990) state that teachers can also practice students' mathematics skills with low-stake quizzes to increase their confidence in mathematics. Ontario teachers effectively cultivate students' confidence with this approach because they encourage students with praise and small prizes.

### Implications for Sociocultural Aspect

Hughesa, Wu, and West (2011) claim that high-quality teachers and advanced technology should be accessible to all students, regardless of their academic level and social status. The government should set minimum education funding for rural areas that can guarantee equitable,

high quality education for all. Apart from the quality of education, gender stereotypes in education remain a problem. Gender bias in schools can significantly influence how students think about themselves as students. However, breaking down gender stereotypes can be challenging as gender discrimination is often camouflaged and difficult to address (Kasman, 2007). One way to address this issue would be to design text books that are more inclusive.

## Chapter 6: Conclusion

In a global context, the areas of science and technology research are considered two significant measurements when evaluating the economic competency of countries. Therefore, math education, as the base of science and technology, has been the focus of a significant amount of research in both Ontario and China. This paper explores some of the factors that influence students' math education in Ontario and China and suggests actionable recommendations to address improve math outcomes. Within these cultural contexts, differing parental attitudes, geography, textbooks, teacher quality, teaching methods, and stereotype all affect students' academic performance. Among these, students are influenced by various scholastic factors. As the target population of this paper is primary school students, social factors may influence their parents' thinking, which could manifest in the expectations they have for their children. Thus, the implications primarily focus on how to improve students' mathematics performance and engagement at school. Therefore, it is critical for the mathematics educators in China and Ontario to have some constructive communication in terms of mutually learning and improving the quality of math education.

In this way, Ontario might be able to adopt, at times and in a limited way, a more teacher-centered classroom, while also developing assessment practices and approaches to more effectively assess and evaluate students and identify issues on an on-going basis. Alternately, China might incorporate student-centered and multi-assessment tools to encourage more creative thinking and more extensive analytical skills among their students. Exploring the different pedagogical practices found in Ontario and China may benefit not only the students themselves, but the teachers and parents as well.

REFERENCES

Abulnour, R. (2016). *Constructivist assessment and evaluation in secondary science: How do Ontario secondary school science teachers who have demonstrated leadership and expertise in the area of constructivist learning theory enact assessment and evaluation?* Retrieved from https://tspace.library.utoronto.ca/bitstream/1807/72140/1/Abulnour_Raghda_A_201606_MT_MTRP.pdf

Alam, M. M. (2013). Banking model of education in teacher-centered class: A critical assessment. *Research on Humanities and Social Sciences, 3*(15), 27-31. Retrieved from http://pakacademicsearch.com/pdf-files/art/448/27-31%20Vol%203,%20No%2015%20(2013).pdf

Albert, J., & Kirwin, B. (2013, December 15). Social and welfare services. In *Historica Canada.* Retrieved from http://www.thecanadianencyclopedia.ca/en/article/social-and-welfare-services/

Alphonso, C. (2017, August 30). Half of grade 6 students fail to meet Ontario math standards. *The Globe and Mail.* Retrieved from https://www.theglobeandmail.com/news/national/half-of-grade-6-students-fail-to-meet-ontario-math-standards/article36124763/

Alphonso, C., & Bocknek, M. (2017, September 6). Wynne acknowledges problems with Ontario's math curriculum, vows 'broader refresh.' *The Globe and Mail.* Retrieved from https://www.theglobeandmail.com/news/national/wynne-ontario-math-curriculum-changes/article36192881/

An, S., Kulm, G., & Wu, Z. (2004). The pedagogical content knowledge of middle school, mathematics teachers in China and the U.S. *Journals of Mathematics Teacher Education, 7*(2), 145-172. Retrieved from https://link.springer.com/article/10.1023/B:JMTE.0000021943.35739.1c

Ayalon, H., & Livneh, I. (2013). Educational standardization and gender differences in mathematics achievement: A comparative study. *Social Science Research, 42,* 432-445. Retrieved from https://ac-els-cdn-com.ledproxy2.uwindsor.ca/S0049089X12002189/1-s2.0-S0049089X12002189-main.pdf?_tid=b1e1782a-2680-4955-baa2-2fa618383975&acdnat=1523856155_8cdd107e1f5d470b7dfbea0472ce1b6f

Barron, K., & Hulleman, C. (2014). Expectancy-value-cost model of motivation. *International Encyclopedia of the Social & Behavioral Sciences, 8*, 503-509. doi:10.1016/B978-0-08-097086-8.26099-6.

Beres, J. L., & Woloshyn, V. E. (2017). Instructional insights gained from teaching a research methods course to Chinese international graduate students studying in Canada. *Journal of International Students, 7*(3), 728-743. Retrieved from http://dx.doi.org.ezproxy.uwindsor.ca/10.5281/zenodo.570030

Bray, M. (2006). Private supplementary tutoring: Comparative perspective on patterns and implication: *A Journal of Comparative Education, 36*(4), 515-530. Retrieved from https://journals-scholarsportalinfo.ledproxy2.uwindsor.ca/pdf/03057925/v36i0004/515_pstcpopai.xml

Cai, J., & Nie, B. (2007). Problem solving in Chinese mathematics education: Research and practice. *ZDM Mathematics Education*, *39*, 459-473. doi:10.1007/s11858-007-0042-3

The Canadian Press. (2015, July 2). What is the best way to teach math? Old school or new? Teachers debate best methods as scores fall. *Macleans*. Retrieved from http://www.macleans.ca/news/canada/what-is-the-best-way-to-teach-math/

Cannon, J., & Ginsburg, H. P. (2008). "Doing the math": Maternal beliefs about early mathematics versus language learning. *Early Education & Development, 19*, 238-260. Retrieved from https://www-tandfonline-com.ledproxy2.uwindsor.ca/doi/pdf/10.1080/10409280801963913?needAccess=true

Carr, M., Barned, N., & Otumfuor, B. (2016). Peers influence mathematics strategy use in early elementary school. *International Journal of Educational Psychology, 5*(1), 27-55. doi:10.17583/ijep.2016.1861

Casad, B. J., Hale, P., & Wachs, F. L. (2015). Parent-child math anxiety and math-gender stereotypes predict adolescents' math education outcomes. *Front Psychol, 6*, 1597. doi:10.3389/fpsyg.2015.01597

Chen, Y. (2016). *Chinese parents' perspectives on parenting: Children's education and future prospects*. Retrieved from http://epublications.uef.fi/pub/urn_nbn_fi_uef-20161093/urn_nbn_fi_uef-20161093.pdf

Chen, X., Hastings, P. D., Rubin, K. H., Chen, H., Cen, G., & Stewart, S. L. (1998). Child rearing attitudes and behavioral inhibition in Chinese and Canadian toddlers: A cross-cultural study. *Developmental Psychology, 34*(4), 677-686. Retrieved from https://pdfs.semanticscholar.org/a287/c168f9a0a3d91eb187e7bf5587b44c98e3c0.pdf

Craven, S. (2003). The state of mathematics education in Ontario: Where we came from and where we are. *Canadian Mathematical Society*. Retrieved from https://cms.math.ca/Events/CSMF2003/panel/OntarioReport.pdf

Csanady, A. (2016, September 5). Ontario's math scores started declining as kids took the new curriculum, according to EQAO data. *National Post*. Retrieved from http://nationalpost.com/news/politics/ontarios-math-scores-started-declining-as-kids-

took-the-new-curriculum-according-to-eqao-data

Cui, L. (n.d.). *Culture makes the difference: The discrepancy between US education and Chinese education.* Retrieved from https://www.math.ksu.edu/math791/finalpaper/liliterm.pdf

Cvencek, D., O'Connor, K., Wischnia, S., Nasir, N. S., & Meltzoff, A. N. (2014). The development of math–race stereotypes: "They say Chinese people are the best at math." *Journal of Research on Adolescence, 25*(4), 630–637. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/jora.12151

Di Martino, P., & Zan, R. (2010). Different profiles of 'negative attitude toward mathematics.' *Journal of Mathematics Teacher Education, 13*(1), 27-48. Retrieved from https://pdfs.semanticscholar.org/8105/68b3a9b93ff9ad70bb48f064e7acc561b737.pdf

Devine, A., Fawcett, K., Szűcs, D., & Dowker, A. (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. *Behavioral and Brain Functions, 8*(33), 1-9. Retrieved from http://www.behavioralandbrainfunctions.com/content/8/1/33

DeLay, D., Laursen, B., Kiuru, N., Poikkeus, A., Aunola, K., & Nurmi, J. (2016). Friend influence and susceptibility to influence: Changes in mathematical reasoning as a function of relative peer acceptance and interest in mathematics. *Merrill-Palmer Quarterly, 62*(3), 306-333. Retrieved from https://muse-jhu-edu.ledproxy2.uwindsor.ca/article/656759

Delgado-Gaitan, C. (1991). Involving parents in the schools: A process of empowerment. *American Journal of Education, 100*(1), 20-46. Retrieved from http://www.jstor.org.ledproxy2.uwindsor.ca/stable/pdf/1085651.pdf

Dietrich, J., Dicke, A., Kracke, B., & Noack, P. (2015). Teacher support and its influence on students' intrinsic value and effort: Dimensional comparison effects across subjects. *Learning and Instruction, 39,* 45-54. Retrieved from https://doi.org/10.1016/j.learninstruc.2015.05.007

Education Quality and Accountability Office. (2013). *EQAO: Ontario's provincial assessment program its history and influence 1996-2012.* Retrieved from http://www.eqao.com/en/about_eqao/about_the_agency/communication-docs/EQAO-history-influence.pdf

Expert Panel on Literacy and Numeracy Instruction for Students with Special Education Needs. (2005). *Education for all: The report of the expert panel on literacy and numeracy instruction for students with special education needs, kindergarten to grade 6.* Retrieved from http://www.oafccd.com/documents/educationforall.pdf

European Commission. (2011). *Mathematics education in Europe: Common challenges and national policies*. Retrieved from http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/132EN.pdf

Escribano, J. (2016). Six reasons Asians are better at math. *Medium*. Retrieved from https://medium.com/@fesja/6-reasons-asians-are-better-at-math-ab88fcb3db0

Ewing, K., & Huguelet, B. (n.d.). The English of math: It's not just numbers. In *Authenticity in the Language Classroom and Beyond: Adult Learner* (pp. 71-83). Retrieved from http://www.tesol.org/docs/books/bk_CP_authenticityadults_608

Farood, M. S., & Shan, S. Z. U. (2008). Students' attitude towards mathematics. *Pakistan Economic and Social Review, 46*(1), 75-83. Retrieved from https://www.jstor.org/stable/pdf/25825325.pdf?refreqid=excelsior%3Ad02588bbe5952b957d8a23249b968c46

Feng, H., & Li, J. (2016). Head teachers, peer effects, and student achievement. *China Economic Review, 41,* 268-283. Retrieved from https://ac-els-cdn-com.ledproxy2.uwindsor.ca/S1043951X16301377/1-s2.0-S1043951X16301377-main.pdf?_tid=e0c5d8cd-e0d8-4ebf-afeb-bfb96b7062b0&acdnat=1522994244_13dcceea234f22191d3512e781d08190

Freire, P. (2005). *Pedagogy of the oppressed*. New York, NY: Continuum.

Froiland, J. M., & Davison, M. L. (2016). The longitudinal influences of peers, parents, motivation, and mathematics course-taking on high school math achievement. *Learning and Individual Differences, 50,* 252-259. Retrieved from https://ac-els-cdn-com.ledproxy2.uwindsor.ca/S1041608016301352/1-s2.0-S1041608016301352-main.pdf?_tid=7577f721-ca3e-44cb-88e1-76c7bbbecbeb&acdnat=1522994308_d63effff0a8d662de7b10795b65ea92e

Ganley, C. M., & Lubienski, S. T. (2016). Mathematics confidence, interest, and performance: Examining gender patterns and reciprocal relations. *Learning and Individual Differences, 47,* 182-193. Retrieved from https://ac-els-cdn-com.ledproxy2.uwindsor.ca/S1041608016300024/1-s2.0-S1041608016300024-main.pdf?_tid=3fcf78e4-c090-4d8b-bc81-cac1a230f66a&acdnat=1522994372_a4f614281ae2e824ced0c54afdbfb2bf

Gardener, D. K. (2017). *EQAO preparation and the effects on in-classroom instruction.* Retrieved from http://hdl.handle.net/1807/77011

Georgiou, S., Stavrinides, P., & Kalavana, T. (2007). Is Victor better than Victoria at maths? *Educational Psychology in Practice, 23*(4), 329-342. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/02667363/v23i0004/329_ivbtvam.xml

Gniewosz, B., & Watt, H. M. G. (2017). Adolescent-perceived parent and teacher overestimation of mathematics ability: Developmental implications for students' mathematics task

values. *Developmental Psychology, 53*(7), 1371-1383. Retrieved from https://journals-scholarsportalinfo.ledproxy2.uwindsor.ca/pdf/00121649/v53i0007/1371_apatooifsmtv.xml

Golafshani, N. (2013). Teachers' beliefs and teaching mathematics with manipulatives. *Canadian Journal of Education, 36*(3), 137-159. Retrieved from https://search-proquest-com.ledproxy2.uwindsor.ca/docview/1540743115?rfr_id=info%3Axri%2Fsid%3Aprimo

Guo, J., Marsh, H. W., Parker P. D., Morin, A. J. S., & Yeung, A. S. (2015). Expectancy-value in mathematics, gender and socioeconomic background as predictors of achievement and aspirations: A multi-cohort study. *Learning and Individual Differences, 37*, 161-168. Retrieved from https://ac-els-cdn-com.ledproxy2.uwindsor.ca/S1041608015000138/1-s2.0-S1041608015000138-main.pdf?_tid=9d4d0768-4e90-4c12-8c4f-0b00b682e2ed&acdnat=1522994652_11d0f00b70955b23cfe0b78f1f7dbbf3

Guo, S. (2017). Guanyu suoxiao gaokao wenli kelu qubi licha jude tian. [Proposal on narrowing the disparity of liberal arts in college entrance examination]. *Baidu Library*. Retrieved from https://wenku.baidu.com/view/c067e098b8d528ea81c758f5f61fb7360b4c2b19

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles, 66*, 153-166. doi:10.1007/s11199-011-9996-2

Green, S. K. (2002). Using an expectancy-value approach to examine teachers' motivational strategies. *Teaching and Teacher Education, 18*, 989-1005. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/0742051x/v18i0008/989_uaeatetms.xml

Hall, D. L., & Ames, R. T. (1947). *Thinking through Confucius.* New York, NY: State

University of New York Press.

Hanushek, E. A., Woessmann, L., Jamison, E. A., & Jamison, D. T. (2008). Education and economic growth. *Education Next, 8*(2). Retrieved from http://educationnext.org/education-and-economic-growth/

Hastings, M. N. (2013). *The gender of mathematics: Math is not born male*. Retrieved from https://epublications.regis.edu/cgi/viewcontent.cgi?referer=https://www.google.ca/&httpsredir=1&article=1618&context=theses

Heng, W. (2013). *Cultural interpretations of Socratic and Confucian education philosophy*. Retrieved from https://ir.library.louisville.edu/etd/605/

Hill, F., Mammarella, I. C., Devine A., Caviola S., Passolunghi, M. C., & Szűcs D. (2016). Maths anxiety in primary and secondary school students: Gender differences, developmental changes and anxiety specificity. *Learning and Individual Differences, 48*, 45-53. Retrieved from https://ac-els-cdn-com.ledproxy2.uwindsor.ca/S1041608016300164/1-s2.0-S1041608016300164-main.pdf?_tid=da88932a-6aba-4155-9809-89d1dee4cdd6&acdnat=1522994905_e296ae002ff8d9df2d90c016a42f8a01

Hu, J., & Hagedorn, L. S. (2014). Chinese parents' hopes for their only children: A transition program case study. *Education Publications. 223*, 34-42. Retrieved from http://lib.dr.iastate.edu/edu_pubs/16

Huntsinger, C. S., Jose, P. E., Larson, S. L., Krieg, D. B., & Shaligram, C. (2000). Mathematics, vocabulary, and reading development in Chinese American and European American children over the primary school years. *Journal of Educational Psychology, 92*, 745-760. doi:10.1037==0022-0663.92.4.745

Hughes, J. N., Dyer, N., Luo, W., & Kwok, O. M. (2009). Effects of peer academic reputation on achievement in academically at-risk elementary students. *Journal of Applied Developmental Psychology, 30*(2), 182-194. Retrieved from https://ac-els-cdn-com.ledproxy2.uwindsor.ca/S0193397308001433/1-s2.0-S0193397308001433-main.pdf?_tid=c4d5a862-f5af-48f8-a4ae-97f05b807263&acdnat=1522992369_6d8c267e4ccfc31fde5ec4f6af2ee73b

Hughesa, J. N., Wu, W., & West, S. G. (2011). Teacher performance goal practices and elementary students' behavioral engagement: A developmental perspective. *Journal of School Psychology, 49,* 1-23. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/00224405/v49i0001/1_tpgpaesbeadp.xml

Honigsfeld, A., & Dunn, R. (2009). Learning-style responsive approaches for teaching typically performing and at-risk adolescents. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 82*(5), 220-224. doi:10.3200/TCHS.82.5.220-224

Hoover-Dempsey, K. V., Bassler, O. C., & Burow, R. (1995). Parents' reported involvement in students' homework: strategies and practices. *The Elementary School Journal 95*(5), 435-450. Retrieved from http://www.jstor.org.ledproxy2.uwindsor.ca/stable/pdf/1001657.pdf?refreqid=excelsior:59ce09792e06929496e3de319618a7c4

Hoover-Dempsey, K., Walker, J., Sandler, H., Whetsel, D., Green, C., Wilkins, A., & Closson, K. (2005). Why do parents become involved? Research findings and implications. *The Elementary School Journal, 106*(2), 105-130. doi:10.1086/499194

Ibrahim, A., Aulls, M. W., & Shore, B. M. (2017). Teachers' roles, students' personalities, inquiry learning outcomes, and practices of science and engineering: The development and validation of the McGill Attainment Value for inquiry engagement survey in STEM

disciplines. *International Journal of Science and Math Education, 15,* 1195-1215. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/browse/15710068

Jaramillo, J. A. (1996). Vygotsky's sociocultural theory and contributions to the development of constructivist curricula. Education, *17*(1). 133-141. Retrieved from http://go.galegroup.com/ps/i.do?id=GALE%7CA18960235&sid=googleScholar&v=2.1&it=r&linkaccess=fulltext&issn=00131172&p=AONE&sw=w&authCount=1&u=wind05901&selfRedirect=true

Johnson, P. D. (2004). *Girls and science: A qualitative study on factors related to success and failure in science.* Retrieved from ScholarWorks. (1114)

Jones, M. G., & Brader-Araje, L. (2002). The impact of constructivism on education: Language, discourse, and meaning. *American Communication Journal, 5*(3), 1-10. Retrieved from http://ac-journal.org/journal/vol5/iss3/special/jones.pdf

Jones, S. (2016). A case for more testing: The benefits of frequent, low-stakes assessments. *Inside Teaching MSU*. Retrieved from http://insideteaching.grad.msu.edu/a-case-for-more-testing-the-benefits-of-frequent-low-stakes-assessments/

Jordan, N. C., Kaplan, D., Olah, L. N., & Locuniak, M. N. (2006). Number sense growth in kindergarten: A longitudinal investigation of children at risk for mathematics difficulties. *Child Development, 77,* 153-175. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/00093920/v77i0001/153_nsgikacarfmd.xml

Kaufman, J. E., & Rosenbaum, J. E. (1992). The education and employment of low-income black youth in white suburbs. *Educational Evaluation and Policy Analysis, 14*(3), 229-240. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/

01623737/v14i0003/229_teaeolbyiws.xml

Khattab, N. (2015). Students' aspirations, expectations and school achievement: What really matters? *British Educational Research Journal, 41*(5), 731-905. Retrieved from https://onlinelibrary-wiley-com.ledproxy2.uwindsor.ca/doi/epdf/10.1002/berj.3171

Kilgo, R. W., & White, A. A. (2014). Virtual versus physical: Manipulatives in the mathematics classroom. *26th International Conference on Technology in Collegiate Mathematics, 26,* 213-220. Retrieved from http://archives.math.utk.edu/ICTCM/VOL26/S097/paper.pdf

Kirkpatrick, R., & Zang, Y. (2011). The negative influences of exam-oriented education on Chinese high school students: Backwash from classroom to child. *Language Testing in Asia, 1*(3), 36-45. Retrieved from https://languagetestingasia.springeropen.com/track/pdf/10.1186/2229-0443-1-3-36

Kim, P. Y., & Lee, D. (2014). Internalized model minority myth, Asian values, and help-seeking attitudes among Asian American students. *Cultural Diversity and Ethnic Minority Psychology, 20*(1), 98-106. doi:10.1037/a0033351 10.1186/2229-0443-1-3-36

Krkovica, K., Samuel Greiff, S., Kupiainenb, S., Vainikainenb, M., & Hautamäkib, J. (2014). Teacher evaluation of student ability: What roles do teacher gender, student gender, and their interaction play? *Educational Research, 56 (*2), 244-257. Retrieved from http://dx.doi.org/10.1080/00131881.2014.898909

Koch, M. J., & DeLuca, C. (2012). Rethinking validation in complex high-stakes assessment contexts. *Assessment in Education: Principles, Policy & Practice, 19* (1), 99-116. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/0969594x/v19i0001/99_rvichac.xml

Kochenderfer-Ladd, B., & Pelletier, M. E. (2008), Teachers' views and beliefs about bullying: Influences on classroom management strategies and students' coping with peer victimization. *Journal of School Psychology, 46*(4), 431-453. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/00224405/v46i0004/431_tvababascwpv.xml

Kotsopoulos, D. (2010). An Analysis of talking aloud during peer collaborations in mathematics. *International Journal of Science and Mathematics Education*, *8*(6), 1049-1070. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/15710068/v08i0006/1049_aaotadpcim.xml

Lancaster, P. (2006). Mathematics and society. *The Canadian Encyclopedia.* Retrieved from http://www.thecanadianencyclopedia.ca/en/article/mathematics-and-society/.

Larson, C. (2007). The importance of vocabulary instruction in everyday mathematics. Retrieved from https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1033&context=mathmidactionresearch

Leaper, C., Farkas, T., & Brown, C. S. (2012). Adolescent girls' experiences and gender-related beliefs in relation to their motivation in math/science and English. *Journal Youth Adolescence, 41,* 268-282. doi:10.1007/s10964-011-9693-z

Lee, J. C., Yu, Z., Huang, X. H., & Law, E. H. (2016). *Educational Development in western China*. Netherlands: Sense Publishers. Retrieved from https://www.sensepublishers.com/media/2636-educational-development-in-western-china.pdf

Leung, F. K. S., Graf, K., & Lopez-Real, F. J. (2006). *Mathematics education in different cultural traditions: A comparative study of East Asia and the West*. New York, NY: Springer.

Leung, G. T. Y., & Shek, D. T. L. (2011). "All I can do for my child." Development of the Chinese parental sacrifice for child's education scale. *International Journal on Disability and Human Development, 10*(3), 201-208. Retrieved from http://ira.lib.polyu.edu.hk /bitstream/10397/5130/1/C12.pdf

Li, J. (2003). The core of Confucian learning. *American Psychologist, 58*(2), 146-147. doi:10.1037/0003-066X.58.2.146

Li, Y. (2007). Examining and understanding mathematics classroom instruction and possible contributing factors through a cross-national lens. *School Science and Mathematics, 107*(8), 308. Retrieved from http://link.galegroup.com.ezproxy.uwindsor.ca/apps /doc/A173747819/AONE?u=wind05901&sid=AONE&xid=6ca1367d.

Li, Y., & Kaiser, G. (2011). *Expertise in mathematics instruction: An international perspective.* New York: Springer. Retrieved from https://link-springer-com.ledproxy2.uwindsor .ca/book/10.1007%2F978-1-4419-7707-6

Li, Q., & Ni, Y. J. (2012). Debates on the basic education curriculum reform and teachers' challenges in China: The case of mathematics. *Chinese Education and Society, 45*(4), 9-21. Retrieved from https://www-tandfonline-com.ledproxy2.uwindsor.ca/doi/pdf/ 10.2753/CED1061-1932450401?needAccess=true

Lindberg, S., Linkersdörfer, J., Ehm, J., Hasselhorn, M., & Lonnemann, J. (2013). Gender differences in children's math self-concept in the first years of elementary school. *Journal of Education and Learning, 2*(3), 1-8. Retrieved from https://scholar.google.ca/scholar?q=Gender+++differences+in+children's+math+self-concept+in+the+first+years+of+elementary+school&hl=en&as_sdt=0&as_vis=1&oi=scholart&sa=X&ved=0ahUKEwif88O8gqXaAhVrwVQKHUZLAYkQgQMIJzAA

Lu, L., Weber, H. S., Spinath, F. M., & Shi, J. (2011). Predicting school achievement from cognitive and non-cognitive variables in a Chinese sample of elementary school children. *Intelligence, 39*, 130-140. https://doi.org/10.1016/j.intell.2011.02.002

Luo, C., Frijters, P., & Meng, X. (2012). Child education and the family income gradient in China. *School of Economics,* (470), 1-39. Retrieved from http://www.uq.edu.au/economics/abstract/470.pdf

Luo, W. (n.d.). Zhong li qing wen: Gao deng jiao yu "shi su lian" de jiao xun. [Stress science than arts: the "lesson" from Soviet Union]. *News 163*. Retrieved from http://view.163.com/special/reviews/education1209.html.

Lynch, J., & Alsop, S. (2007). *What works? Research into practice*. The literacy and numeracy secretariat and Ontario association of deans of education. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.495.5896&rep=rep1&type=pdf

Ma, L. (2010). Comparisons between mathematics education in China and the United States. National Research Council. *The Teacher Development Continuum in the United States and China: Summary of a Workshop*. Retrieved from https://www.nap.edu/read/12874/chapter/2

Ma, X. (2001). Participation in advanced mathematics: Do expectation and influence of students, peers, teachers, and parents matter? *Contemporary Educational Psychology, 26,* 132-146. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/11161644

Mata, M. L., Monteiro, V., & Peixoto, F. (2012). Attitudes towards mathematics: Effects of individual, motivational, and social support factors. *Child Development Research, 1*(11). Retrieved from https://www.hindawi.com/journals/cdr/2012/876028/

Meece, J. L., Wigfield, A., & Eccles, J. S. (1990). Predictors of math anxiety and its influence on young adolescents' course enrollment intentions and performance in mathematics. *Journal of Educational Psychology, 82*(1), 60-70. doi:10.1037/0022-0663.82.1.60

Mendaglio, A. (2014). A comparative review of mathematics educational strategies in Ontario and Finland. *Fields Mathematics Education Journal, 2,* 2-24. Retrieved from http://www.fields.utoronto.ca/journalarchive/FMEJ/100-58.pdf

Miller, G. A. (1995). WordNet: A lexical database for English. *Communications of ACM, 38*(11), 39-41. Retrieved from https://dl.acm.org/citation.cfm?id=219748

Missall, K., Hojnoski, R. L., Caskie, C. I. L., & Repasky, P. (2015). Home numeracy environments of preschoolers: Examining relations among mathematical activities, parent mathematical beliefs, and early mathematical skills. *Early Education and Development, 26*(3), 356-376. doi:10.1080/10409289.2015.968243

Monastersky, R. (2005). Why Chinese students score high in math. *The Chronicle of Higher Education, 51*(26). Retrieved from http://go.galegroup.com.ezproxy.uwindsor.ca /ps/i.do?&id=GALE%7CA147099318&v=2.1&u=wind05901&it=r&p=AONE&sw=w&authCount=1

Morgenroth, T., Ryan, M. K., & Peters, K. (2015). The motivational theory of role modeling: How role models influence role aspirants' goals. *Review of General Psychology, 19*(4), 465-483. Retrieved from http://psycnet.apa.org.ezproxy.uwindsor.ca/fulltext/2015-53029-001.pdf

Murayama, K., Suzuki, M., Pekrun, R., Marsh, H.W., & Lichtenfeld, S. (2016). Don't aim too high for your kids: Parental overaspiration undermines students' learning in mathematics.

*Journal of Personality and Social Psychology, 111*(5), 766-779. Retrieved from https://www.apa.org/pubs/journals/releases/psp-pspp0000079.pdf

Neill, J. (2008). EQAO and the Mismeasurement of Schools. *Education form*. 33-35. Retrieved from:http://susihomes.com/wp-content/uploads/2012/10/EQAO-and-the-Mismeasure-of-Schools.pdf

Ng, S. S. N., & Rao, N. (2008). Mathematics teaching during the early years in Hong Kong: A reflection of constructivism with Chinese characteristics? *Early Years, 28*(2), 159-172. doi:10.1080/09575140802020917

Ni, Y., Chiu, M., & Cheng, Z. (2012). Chinese children learning mathematics: From home to school. In M.H. Bond (Ed.), *Oxford Handbook of Chinese Psychology*. doi:10.1093/oxfordhb/9780199541850.013.0011.

Ontario College of Teachers. (n.d.). *Thinking about teaching?* Retrieved from http://www.oct.ca/~/media/D14950CF1D3648BA8772445A89046FF3.ashx

Ontario College of Teachers. (2016). *Foundations of professional practice.* Retrieved from https://www.oct.ca/-/media/PDF/Foundations%20of%20Professional%20Practice /Foundation_e.pdf

Ontario English Catholic Teachers' Association. (2016). *Encouraging math learning at home: A guide for parents.* Retrieved from http://www.niagaracatholic.ca/wp-content/uploads /2013/11/MathResourceforParents.pdf

Ontario Ministry of Education. (2005). *The Ontario curriculum grade 1-8: Mathematics.* Retrieved from http://www.edu.gov.on.ca/eng/curriculum/elementary/math18curr.pdf

Ontario Ministry of Education. (2008). *Guidelines for Approval of Textbooks.* Retrieved from http://www.trilliumlist.ca/files/Textbook_Guide_English_2008.pdf

Ontario Ministry of Education. (2009). *Realizing the promise of diversity: Ontario's equity and inclusive education strategy*. Retrieved from http://www.edu.gov.on.ca/eng/policyfunding/equity.pdf

Ontario Ministry of Education. (2010a). *Teacher assignment in Ontario schools, A resource guide.* Retrieved from http://www.edu.gov.on.ca/eng/teacher/pdfs/assignment.pdf

Ontario Ministry of Education. (2010b). *A parent engagement policy for Ontario schools.* Retrieved from http://www.edu.gov.on.ca/eng/parents/involvement/FS_PE_PolicyEn.pdf

Ontario Ministry of Education. (2010c). *Parents in partnership-a parent engagement policy for Ontario schools*. Retrieved from http://www.edu.gov.on.ca/eng/parents/involvement/pe_policy2010.pdf

Ontario Ministry of Education. (2016). Ontario dedicating $60 million for renewed math strategy [News Release]. Retrieved from https://news.ontario.ca/edu/en/2016/04/ontario-dedicating-60-million-for-renewed-math-strategy.html

Ontario Ministry of Education. (2016). *A renewed math strategy for Ontario.* Retrieved from http://www.edu.gov.on.ca/eng/policyfunding/memos/april2016/min_math_strategy.html

Ontario Ministry of Education. (2018). Reading and writing with your child, kindergarten to grade 6: A parent guide. Retrieved from http://www.edu.gov.on.ca/eng/literacynumeracy/parentGuideLitEn.pdf

Ontario Ministry of Education. (n.d.a). Doing mathematics with your child, kindergarten to grade 6. Retrieved from http://www.edu.gov.on.ca/eng/literacynumeracy/parentGuideNumEn.pdf

Ontario Ministry of Education. (n.d.b). *A guide to effective instruction in mathematics, kindergarten to grade 6-Volume two*. Retrieved from http://www.eworkshop.on.ca/edu/resources/guides/Guide_Math_K_6_Volume_2.pdf

Pang, X., & Rogers, W. T. (2013). Comparative examination of the influence of selected factors on achievement in Grade 9 academic and applied mathematics courses in English-language schools in Ontario. Retrieved from http://www.eqao.com/en/research_data/Research_Reports/DMA-docs/factors-influence-g9-achievement.pdf

Peng, G. (2002). Two student-centred teaching methods in mathematics. *The China Papers*, 12-17. Retrieved from http://science.uniserve.edu.au/pubs/china/vol1/peng.pdf

Penk, C., & Schipolowski, S. (2015). Is it all about value? Bringing back the expectancy component to the assessment of test-taking motivation. *Learning and Individual Differences 42*, 27–35. Retrieved from http://daneshyari.com/article/preview/364564.pdf

Peters, F. (2012, April 3). School system. In *Historica Canada*. Retrieved from http://www.thecanadianencyclopedia.ca/en/article/school-systems/

Professional Learning Board. (n.d.). *The Socratic method in the classroom*. [Web log comment]. Retrieved from: https://k12teacherstaffdevelopment.com/tlb/the-socratic-method-in-the-classroom/

Rogers, W. T. (2013). What is the quality of EQAO assessments? *EQAO*. Retrieved from http://www.eqao.com/en/research_data/Research_Reports/DMA-docs/quality-EQAO-assessments-excellent.pdf

Rohaidi, N. (2016, May 5). Why are Asians so good at maths and science? *Asian scientist*. Retrieved from: https://www.asianscientist.com/2016/05/academia/asian-students-good-maths-science/

Rubie-Davies, C. M. (2006). Teacher expectations and student self-perceptions: Exploring relationships. *Psychology in the Schools, 43*(5), 537-552. Retrieved from http://resolver.scholarsportal.info/resolve/00333085/v43i0005/537_teasser

Rushowy, K. (2015, October 7). End streaming in schools, report to Toronto trustees recommends. *The Star*. Retrieved from https://www.thestar.com/yourtoronto/education/2015/10/07/end-streaming-in-schools-report-to-toronto-trustees-recommends.html

Saad, C. S., Meyer, O. L., Dhindsa, M., & Zane, N. (2015). Domain identification moderates the effect of positive stereotypes on Chinese American women's math performance. *Cultural Diversity and Ethnic Minority Psychology 21*(1), 162-167. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/25622286

Schleppegrell, M. J. (2007). The linguistic challenges of mathematics teaching and learning: A research review. *Reading & Writing Quarterly, 23(2),* 139-159. doi:10.1080/10573560601158461

Schulz, W. (2005). Mathematics self-efficacy and student expectations. Results from PISA 2003. Retrieved from https://files.eric.ed.gov/fulltext/ED490044.pdf

Shao, K., & Tamashiro, R. (2013). Comparing teacher dispositions in China and the USA. *Research in Higher Education Journal*, *21*(1). 1-7. Retrieved from https://files.eric.ed.gov/fulltext/EJ1064694.pdf

Rong, X., & Shi, T. (2001). Inequality in Chinese education. *Journal of Contemporary China, 10*(26), 107-124. Retrieved from http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan002178.pdf

Shim, S. S., Cho, Y., & Wang, C. (2013). Classroom goal structures, social achievement goals, and adjustment in middle school. *Learning and Instruction, 23*, 69-77. Retrieved from

https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/09594752/v23inone_c/69_cgssagaaims.xml

Sinay, E., & Nahornick, A. (2016). Teaching and learning mathematics research series ll: Effective intervention strategies. (Research Report No. 16/17-09). Retrieved from http://www.tdsb.on.ca/Portals/research/docs/reports/Teaching%20and%20Learning%20Math%20Research%20Series%202.pdf

Sigley, R., & Wilkinson, L. C. (2015). Ariel's cycles of problem solving: An adolescent acquires the mathematics register. *Journal of Mathematical Behavior, 40,* 75-87. Retrieved from http://daneshyari.com/article/preview/360643.pdf

Sly, G. (2016, October 19). Ontario's textbook wars. *The Whig*. Retrieved from http://www.thewhig.com/2016/10/19/ontarios-textbook-wars

Soni, A., & Kumari, S. (2015). The role of parental math attitude in their children math achievement. *International Journal of Applied Sociology, 5*(4), 159-163. Retrieved from http://article.sapub.org/10.5923.j.ijas.20150504.01.html

Student Achievement Division. (2011). Maximizing student mathematical learning in the early years. *Capacity Building Series*. Retrieved from http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/CBS_Maximize_Math_Learning.pdf

Student Achievement Division. (2012). The third teacher: Designing the learning environment for mathematics and literacy, K to 8. *Capacity Building Series.* Retrieved from http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/CBS_ThirdTeacher.pdf

Stokke, A. (2015). What to do about Canada's declining math scores? *Social Science Research Network*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2613146

Stout, K. L. (2013, December 17). Mind the gap: China's great education divide. *CNN*. Retrieved

from https://www.cnn.com/2013/12/17/world/asia/china-education-gap-stout/index.html

Spagnolo, F., & Paola, B. D. (2010). European and Chinese cognitive styles and their impact on teaching mathematics. *Studies in Computational Intelligence, 277,* 1-267. Retrieved from http://educationforatoz.com/images/11.Benedetto_Di_Paola_Filippo_Spagnolo.pdf

Sullivan, P. (June 26, 2015). Philip Sullivan: Discovery learning' is failing our children. *National Post*. Retrieved from http://nationalpost.com/opinion/philip-sullivan-discovery-learning-is-failing-our-children

Suurtamm, C., Koch, M., & Arden, A. (2010). Teachers' assessment practices in mathematics: Classrooms in the context of reform. *Assessment in Education: Principles, Policy & Practice, 17*(4), 399-417. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/0969594x/v17i0004/399_tapimcitcor.xml

Suurtamm, C. (2017). Classroom assessment in mathematics: paying attention to students' mathematical thinking. *The Learning Exchange*. Retrieved from https://thelearningexchange.ca/classroom-assessment-mathematics-paying-attention-students-mathematical-thinking/

Thomas, J. A., & Strunk, K. K. (2017). Expectancy-value and children's science achievement: Parents matter. *Journal of Research in Science Teaching, 54*(6), 693-712. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/00224308/v54i0006/693_eacsapm.xml

3P Learning Ltd. (2009). *Algebra Basics.* Retrieved from http://west.cdn.mathletics.com/IWB/Book/345/131080766.H_Algebra_Basics_CAN.pdf

Tirosh, O. (2014, November 10). Why English is bad for learning math, backed by science. *Tomedes.* Retrieved from https://www.tomedes.com/translator-hub/why-english-is-bad-

for-learning-math.php

Tudge, J., & Doucet, F. (2004). Early mathematical experiences: Observing young Black and White children's everyday activities. *Early Childhood Research Quarterly, 19,* 21-39. Retrieved from https://pdfs.semanticscholar.org/8ffa/b8a7d436e52edd85f270 4f59df9228e9724c.pdf

Underwood, K. (2010). Involving and engaging parents of children with IEPs. *Exceptionality Education International, 20,* 18-36. Retrieved from http://ir.lib.uwo.ca/eei/vol20/iss1/3

Uptegrove, E. B. (2015). Shared communication in building mathematical ideas: A longitudinal study. *Journal of Mathematical Behavior, 40*, 106-130. Retrieved from https://ac-els-cdn-com.ledproxy2.uwindsor.ca/S0732312315000188/1-s2.0-S0732312315000188-main.pdf?_tid=0d8833e0-c247-4175-b231-d08b36253d78&acdnat=1522990655_d2182fe202ff08162f0df0e08aabeac0

Vinson, B. M. (2001). A comparison of pre-service teachers' mathematics anxiety before and after a methods class emphasizing manipulatives. *Early Childhood Education Journal, 29*(2), 89-94. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca /pdf/10823301/v29i0002/89_acoptmaamcem.xml

Wade, L. (2013, March 7). The truth about gender and math. *The Society Pages*. Retrieved from https://thesocietypages.org/socimages/2013/03/07/the-truth-about-gender-and-math/

Wali, K. (2013, Septermber 11). Is a 'science student' smarter than an 'arts student'? *Blogs*. Retrieved from https://blogs.tribune.com.pk/story/18565/is-a-science-student-smarter-than-an-arts-student/

Wang, C., Geng, F., Yao, Y., Weng, J., Hu, Y., & Chen, F. (2015). Abacus training affects math and task switching abilities and modulates their relationships in Chinese children. *PLOS ONE, 10*(10), 1-15. doi:10.1371/journal.pone.0139930

Wang, T. L., & Yang, D. C. (2016). A comparative study of geometry in elementary school mathematics textbooks from five countries. *European Journal of STEM Education, 1*(3) 58. http://dx.doi.org/10.20897/lectito.201658

Warnock, S. (2013). *Frequent, low-stakes grading: Assessment for communication, confidence*. Faculty Focus. Madison, WI: Magna Publications.

Wei, K. (2014). Explainer: What makes Chinese maths lessons so good? *The Conversation*. Retrieved from https://theconversation.com/explainer-what-makes-chinese-maths-lessons-so-good-24380

Wigfield, A. (1994). Expectancy-value theory of achievement motivation: A development perspective. *Educational Psychology Review, 6*(1), 49-78. Retrieved from http://maaikerotteveel.pbworks.com/f/Wigfield+expectancy+value+theory+2000.pdf

Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology, 25*, 68-81. Retrieved from https://ac.els-cdn.com/S0361476X99910159/1-s2.0-S0361476X99910159-main.pdf?_tid=1c4a1167-ff92-4051-8de3-b452f5a025ac&acdnat=1522990861_f9d3da8dc1723116dbe0c1024e28c0db

Wiliam, D. (2010). Educational Psychologist. *Schooling in the Age of Accountability, 45*(2), 107-122. Retrieved from https://www.tandfonline.com/doi/citedby/10.1080/00461521003703060?scroll=top&needAccess=true

Xie, Y., Zhang, C., & Lai, Q. (2014), China's rise as a major contributor to science and technology. *Proceedings of the National Academy of Sciences of the United States of America, 111*(26), 9437-9442. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4084436/

Xu, B. (2016). *Math stories in elementary mathematics education in China and North America.* Retrieved from Electronic thesis and Dissertation Repository. (AAT 3973)

Yamamoto, Y., & Holloway, S. D. (2010). Parental expectations and children's academic performance in sociocultural context. *Education Psychology Review, 22,* 189-214. doi:10.1007/s10648-010-9121-z

Yang, X. (2014). Conception and characteristics of expert mathematics teachers in China. https://doi-org.ledproxy2.uwindsor.ca/10.1007/978-3-658-03097-1

Zhang, X. (2005). China's mathematics teachers and teacher education. In *Department of mathematics*. 51-54. Retrieved from http://math.unipa.it/~grim/quad15_zhang_05.pdf

Zhao, D. C. (2016). *Chinese Students' Higher Achievement in Mathematics Comparison of Mathematics Education of Australian and Chinese Primary Schools.* Aussie-Sino Studies Kingswood, NSW: Australia.

Zhu, Y., & Fan, L. (2006). Focus on the representation of problem types in intended curriculum: A comparison of selected mathematics textbooks from mainland China and the United States. *International Journal of Science and Mathematics Education, 4*(4), 609-626. Retrieved from https://journals-scholarsportal-info.ledproxy2.uwindsor.ca/pdf/15710068/v04i0004/609_fotropmcatus.xml

Zhong, L. (2011). Chinese immigrant parents' involvement in the education of their elementary school children in Windsor, Ontario: Perceptions and practices. Retrieved from Scholarship at UWindsor. (427)

Zhou, J. (2014). Persistence motivations of Chinese doctoral students in science, technology, engineering, and math. *Journal of Diversity in Higher Education, 7*(3), 177-193. Retrieved from http://psycnet.apa.org.ezproxy.uwindsor.ca/fulltext/2014-37844-003.pdf

# VITA AUCTORIS

| | |
|---|---|
| NAME: | Tian Lan |
| PLACE OF BIRTH: | China |
| YEAR OF BIRTH: | 1990 |
| EDUCATION: | Yinxing Hospitality Management College of Chengdu University of Information Technology, B.A., Chengdu, China, 2009 |
| | University of Windsor, M.Ed., Windsor, ON, 2017 |