Faculty of Cognitive Sciences and Human Development

ADOLESCENTS’, PARENTS’ AND PEERS’ MATHEMATICS ANXIETY, ATTITUDES TOWARD MATHEMATICS AND MATHEMATICS ACHIEVEMENT

CHONG YUNG YUNG
13030132

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ADOLESCENTS’, PARENTS’ AND PEERS’ MATHEMATICS ANXIETY, ATTITUDES TOWARD MATHEMATICS AND MATHEMATICS ACHIEVEMENT

CHONG YUNG YUNG
13030132

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Received for examination by:

__________________________
(Prof. Dr Hong Kian Sam)

Date:

__________________________
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Statement of Originality

The work described in this project, entitled “Adolescents’, parents’ and peers’ mathematics anxiety, attitudes toward mathematics and mathematics achievement” is to the best of the author’s knowledge that of the author except where due reference is made.

_________________  ___________________
(Date submitted)     (Student’s signature)

Full Name: Chong Yung Yung
Matric Number: 13030132
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ABSTRACT

ADOLESCENTS’, PARENTS’ AND PEERS’ MATHEMATICS ANXIETY, ATTITUDES TOWARD MATHEMATICS AND MATHEMATICS ACHIEVEMENTS

Chong Yung Yung

The significance of attitudes toward mathematics in mathematics teaching and learning has been highlighted in the literature, but with less emphasis as compared to mathematics anxiety. Attitudes toward mathematics and mathematics anxiety are two essential variables in determining students’ mathematics performances and achievements in mathematics. Moreover, there were less research that studied the correlation between students’ own mathematics anxiety and attitudes toward mathematics. Therefore, the main focus of this research is to investigate the correlation between mathematics anxiety, attitudes toward mathematics, and mathematics achievements, their relationships to adolescents’ perceptions of parents’ and peers’ mathematics anxiety and attitudes toward mathematics, and gender differences in adolescents’ mathematics anxiety, attitudes toward mathematics, and mathematics achievement. This correlational and comparative research design study involved 480 adolescents Form Four students from six rural secondary schools. The focus on middle adolescents of Form Four Students, as the samples of this study was due to the reason that middle adolescents represent students who are starting to face more difficulties as the level of complexity and mathematics abstraction increased as compared to lower secondary. Adolescents’ perception of parents’ and peers’ were investigated as possible influence variables of adolescents’ mathematics anxiety level, positive or negative attitudes toward mathematics and level of mathematics achievements. The main instrument of this study was a questionnaire which composed of the Mathematics Anxiety Rating Scale-Revised (MARS-R) and revised model of Attitude toward Mathematics Inventory (ATMI). Results indicated positive relationships between adolescents’ mathematics anxiety with their perceptions of their parents’ mathematics anxiety ($r = 0.534$, $p < 0.005$), and their peers’ mathematics anxiety ($r = 0.625$, $p < 0.005$); between adolescents’ attitudes toward mathematics and their perceptions of their parents’ attitudes toward mathematics ($r = 0.799$, $p < 0.005$) and their peers’ attitudes toward mathematics ($r = 0.814$, $p < 0.005$); and relationships between adolescents’ perceptions of their own mathematics achievement with their own attitudes toward mathematics ($r = 0.524$, $p < 0.005$), perceptions of their parents’ attitudes toward mathematics ($r = 0.382$, $p < 0.005$), and perceptions of their peers’ attitudes toward mathematics ($r = 0.415$, $p < 0.005$). The findings of present study also found negative relationships between adolescents’ perceptions of own mathematics achievements with their own mathematics anxiety level ($r = -0.303$, $p < 0.005$), with perceptions of their parents’ mathematics anxiety ($r = -0.252$, $p < 0.005$), and perceptions of peers’ mathematics anxiety ($r = -0.201$, $p < 0.005$); and also negative relationships between adolescents’ mathematics anxiety and attitudes toward mathematics ($r = -
0.118, \( p = 0.010 \). The findings of study also indicated that there were no significant differences in adolescents’ mathematics anxiety, attitudes toward mathematics, and perceptions of their own mathematics achievements based on gender. Overall, this study found that adolescents from these six secondary schools faced moderate level of mathematics anxiety, have positive attitudes toward mathematics and perceived themselves to have moderate level of achievement in mathematics.
ABSTRAK

KEGELISAHAN MATEMATIK, SIKAP TERHADAP MATEMATIK DAN PENCAPAIAN MATEMATIK REMAJA, IBU BAPA DAN RAKAN

Chong Yung Yung

Kepentingan sikap pelajar terhadap matematik dalam pengajaran dan pembelajaran matematik sering dinyatakan dalam literatur, tetapi kurang diberi perhatian berbanding dengan kegelisahan matematik. Sikap terhadap matematik dan kegelisahan matematik merupakan dua pemboleh duh yang penting dalam menentukan prestasi dan pencapaian pelajar dalam matematik. Lebih-lebih lagi, kurang penyelidikan dijalankan bagi mengkaji korelasi antara kegelisahan matematik dan sikap terhadap matematik. Oleh itu, fokus utama penyelidikan ini adalah untuk mengkaji hubungan antara kegelisahan matematik, sikap terhadap matematik, dan pencapaian matematik remaja, dan juga dengan persepsi remaja terhadap perasaan kegelisahan matematik ibu bapa dan rakan dan sikap ibu bapa dan rakan terhadap matematik, serta pembezaan jantina dalam kegelisahan matematik, sikap terhadap matematik, dan pencapaian matematik remaja. Reka bentuk penyelidikan ini berbentuk korelasi dan perbandingan dengan melibatkan 480 remaja Tingkatan Empat dari enam sekolah menengah luar bandar. Pemilihan pelajar dalam peringkat remaja pertengahan sebagai sampel dalam penyelidikan ini disebabkan pelajar dalam kumpulan ini merupakan kumpulan yang mula menghadapi lebih kesukaran kerana tahap kerumitan dan abstraksi matematik yang meningkat berbanding dengan menengah rendah. Persepsi remaja terhadap ibu bapa dan rakan dikaji sebagai penyebab yang berkemungkinan mempengaruhi tahap kegelisahan matematik, sikap positif atau negatif terhadap matematik, dan tahap pencapaian matematik. Instrumen utama kajian ini ialah soal selidik yang merangkumi Mathematics Anxiety Rating Scale-Revised (MARS-R) dan Attitude toward Mathematics Inventory (ATMI) yang diubahsuai. Keputusan kajian menunjukkan korelasi positif dalam hubungan antara kegelisahan remaja dalam matematik dengan persepsi mereka terhadap perasaan kegelisahan mateatik ibu bapa (r = 0.534, p < 0.005), dan dengan persepsi mereka terhadap perasaan kegelisahan rakan terhadap matematik (r = 0.625, p < 0.005); hubungan antara sikap remaja terhadap matematik dan persepsi terhadap sikap ibu bapa terhadap matematik (r = 0.799, p < 0.005), dan persepsi terhadap sikap rakan terhadap matematik (r = 0.814, p < 0.005); dan hubungan antara persepsi remaja terhadap pencapaian mereka dalam matematik dengan sikap mereka terhadap matematik (r = 0.524, p < 0.005), dengan persepsi mereka terhadap sikap ibu bapa terhadap matematik (r = 0.382, p < 0.005), dan persepsi remaja terhadap sikap rakan terhadap matematik (r = 0.415, p < 0.005). Hasil kajian ini juga menunjukkan korelasi negatif dalam hubungan antara persepsi remaja terhadap pencapaian mereka dalam matematik dengan tahap kegelisahan mereka (r = -0.303, p < 0.005), dengan persepsi mereka terhadap tahap kegelisahan matematik ibu bapa (r = -0.252, p < 0.005), dan persepsi mereka terhadap tahap kegelisahan matematik rakan (r = -0.201, p < 0.005); juga hubungan negatif antara tahap kegelisahan remaja terhadap matematik dan
sikap remaja terhadap matematik \( r = -0.118, p = 0.010 \). Kajian ini juga medapati tiada pembezaan dalam tahap kegelisahan matematik, sikap terhadap matematik, dan persepsi terhadap pencapaian matematik berdasarkan jantina. Secara keseluruhan, kajian ini mendapati remaja mencapai sederhana kegelisahan remaja terhadap matematik, bersikap positif terhadap matematik dan mengikut persepsi mereka kebanyakan mencapai pencapaian sederhana dalam matematik.
CHAPTER ONE
INTRODUCTION

1.0 Introduction

The aim of this research is to investigate the relationship between adolescents’ perceptions of parents’ and peers’ mathematics anxiety and attitudes toward mathematics and adolescents’ own mathematics anxiety, attitudes toward mathematics and mathematics achievement. This chapter presents a general introduction to the study and it includes the background of study, problem statement, purpose and objective of the study, research questions, research hypotheses,
research framework, significance of the study, and definition of terms used in this study. This chapter ends with a brief summary of the chapter.

1.1 **Background of the Study**

Mathematics is one of the major subjects that have been studied for over hundreds of years. It is a unique body of knowledge which requires mental abstraction and this makes it hard for students to master it well (Ashcraft & Ridley, 2005; Nunez, 2008). Compared to other learning fields, mathematics is ranked as one of the most difficult subjects to be learned (Dawkins, 2006). The abstract nature of mathematical concept is one of the major reasons why students faced difficulties in learning mathematics (Nunez, 2008). Ashcraft and Krause (2007) further elaborate that the highly abstract nature of mathematical concepts and its requirement of manipulation of symbols cause it to be a cognitively challenging subject to learn.

According to the results of the Programme for International Student Assessment (PISA) in the year 2012, Malaysian students were reported to have average improvement in mathematics compared to the previous year’s result, but among the participating counties, the results were still in the lower rank (Guardian News, 2014). Various issues related to mathematics teaching and learning has been studied by researchers all over the world, and one of the recurring issues is mathematics anxiety. Mathematics anxiety is one of the critical issues which many students have problems dealing with in their learning of mathematics. As reported in several research done in the Malaysian context, majority of Malaysian
students were found to have moderate level of mathematics anxiety (Usop, Sabri, Hong, & Tan, 2009; Zakaria, Zain, Ahmad & Erlina; 2012).

Mathematics anxiety refers to the feeling of over-anxiousness towards mathematics, and includes learning and carrying out tasks or activities that require mathematics. Whyte and Anthony (2012) stated that the state of anxiety is an actual situational stress experienced that is specific to personally stressful circumstances, and for mathematics anxiety, it means that the stress is attributed to the subject of mathematics. According to Luo, Wang and Luo (2009, p. 12), “Mathematics anxiety is a kind of disease. It is cognitively passive mood produced by mathematics.” Students’ negative perceptions and fears toward mathematics will become a barrier for them to achieve their full potential in mathematics (Mashego, 1993) and subsequently will affect their learning performance in the subject (Meece, Wigfield, & Eccles, 1990). In addition, many past researches indicate that mathematics anxiety is negatively correlated with learners performance, behavior, self-beliefs, learning efficacy, and mathematics achievement (Devine, Fawcett, Szucs, & Dowker, 2012; Scarpello, 2005; Zakaria et al., 2012)

Attitude toward mathematics is one of the major elements in both teaching and learning process of mathematics, which significantly affect students’ mathematics performance (Farooq & Shah, 2008). Attitude can be explained as one’s evaluative response to a particular object or subject matter, positively or negatively (Aiken, 1970; Mohamed & Waheed, 2011), and in this case it would be focusing on respond towards mathematics. One’s attitude will influences his or her personal construction in making sense of something based on the information
or experience that one faced with, learnt or experienced (He, 2007). When one has negative attitudes towards mathematics, the things he or she will perceive and act in mathematics learning are likely to be responded negatively rather than positively. In mathematics teaching and learning field, attitudes towards mathematics said to be strongly related to mathematics achievement; theoretically or practically (He, 2007). It has been consistently studied and reported that students’ attitudes toward mathematics is one of the important factor influencing students’ mathematics achievement (Mohamed & Waheed, 2011).

Students’ attitudes toward mathematics is also found to be correlated with students’ mathematics anxiety. Akin and Kurbanogle (2011) stated that attitudes toward mathematics is closely related to mathematics anxiety, as it is one of the essential predictor of the level of mathematics anxiety. Several studies have shown that students’ attitudes toward mathematics negatively correlated with mathematics anxiety. In Hembree (1990) meta-analysis paper, results from 151 studies showed that students who experienced higher level of mathematics anxiety were those who had negative attitudes toward mathematics. Also, for students with high mathematics anxiety, their attitudes would become more negative and they also form negative perception of mathematics such as viewing mathematics as an unachievable and unrealistic subject matter to be learned (Bekdemir, 2010; Heydari, Abdi, & Rostani, 2013), tend to believe that mathematics is useless, and avoid mathematics related activities (Neale, 1969; cited in He, 2007). These negative attitudes will affect students’ performance in mathematics learning.

Another major aspect in the study of adolescents’ mathematics learning is parents’ and peers’ influence on adolescents’ mathematics anxiety and attitudes
toward mathematics. Students’ attitude is significantly associated with perceptions of people who are important for them (Philip, Hong, Liau, Usop, & Ting, 2010). The important persons closely related to students would most likely be their parents and peers. Parental influence includes parental encouragement, expectation, and attitudes towards mathematics (Kleanthous & Williams, 2010) and these influences will affect students’ perception of their academic abilities. Phillipson’s (2010) research stated that parental affective factors was one of the main predictor of students’ achievement. In addition, Philip et al. (2010) also stated that students will tend to adopt belief, behavior, or attitude from their perception of parents’ belief, behavior, or attitude toward mathematics (Philip et al., 2010). In addition, Rossnan (2006) claims that parents’ personal view of mathematics often negatively affect students’ mathematics anxiety’s level. Peer is another group of people who is recognized as an important factor which influences adolescents’ socialization, motivation and achievement, especially during adolescent (Philip et al., 2010). Their influence is strong especially when adolescents try to gain a sense of belonging in the peers group; where one of the ways is to adopt the attitude of peer (Philip et al., 2010). Therefore, when their peer hold positive attitude toward mathematics, students would likely to adopt the same attitude and be motivated to perform well in mathematics learning.

Due to the importance of mathematics in students learning and the importance of achieving global mathematics standard, educators and researchers emphasize on the need to further investigate the relationships between mathematics anxiety and various contributing factors such as students’ learning experiences, environmental factors and so forth, and for ways to mitigate this
issue. In order to investigate suitable ways to mitigate mathematics anxiety among the students, researchers or educators need to investigate possible predictor or causes of mathematics anxiety of a particular group of students as there are many different causal factors in different culture, different situation. This study would mainly look into adolescents’ perception of parents’ and peers’ mathematics anxiety and attitude toward mathematics, whether it related to or able to predict adolescents’ own mathematics anxiety, attitudes toward mathematics, and mathematics achievement, in the Malaysian context and culture.

1.2 Problem Statement

Mathematics anxiety is one of the most popular issues in learning mathematics related subject. Mathematics anxiety is the feeling of fear and anxiety towards mathematics, which may due to cultural belief and negative experience with mathematics. According to Devine et al. (2012), it is important to identify the existence of mathematics anxiety in students as it will affect ones’ career choices and prospects. Negative feeling towards mathematics and poor health condition will affect students’ performance in mathematics work. Chan (2012) stated that there is increased activity in the brain region linked with fear for students faced with mathematics anxiety, and this affect on the brain region linked to problem-solving.

There are many different type of causes for mathematics anxiety, which could be classified into family influences, societal influences, school influences, internal influences and neurological consideration (Clark, 2013), or environmental variables (e.g. negative experiences), intellectual variables (e.g. abstraction
aspect), and personality variables (e.g. self-concept or attitude) (Eden, Heine, & Jacobs, 2013). Different people may caused by different factor, especially when it involves different environment condition and cultural belief. Therefore, the study of the potential causes of mathematics anxiety is essential as it influences consideration of suitable ways to mitigate students’ mathematics anxiety.

Attitude toward mathematics is another significant factor which plays as significant role in students’ mathematics learning process. However, generally the research concern has been more towards mathematics anxiety rather than students’ mathematics attitude (Tapia & Marsh, 2004). A number of past findings has shown that students’ attitudes toward mathematics was significantly related to students’ mathematics performance (Aiken, 1970; Cheung, 1988; Chua, Hong, Law, Ting & Othman, 2010; Mohamed & Waheed, 2011; Farooq & Shah, 2008) and negatively correlated with mathematics anxiety level (Akin & Kurbanoglu, 2011; Gierl & Bisanz, 1995; Hembree, 1990; Heydari et al., 2013). Most of the findings indicated that, students’ with positive attitudes toward mathematics would be more likely to achieve better achievement in mathematics (Canh, & Sabo, 2012; Mohamed & Waheed, 2011), it is significant in students success and motivation to learn (Akin & Kurbanoglu, 2011). Similar to mathematics anxiety, attitudes toward mathematics also encounter similar situation in terms of the factor influencing the positive and negative attitudes toward mathematics. It had been long time that mathematics anxiety and attitudes toward mathematics found to be correlated with each other reciprocally, but the correlation of these two variables with the involvement of parents and peers still lacking. Therefore, this study focuses on potential factor such as parental and peers influence and its
relationship with adolescents’ mathematics anxiety and attitudes toward mathematics.

Another issue in this research field is, the often contradictors findings especially gender differences in mathematics anxiety level. Society always has the belief that males are able to perform well compared to females in solving mathematics problems. These negative beliefs cause female students to have negative assumption on their capability in performing mathematics activities and negatively influence their mathematics achievement (Zakaria et al., 2012). Compared to the male students, they tend to have more positive interpretation on their capability in performing mathematics activities; as they felt that they are able to perform better than the female students (Zakaria et al., 2012). Therefore, researchers or educators are questioning these issues and carrying out the investigation, but until now the finding is still inconsistent in terms of the differences of mathematics anxiety, attitudes toward mathematics, and mathematics achievement based on gender.

1.3 Purposes of the Study

The purpose of the current study is to study the influence of adolescents’ perception of parents’ and peers’ mathematics anxiety and attitudes toward mathematics on adolescents’ mathematics anxiety, attitudes toward mathematics, and mathematics achievement. This study also intends to study the relationship between adolescents’ mathematics anxiety, attitudes toward mathematics, and mathematics achievement. This research also intends to look at differences in
adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on gender.

1.4 Research Objective

1.4.1 General objective

The general objective of the study is to investigate adolescents’ perception of parents and peers’ mathematics anxiety and attitudes toward mathematics and its relation towards adolescents’ mathematics anxiety level, adolescents’ attitudes toward mathematics, and mathematics achievement.

1.4.2 Specific objectives

Specifically, this study aimed to look for:

1. The relationships between adolescents’ mathematics anxiety and their perception of their parents’ and peers’ mathematics anxiety.

2. The relationships between adolescents’ attitudes toward mathematics and their perception of their parents’ and peers’ attitudes toward mathematics.

3. The relationships between adolescents’ mathematics anxiety, attitudes toward mathematics, and mathematics achievements.

4. The relationships between adolescents’ mathematics achievement and their perception of their parents’ mathematics anxiety and attitudes toward mathematics.

5. The relationships between adolescents’ mathematics achievement and their perception of their peers’ mathematics anxiety and attitudes toward mathematics.
6. The differences in adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on gender.

1.5 Research Questions

1. Were there any significant relationships between adolescents’ mathematics anxiety and their perception of their parents’ and peers’ mathematics anxiety?
2. Were there any significant relationships between adolescents’ attitudes toward mathematics and their perception of their parents’ and peers’ attitudes toward mathematics?
3. Were there any significant relationships between adolescents’ mathematics anxiety, attitudes toward mathematics, and mathematics achievement?
4. Were there any significant relationships between adolescents’ mathematics achievement and their perception of their parents’ mathematics anxiety and attitudes toward mathematics?
5. Were there any significant relationships between adolescents’ mathematics achievement and their perception of their peers’ mathematics anxiety and attitudes toward mathematics?
6. Were there any significant differences in adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on gender?

1.6 Research Hypotheses

H₀₁ There were no significant relationships between adolescents’ mathematics anxiety with parents’ and peers’ mathematics anxiety.
H₀₂ There were no significant relationships between adolescents’ attitudes toward mathematics with parents’ and peers’ attitudes toward mathematics.

H₀₃ There were no significant relationships between adolescents’ mathematics achievement, mathematics anxiety and attitudes toward mathematics.

H₀₄ There were no significant relationships between adolescents’ mathematics achievement with parents’ mathematics anxiety and attitudes toward mathematics.

H₀₅ There were no significant relationships between adolescents’ mathematics achievement with peers’ mathematics anxiety and attitudes toward mathematics.

H₀₆ There were no significant differences between adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on gender.

1.7 Research Framework

Figure 1. Research framework of the study.

The research framework of the study is as shown in Figure 1 which illustrates the relationships of various variables in the study.
1.8 **Significance of the Study**

This study is important as it looks into two important factors which may give impact on the teaching and learning of mathematics, namely mathematics anxiety and attitudes towards mathematics. This study investigated possible predictors of adolescents’ mathematics anxiety and attitudes toward mathematics; parents’ and peers’ influence. There are many different causes such elevated mathematics anxiety level and increased negative or poor attitudes toward mathematics and different people might be influenced or affected by the same or different factors. Therefore, there is a need to discover the potential causes of mathematics anxiety and possible influence of students, especially in Malaysian context, different country have difference life-style, different learning context and environment and different cultural practice. Most Western research found significant correlation of parental and peers’ influence on students’ mathematics anxiety and attitudes toward mathematics, but such information is lacking in the Malaysian context.

Identification of possible causes or factors of mathematics anxiety and negative attitudes toward mathematics is essential for preparing mitigation strategies to reduce mathematics anxiety and improve students’ attitudes toward mathematics. Furthermore, although attitudes toward mathematics is a major factor influencing mathematics teaching and learning, less attention have being paid to it compared to mathematics anxiety (Tapia & Marsh, 2004). Moreover, the research related to mathematics anxiety and attitudes toward mathematics are mostly carried out in 1960s till 2000s. The related research seems to be lacking in recent years especially the research that involves parents and peers aspect in
attitudes toward mathematics. Therefore, this research may contribute to the field of research of students’ attitudes toward mathematics rather than just focusing on mathematics anxiety.

The findings of the study will provide information on how parents’ and peers’ mathematics anxiety and attitudes toward mathematics influence adolescents’ mathematics learning. It will help in understanding whether and how adolescents’ parents’ and peers’ influence adolescents’ mathematics learning from their own beliefs and attitudes toward mathematics. Especially for parents to realize that they as the first role model for their children, how would their way of acts and beliefs in mathematics might influence their children’s mathematics learning. Realization of parental influence enable parents to avoid negative developments of their children’s negative concepts on mathematics learning and engagement in develop positive perspectives toward mathematics. It will also enable academicians and teachers to design and plan suitable teaching and learning to decrease the risk of mathematics anxiety formation and increase positive attitudes toward mathematics.

This investigation may contribute to information on middle adolescents’ mathematics learning. From the literature, most of the research focused on students in young adolescents rather than middle adolescence. During young adolescence period, young adolescents thinking is more concrete and involved less advance cognitive skills, and the mathematics difficulties they face are lesser compared with difficulties they need to face during middle adolescents. Besides middle adolescence period is the most essential period where adolescence developed their identity and decide on their career path; and mathematics
achievement play significant role in their career choice. Negative recognition of identity in mathematics along with high mathematics anxiety and poor attitudes toward mathematics always limit adolescents’ opportunity to pursue and involve in academic and career path that require a lot of mathematics. Therefore, study of mathematics learning is important for improve their academic achievements and to avoid limiting of opportunity in higher education course choices and career choices.

1.9 Limitation of Study

There were several limitations in this study. One of the major limitations was the method and the mode of data collection. The data was collected only through questionnaire and it was fully self-assessment and self-report by respondents with respect to the research items. Respondents need to self-assess their own mathematics anxiety and attitudes toward mathematics, and self-report on their overall mathematics performances and mathematics achievement by Likert-scale rating. They also need to assess on their perceptions of their parents’ and peers’ mathematics anxiety and attitudes toward mathematics. There was no other data collection method used in this study to corroborate the data collected through questionnaire. Self-assessment and self-report method may cause an issue of data accuracy as it may be affected by individual personal bias especially on personal perception of parents and peers related information.

Another limitation of the study was the generalize-ability of the findings. The findings may not be generalized to all adolescents in Malaysia as it only involved Form Four students from selected rural area secondary schools. In
addition, the findings may not be able to be generalized to all secondary school students in Malaysia. Besides that, another limitation is the consideration of parents influence does not separate to the mother and father individually and it is an issue when the influence from mother and father may not be equal for every respondents. The differences always happen especially when it relates to the aspect of gender; influences from a father to his children or influences of a mother to her children with or without control of children’s gender (Jacobs, 1991; Parsons, Adler, & Kaczala, 1982).

1.10 Definition of Terms

1.10.1 Mathematics Anxiety

Conceptual Definition

Mathematics anxiety is a negative feeling which can be describe as an actual situational stress experienced that is specific to personally stressful circumstances with relate to mathematics (Whyte & Anthony, 2012). It is a learned emotional response through actual negative experience and negative information encounter from the surrounding (Rossnan, 2006), especially frequent failure in mathematics learning. This type of anxiety is found to negatively affect on one’s mathematics believe, attitude and performance (Akin & Kurbanoglu, 2011; Daneshamooz, Alamolhodaei, & Darvishian, 2012; Mohamed & Tarmizi, 2010).

Operational Definition

The term of mathematics anxiety in this study referred to negative emotion experienced by students towards mathematics related matters. It is a type of
anxiety which is negatively related to students’ attitudes towards mathematics and mathematics performance. In this study mathematics anxiety not only refers to students’ own mathematics anxiety level but also how students perceived mathematics anxiety of their parents and peers, which was rated through the use of mathematics anxiety instrument, the Mathematics Anxiety Rating Scale-Revised.

1.10.2 Attitudes toward Mathematics

Conceptual Definition

An attitude is defined as a mindset to act in a particular way; as a result of individual’s personality, beliefs and experience towards a particular matter (Allport, 1935; cited in Pickens, 2005). Pickens (2005) also define it as a combination of one’s personality, behaviours, values, beliefs, and motivation; which form through learning experiences and modeling others. Attitudes toward mathematics is recognized as an affective factor in mathematics learning, which refer to valuation, appraisal and enjoyment in mathematics learning (Blanco, Barona, & Carrasco, 2013; Palacios, Atias, & Arias, 2014). As defined by He (2007, pg. 9), attitudes toward mathematics is: “an aggregated measure of a liking or disliking of mathematics, a tendency to engage in or avoid mathematics activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless”. It is a significant domain that influences mathematics teaching and learning process, especially when it relates to students’ self-perception of mathematics ability and mathematics enjoyment (Ignacio, Nieto, & Barona, 2006; Palacios et al., 2014).
**Operational Definition**

Attitudes toward mathematics in this study referred to the value part of mathematics learning, which is about adolescents’ thoughts or feelings in perceiving the value of mathematics in learning and in life usage. Besides adolescents’ own attitude toward mathematics, their perception of their parents and peers’ attitudes toward mathematics are also taken into account in the study. The level of adolescents’ and their perception of their parents’ and peers’ attitudes toward mathematics was measured using an instrument with ten items of value scale of the Attitude toward Mathematics Inventory (ATMI).

**1.10.3 Mathematics Achievement**

**Conceptual Definition**

Generally mathematics achievement refers to students’ result or test score in mathematics test performed by student (Philip et al., 2010). There are different types of test scale, such as the most recent test before the investigation and scores of the mathematics test conducted within the investigation.

**Operational Definition**

In this study, mathematics achievement referred to adolescents overall performance in learning mathematics; their perception and judgment on their own mathematics performance. It was measured with rating from one to five, where one for extremely low performance and five for high performance. The mathematics achievements data were based on the participants’ self-report in the study.
1.10.4 Adolescent

**Conceptual Definition**

According to World Health Organization (2009), “adolescence, the second decade of life, is a period in which an individual undergoes major physical and psychological changes”. It could be divided to three main periods, where 11 to 14 years old is early adolescence, 15 to 17 is middle adolescence, and 18 to 21 is late adolescence period (Stang & Story, 2005). Adolescence is a period of identity seeking, experience lot of different physical change, cognitive and psychology development (American Psychological Association, 2002; Stang & Story, 2005).

**Operational Definition**

The term adolescent in this study referred to 16 years old students, Form 4 secondary school students, a group of students who seek the value identification the most. This group of students is also exposed to more abstract setting mathematics. Higher secondary level of education results in students facing more abstract setting of mathematics, which may influence their perception on the learning value, ability to master the domain, and emotion about mathematics learning.

1.10.5 Perceptions

**Conceptual Definition**

Perception is a way or a process of how an individual perceives a particular subject or meaning of the world through stimuli interpretations (Pickens, 2005). Perception involved the process of interpreting entered sensory input meaningfully (Galotti, 2013), and the interpreted meaning lead to how one
perceive a subject matter. There are two main processes of perceptions, which is: bottom-up process, process of combining small pieces of information of an environment into large picture; and top-down process, where the process of perception is guided by theories or expectation about the stimuli (Galotti, 2013). One of the types of perception is social perception. It “is how an individual ‘sees’ others and how others perceive an individual” (Pickens, 2005, p. 60).

**Operational Definition**

Perceptions in this study referred to how adolescents’ perceived their parents’ and peers’ mathematics anxiety and attitudes toward mathematics. The stimulation of their perception would be from the environmental information around them or between them with their parents and peers. From what they had perceived regarding their parents and peers’ beliefs and attitudes, adolescents form an “understanding” of how they “see” their parents and peers with regard to mathematics anxiety and attitudes toward mathematics. Their perceptions of their parents and peers mathematics anxiety were measured through twelve-items, mathematics anxiety instrument, Mathematics Anxiety Rating Scale-Revised (MASR). Their perceptions of their parents’ and peers’ attitudes toward mathematics were measured through Attitudes toward Mathematics Inventory (ATMI) instrument.
1.11 Summary

This study aimed to investigate the relationships between adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement, with their perception of their parents’ and peers’ mathematics anxiety and attitudes toward mathematics. It also investigated whether there were any significant differences in adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on the demographic variable, gender. Findings of this study could be beneficial for further investigation on the factors influencing students’ mathematics learning and achievement.
CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

The literature review in this chapter covers various aspects of adolescents’ learning, mathematics anxiety and attitudes toward mathematics. The contexts of literatures reviewed in this study involve Western, Asian and local context. The literature review is divided into six sections. These six sections are about adolescents and learning; definition of mathematics anxiety and information of causes and effects of mathematics anxiety; attitudes toward mathematics and the instrument of attitudes toward mathematics; parental influences in adolescents’
mathematics learning; peers’ influence in adolescents’ mathematics learning; and gender differences in mathematics learning related to mathematics anxiety, attitudes toward mathematics and mathematics achievement. This chapter ends with a brief summary on the literature review.

2.1 Adolescents

Adolescence is a transitional period between childhood and adulthood (American Bar Association, 2004; Cohen, n.d.; Morgan & Huebner, 2009). It is a transition of children to another higher level of human development. Adolescence is the most dynamic second development stage of human life (World Health Organization, 2009), from the age of 11 to 21 years old. There are three periods in adolescence developmental stage, which are divided according to the age of adolescents. These three periods are: young adolescence, from the age of 11 to 14 years old; middle adolescence, from the age of 15 to 17 years old; and last period, late adolescence, from the age of 18 to 21 years old (Stang & Story, 2005).

Adolescents in this period experience dynamic change physically, psychologically and cognitively (Cohen, n.d; World Health Organization, 2009). Obvious physical change would be rapid development of height and weight, and the development of secondary sex characteristics of male and female adolescents (Ruffin, 2009). While from the aspect of cognitive development, in involves the development of cognitive skills such as abstract thinking, reasoning, and the skills of meta-cognition (Stang & Story, 2005; Ruffin, 2009) which refers to the capability to recognize their strengths and weaknesses in various aspects which is crucial in self-development and learning. For cognitive development, at early
adolescence stage, it involves more concrete thinking; while in middle adolescence, more advance cognitive ability start to emerge especially abstract thinking, problem solving, and reasoning along with the change of the increase of school demands; and for late adolescents, it is more on expansion of these complex cognitive skills (American Psychological Association, 2002; Stang & Story, 2009). Psychologically, it involves development of self-identity, autonomy, intimacy, comfort of one’s sexuality, and achievement preference (Ruffin, 2009).

Along all the changes and developments from various aspects, during the adolescence period, one of the most crucial part for adolescents would be searching, recognize and establishing self-identity (American Psychological Association, 2002; Ruffin, 2009; Stang & Story, 2005). Identity refer to the identification of where they belong to (Watson, 2007). In adolescence period, adolescents always tend to search their true identity especially what is their ability, strength or weakness that affect how they see themselves, how they judge or see other people judging themselves; or can be explained as their personal special characteristics that they own which make them different or same with other people around them. Positive recognition of good ability would establish positive strength and confidence identity, while negative one will brings up negative establishment such as false thought or low self-esteem. These judgements make them who they are and how they would become in the future. There are two concepts of identity, which are: self-concept and self-esteem (American Psychological Association, 2002). The first concept, self-concept refers to one’s belief of his or her own ability, roles, interests and values in various aspects including learning. While for self-esteem, it refers to evaluation towards one’s
self-concepts. For example in mathematics learning, the example of self-concept in learning is the belief of ability to perform mathematics and the value of mathematics to adolescents’ life, then self-esteem would be how they evaluate their ability in learning or perform mathematics. One’s self-concepts and self-esteem affects one’s behaviour, action and their life.

2.1.1 Adolescents Self-Identification and Learning

This section explains more on adolescents’ self-identification related to academic learning. Brown (2009) listed six types of identities related to adolescents’ learning and performance. There are six different identities, which include: gender, relational, physical, ethnic, oppositional, and socioeconomic. Brown also pointed out that, “the search for identity reflects personal characteristics that affect daily academic performance” (2009, p. 1).

Brown (2009) explained how each type of identities relates to academic performance with several examples. From the aspect of gender identity, one might questions on the category of professions according to gender (e.g. fire fighter is a male’s job and nurse is a female’s job) and academically how a male or female should perform (e.g. Mathematics is for boys not girls) (Brown, 2009; Cvencek, Meltzoff, & Greenwald, 2011). This identification is focusing between the subject matters and ‘me’ as boy or girl. The second identity is relational identity, an identity which concern the relationship between adolescents with family, friends and teachers. Identity of adolescents’ relationship with people around them leads to the issue of how these people would influence them in their life and academically (Brown, 2009). The significance of adolescents’ relationships with
others will influence how would they make decision. For example, parents as a significant character in an individual life, their expectation and encouragement will influence the individual’s interest, performance and how he valued and act on the subject related (Kleanthous & Williams, 2010).

Physical identity, another type of identity that related to how an individual perceive his or her physical condition and deal with decision making in related subject matters. For example, when an individual found that he is physically fit and good at sports, and he might decide to take up athlete as a future career choice and his academic attention would shift to the path he has chosen (Brown, 2009). Sifting of attention will influence one’s academic performance, especially when an individual does not value the need for academic knowledge and is not interested to do well academically. Another type of identity is ethnic identity. It is similar to gender identity but the concern is on the ethnicity of adolescents which includes race, social beliefs, cultural practices, and social agents’ (e.g. parents and peers) expectation of how one should act. Ethnicity identity is the belief that Non-Malay students perform better in Mathematics compared to Malay students (Liew, 2009). According to American Psychological Association (2002), students with strong ethnic identity tend to have higher self-esteem.

The fifth type of identity is oppositional identity. The word ‘oppositional’, indicate recognition of character, belief or action that one tend to act oppositely from others. Brown (2009) explained, “I don’t want to act like the majority in a culture to which my family and I do not belong”. As for socioeconomic identity, it is about the identification of his or her economic status and makes decision accordingly (Brown, 2009). For example, when one comes from poor background,
positively one would want to make efforts to change for better life; but negatively if one does not recognise hard works will make changes he or she will probably not try to work hard in any form including in learning.

From the above explanation on the types of identity and how these identities developed; these identities are learned behaviours from the environment (Sammons, 2008). Environmental factors and social agents play significant roles in adolescents’ identity development, explained through social learning theory. The main idea of social learning theory is about how an individual learn from environment, learning from the process of observation, action of observing social agents’ behaviours and acting on particular subject matter (Bandura, 1971). During observation, he or she pays attention on the subject or model, encodes information gain, imitates behaviour observed, evaluates and develops self-behaviour. For example, the development of gender identity; an individual develop identity through their observation of adult male or female behaviour and action and adopt the pattern which relate to social cultural and beliefs (Bandura, 1969).

Generally, in the identification of an adolescent’s self-identity, one’s recognition form how they would behave, believe, value, and act. From the identity they found and identified though experiments, learning processes, and learned experiences, they begin to choose and make decision according to their strength, limitation and character of what to invest in and learn how to make it better (Halpern, Heckman, & Larson, 2013). What adolescents experience through learning and the processes and results of learning form their identity for academic learning and has major implication for future academic way and career choices.
From the explanation above, in the adolescents’ search of self-identity, adolescent is not the only character involved but other social agents (e.g. parents, friends, peers, and teacher) also play their roles respectively. As discussed in the ecological theory of human development, human learns through interaction with other social agents and object of the environment, where environment as the context of development; one make sense and construct meaning of the world through interaction and relation with the environmental agents and objects (Bronfenbrenner, 1994).

During adolescence, adolescents transit from primary school level (Primary 4 and Primary 5) to lower secondary (Form 1 to Form 3) and then to upper secondary level (Form 4 to Form 6). Along with these transitions, adolescents face with more challenges and complex issues in academic learning process and academic performance (American Psychological Association, 2002). Especially during middle adolescence, it is a period of enormous potential for learning (Halpern et al., 2013). The emergence of complex cognitive skills makes them more capable to perform multilevel thinking, with mixed emotions and complex issues (Halpern et al., 2013). But all these advance and complex tasks come along with massive challenges that adolescents would face with. When they fail to hander the challenges, they will start to self-question and self-critic their ability which links with low self-esteem and most likely to face feeling of dislike and anxious on that particular practice (Department of Education, 2014), which may lead to avoidances, anxiety, truancy and school dropout (Cohen, n.d.). Identification of adolescents’ identity will also affect their motivation to learn, one of the crucial part that influence learning performances. This is because
motivation is closely linked with one’s preference, beliefs, prior-knowledge, and interests (Halpern et al., 2013).

Therefore, direct or indirect development of self-identity among the adolescents influences their academic performance. From learning experiences they recognize and establish their strengths, beliefs and values, and these influence how they set the structure and act on personal goals (Halpern et al., 2013). In other word, the formation of self-identity, one’s behaviour, interests, value and emotions towards a particular subject matter, are all learned from their experiences. Recognition of their self-identity, adolescents formed their attitudes to the subject matter, build recognized emotions (could be positive or negative), self-esteem (high or low) and behaviour of avoidance or further establishing their ability or subject matter according to their identity; an identity that will have long lasting impact on their future live quality (Cohen, n.d.). The Magdol’s argument also stated that adolescents’ low self-concept and self-esteem correlate with poor academic performance (Magdol, 1992). Hence, development of positive and healthy perception of adolescents’ identity is crucial for academic success and better life quality (Brown, 2009).

2.1.2 Adolescents and Mathematics Learning

Similar to adolescents’ self-identity and learning, in mathematics learning along the learning process, adolescents tend to find their identity in mathematics learning. Adolescent form their identity through their experience in learning mathematics. Therefore, learning experience play significant roles in adolescents mathematics identity. For mathematics anxiety, one of the major causal agent of
mathematics anxiety is negative prior experience in mathematics learning, for example frequent failure in perform mathematics activities and unfriendly incidents (e.g. extreme critiques from parents, teachers and peers) (Arem, 2010; Bekdemir, 2010; Clark, 2013; Eden et al., 2013; Rossnan, 2006). These situations are likely to happen especially at the middle adolescence stage, where the difficulties of mathematics increase and they face with more challenges at higher level of education (Bekdemir, 2010; Ferguson, 1986). In past research findings, students claimed that most of them faced mathematics anxiety during upper secondary levels and university education where the content of mathematics subject became more difficult and complex (Usop et al., 2009).

Difficulties of mathematics are commonly link with the abstract nature of mathematics context which need high abstract reasoning and high mathematics imagination in mathematics learning and problem solving (Berdemir, 2010; Clark, 2013; Sun, 2009; Usop et al., 2009; Watson, 2007). Students might face with more challenges when their skills of abstraction reasoning and imagination skills not highly developed (Stang & Story, 2005), as these complex cognitive skills only start to emerge during middle adolescence (Stang & Story, 2005; Ruffin, 2009) and it is the stage where students start to need it more in upper secondary mathematics learning (Form 4 to Form 6). This is also why some of the educators or researchers claimed that “... the scientific concepts of secondary mathematics can be the beginning of the end of mathematical engagement for adolescents” (Watson, 2007, p. 109). When students fail to handler the challenges, unable to master the mathematics skills and perform poorly in mathematics, from these learned experiences adolescents form negative identity with wrong judgement of
their ability, low motivations, low self-esteem, negative emotions, and negative attitudes toward mathematics (Akin & Kurbanoglu, 2011; Clark, 2013; Jafari, Shahvarani & Behzadi, 2013). These perceptions lead to wider issues of mathematics course and career avoidances, and low rates in human resource of industry and technology advancement that require mathematics skills (Ashcraft, 2002; Ashcraft & Krause, 2007; Buckley, 2013; Clark, 2013; Eden et al., 2013; Hembree, 1990; Heydari et al., 2013; Ma, 1999).

2.2 Mathematics Anxiety (MA)

The term “Mathematics Anxiety” has been included into the glossary of psychology for over four decades with many research carried out and interpretations discussed (Heydari et al., 2013). Generally mathematics anxiety is defined as negative feelings which involve tension, extreme worries, and feeling of fear towards mathematics, no matter which context it is, either when learning it in school or doing school work or in daily life activities which need or involve the use of numerical action (Ashcraft, 2002; Rossnan, 2006). Mathematics anxiety was first detected in 1950s (Kamiri & Venkatesan, 2009) and investigation of this phenomenon started with the incident where a mathematics teacher, M.F. Gough observed and found her students to be struggling when learning mathematics (Hellum-Alexander, 2010). Many people in the world experienced mathematics anxiety, particularly when they have prior negative experiences in learning mathematics (Arem, 2010; Bekdemir, 2010; Eden et al., 2013; Rossnan, 2006).

Mathematics anxiety symptoms or problems can be classified into three categories: cognition, psychology and physical (Luo et al., 2009). Cognitively,
anxiety affects learning abilities which include attention, interpretation, concentration and memory processing (Ashcraft, 2002). It also influences one’s belief of his or her capability in performing mathematics related activities, and the psychological manifestation of this ranges from avoidance of mathematics related activities, panicking easily when dealing with mathematics, and also experiencing negative emotion and mental reaction towards mathematics (Arem, 2010; Bandura, 1989, cited in Scarpello, 2005; Rossnan, 2006; Usop et al., 2009). On the other hand, the physical symptoms of mathematics anxiety include sweaty palms, rapid heartbeat, holding fists tightly, being sick, vomiting, having dry lips, pale face, and brain pain (Lyons & Beilock, 2012; Luo et al., 2009; Maloney & Beilock, 2012).

It is important to further explore mathematics anxiety as it could have a negative influence on one’s life and how one function in the community (Ashcraft & Krause, 2007; Henrich & Lee, 2011; Heydari et al., 2013; Usop et al., 2009). According to Henrich and Lee (2011), mathematics anxiety may affect one’s life not only in the early stages but also throughout adulthood and may continue to affect students’ mathematics learning process (Usop et al., 2009). Therefore, it is important to mitigate mathematics anxiety as mathematics is essential in schools and students’ preparation for future careers (Ashcraft & Krause, 2007). Mathematics also plays an essential role in industrial and technological advancements, a key area for Malaysia as the nation strives to achieve vision 2020 (Heydari et al., 2013).
2.2.1 Causes of Mathematics Anxiety

There are a number of possible causes of mathematics anxiety as reported in previous research. Causes of mathematics anxiety can be classified into three main factors, which are: environmental factor, personality factor and cognitive factor. Environmental factor can further be divided into several aspects, namely, negative experiences; teachers, parents and peers’ influences; social concepts or myths; and teaching method (Arem, 2010; Bekdemir, 2010; Buckley, 2013; Clark, 2013; Daneshamooz et al., 2012; Maloney & Beilock, 2012; Meece et al., 1990; Rossnan, 2006; Usop, et al., 2009). Negative experiences are found to be one of the causes of negative emotions and thoughts towards mathematics which contribute to mathematics anxiety (Arem, 2010; Bekdemir, 2010; Clark, 2013; Rossnan, 2006). Examples of mathematics negative experiences are frequent failure in mathematics activities and unfriendly or extreme incident in learning mathematics (Bekdemir, 2010). Teachers, parents and peers attitudes were said to highly influence students’ mathematics learning process. Students can be influenced by the negative belief; perception and attitude transferred by teachers, parents, and peers who may also experience mathematics anxiety (Heydari et al., 2013; Sun, 2009; Usop et al., 2009), which Bekdemir (2010) explained as the mathematics anxiety cycle.

Findings of previous research also indicated that social misconceptions or myths are also contributors to students’ mathematics anxiety (Bekdemir, 2010; Buckley, 2013; Clark, 2013; Usop et al., 2009). Some social myths are the belief of gender issues, where males are seen to be better in mathematics than females and the belief that mathematics is only for people who want to pursue careers that
demand or require mathematics skills (Buckley, 2013; Usop et al., 2009). Examples of such careers are architecture, computer science, statistician, and scientist. Students’ understanding, beliefs and action, developed from the learned responses to the social environmental context (John-Steiner & Mahn, 1996) may lead to their negative emotions toward mathematics. This is supported by previous research where social misconceptions were negatively correlated with students’ mathematics anxiety (Clark, 2013; Usop et al., 2009).

A number of researchers also found that traditional learning method and e-learning method could also contribute to students’ development of mathematics anxiety (Arem, 2010; Bekdemir, 2010; Daneshamooz et al., 2012; Usop et al., 2009). Traditional learning method is a method which is more teachers centered and involves passive learning rather than active learning; while e-learning is a method which leverage on the use of technology in teaching and learning, requiring a more independent form of learning on the part of the students. The issue of teaching method usually relates to the structure of the teaching method, either too independent, competitive and less student control in nature (Arem, 2010; Daneshamooz et al., 2012; Usop et al., 2009). Lack of opportunity to ask for help when studying independently, or feeling uneasy when competing with other students can lead to mathematics anxiety, especially when they are not confident of their ability and have a fear of failure.

Findings from previous research have also suggested that students’ personality factors are also the cause of mathematics anxiety. These factors include low self-efficacy, low motivation in mathematics learning and negative attitude towards mathematics (Akin & Kurbanoglu, 2011; Bekdemir, 2010; Clute,
Cognitive factors that contribute to mathematics anxiety are related to the nature of mathematics content itself (Bekdemir, 2010; Clark, 2013; Fergusan, 1986; Sun, 2009; Usop et al., 2009). One of the reasons why students face difficulties in learning mathematics is due to the nature of mathematics which is abstract and need complex cognitive function. Ferguson (1986) further stated that, abstraction is one of the major contributors to mathematics anxiety, especially at the secondary school level where there are more abstract content. When students fail to understand even a minor part of the lesson, they will have difficulties to understand the following part because all the concepts are closely related (Maloney & Beilock, 2012). This is also the reason why some research found that some students’ mathematics anxiety increases at the upper secondary school level as mathematics concepts become more difficult and abstract (Berdemir, 2010; Clark, 2013; Sun, 2009; Usop et al., 2009).

2.2.2 Effects of Mathematics Anxiety on Mathematics Learning

There are four main effects of mathematics anxiety toward students’ mathematics learning. Firstly, it impact negatively on cognitive performance and working memory; secondly, it results in a poor mathematics performance and ability; thirdly, it affects one’s personal elements such as self-efficacy, attitude, motivation and self-judgment in mathematics learning; and lastly it could lead to avoidances of mathematics in learning, choice of courses of study and career in the future.
LeFevre, DeStefano, Coleman, and Shanahan (2005) stated that working memory is very crucial as a source of variance in mathematics cognition - a complex mental process that involves inner representation, identification, interpretation and calculation. The impact on working memory increases when the complexity of the problems also increases (Ashcraft & Krause, 2007). The negative emotion towards mathematics takes up a major portion of brain’s activities thus reduces the capacity of the working memory. Subsequently, this will negatively affects cognitive operation and numerical processing (Ashcraft, 2002; Ashcraft & Krause, 2007; Maloney & Beilock, 2012). Students with high mathematics anxiety would face difficulties in mathematics performance where they may take longer reaction time or have higher errors due to the inability to perform well cognitively (LeFevre et al., 2005).

Findings from various researches further show that mathematics anxiety negatively correlates with mathematics performance (Akin & Kurbanoglu, 2011; Ashcraft & Krause, 2007; Daneshamooz et al., 2012; Hembree, 1990; Kamiri & Venkatesan, 2009; Zakaria, et al., 2012; Zakaria & Nordin, 2008). According to Ashcraft (2002), and Ashcraft and Krause (2007), mathematics anxiety lowers mathematics performance because of the preoccupation with negative emotions towards mathematics, and this causes cognitive numerical action to be relegated to secondary task. On the other hand, there were also findings which suggest that mathematics anxiety does not necessary have negative impacts on students’ mathematics performance, and moderate level of mathematics anxiety may help to push students to overcome the challenges of learning mathematics (Meece, et al., 1990).
Some studies also found that mathematics anxiety would cause low self-efficacy, erroneous judgment of one's mathematics ability, low motivation and poor attitude towards mathematics, which can lead to poor performance in mathematics learning (Akin & Kurbanoglu, 2011; Clark, 2013; Jafari et al., 2013; Kamiri & Venkatesan, 2000; Usop et al., 2009; Zakaria & Nordin, 2008). Sufficient efficacy and motivation level, and positive attitude and judgment are required to perform well in learning. These personality elements influence students’ level of motivation to face the challenges; the way how he or she perceives the subject matter; and the amount of effort being put into learning the subject matter, which is highly associated with degree of success in mathematics learning (Akin & Kurbanoglu, 2011; Arem, 2010; Heydari et al., 2013; Meece et al., 1990; Zimmerman, 2000). When a student keeps facing failures in mathematics, it will negatively impact his or her mathematics efficacy, mathematics attitude, mathematics judgment and motivation to perform mathematics task.

Students with mathematics anxiety will tend to avoid mathematics in learning or even in everyday life. They will be less likely engage in mathematics activity and avoid mathematics-associated situation, such as doing mathematics assignment and learning mathematics lesson (Ashcraft & Krause, 2007; Heydari et al., 2013). Students’ avoidances of mathematics not only limit their learning in the mathematics classroom but also lead to avoidance in course choices and career path, which may result in the lack of human resource for some of the careers which require mathematics skills and affect the market’s needs (Ashcraft, 2002; Ashcraft & Krause, 2007; Buckley, 2013; Clack, 2013; Eden et al., 2013;
This shows that, mathematics anxiety not only negatively affects students’ learning but also lead to negative impacts to the community.

### 2.3 Attitudes toward Mathematics

Simple definition of attitudes refers to positive (e.g. like) or negative (e.g. dislike) feelings of an individual towards a target (Cheung, 1988; Nicolaidou & Philippou, 2003; Zan & Di Martino, 2007). Specifically, it refers to affective or emotional domain of individual which formed through learning process, direct experiences with the world, personality, beliefs, values, behaviors and motivation (Aiken, 1970; Nicolaidou & Philippou, 2003; Pickens, 2005). Attitudes is not simply just a psychological construct but also a categorical behavior which formed as a result of different evaluative process (Hannula, 2002). Hannula stated four evaluative processes that involve in attitudes formation, which involve: new situation, prior-experiences-based, partial familiar situation, and life evaluation and value related. These evaluations are strongly influenced by individual’s interpretation with the involvement of cognitive aspects of personality, beliefs, values, behaviors and motivation; social or environmental setting, like: family setting, religion, cultural, and socioeconomic factor; and the association of social agent(s) in the situation (Hannula, 2002; Pickens, 2005).

From the literature, several researchers or educators stated that there are three components of attitudes, which are: affective component (emotional response), cognitive component (set of beliefs regarding the subject) and behavior component (tendency to behave or act toward the subject) (Culberson, 1968;
Marchis, 2011; Pickens, 2005). Emotional response influence the evaluation of the target subject, from the evaluation individual structure set of beliefs regarding the subject and act with reflect to the beliefs structured. There are two types of significant factor that play significant roles in attitudes formation. These factors are: social environmental and personal factors. Social environmental factor include the influence of social agents like parents, peers, and teacher; sociocultural beliefs; knowledge learned and environmental condition (Larsen, 2013; Marchis, 2011). Social agents influence the formation of attitudes through transmission of message about self-concepts, own attitudes, expectations or beliefs directly or indirectly through daily communication, interaction, and modeling (Bandura, 1971; Pickens, 2005). Social cultural beliefs and knowledge learned affects how an individual perceive the world to be (Pickens, 2005). This is also why attitudes formed may not be constant from time to time as it formed in different strengths with the influence of experience and knowledge learned, as gaining more or different experience and knowledge may strengthen or change the attitudes formed (Pickens, 2005). Personal factor such as self-concepts, beliefs, values, and motivation deeply correlation with social environmental factor, as these personal factors involve in the evaluation of environmental factor in attitudes formation (Culberson, 1968; Hannula, 2002; Pickens, 2005).

Attitudes being claimed as central part of an individual’s indentify as it direct an individual’s behavior, influence individual’s response, impact on selective understanding (which most probably what we want to believe and may not be true) (Aiken, 1970; Mohamed & Waheed, 2011; Pickens, 2005). Attitudes will influence preferences evaluation; produces particular emotions towards a
target for example dislike or negative emotions toward mathematics learning; provide a set of belief of a target such as a belief of mathematics only for people who is intelligent and want to pursue in related career; cause particular behavior toward a target, for example choice of course or career path according to self-concept and self-esteem. This also explains that we are able to perceive one’s attitudes through their behavior and action (Pickens, 2005). From here we can see that attitudes play significant role in our life, as it influenced how we think, believe, and act. Attitudes also play significant role in mathematics learning as it is one of the affective domains in mathematics (Palacios et al., 2014).

There are two types of attitudes in mathematics learning, which are: attitudes towards mathematics and mathematics attitudes. From the review of literature of past researches, most of researchers did not distinguish the term attitudes towards mathematics and mathematics attitudes. Recently, Palacios et al. (2014) defined and described how these two terms differ from each other. Attitudes toward mathematics is more on affective side of mathematics, the value, appraisal and enjoyment of learning mathematics; while mathematics attitudes refers more toward cognitive side which more focusing on capacities or cognitive ability like mental openness, cognitive flexibility, and reflective thinking that significantly associate with mathematics learning (Palacios et al., 2014). The following review would only focus on attitudes in mathematics learning. In general, researchers describe attitudes toward mathematics as long-term positive or negative emotions towards mathematics (Marchis, 2011), and it has been in existence since the 1960s.
Majority of past research findings found that students’ attitudes toward mathematics have direct influences on students mathematics achievement (Farooq & Shah, 2008). Farooq and Shah (2008, p. 75) stated that “attitude towards mathematics plays a crucial role in the teaching and learning processes of mathematics”. Positivity or negativity of attitudes toward mathematics may determine the effort, engagement, willingness and motivation to learn and participate in mathematics learning. A numbers of past researches, it had been indicated that attitudes toward mathematics is closely correlated with self-efficacy (He, 2007); where self-efficacy is another essential cognitive component in learning. Self-efficacy is about self-beliefs of an individual of what he or she is able and unable to do. One’s belief in his or her own ability to perform in particular situation is closely related with the capabilities to produce desired levels of performance which will influence their lives (Bandura, 1994). As cited in Schunk (1991), Bandura claims that, the level of self-efficacy will influence an individual’s choice of act, how they perform in learning activities, effort put in the activities and one’s determination to perform.

As stated before, one’s attitudes will determine how he or she think, behave and act, his or her personal construction of self-concepts in mathematics will affect his respond toward learning mathematics in terms of behavior, value and motivation (He, 2007). In other word, attitudes towards mathematics as affective domain in mathematics learning is significantly correlated with cognitive domain in mathematics learning; and the correlation influence students’ performance and achievement in mathematics (Nicolaidou & Philippou, 2003). This is supported by the findings of attitudes towards mathematics as one of the
significant factors that influence students’ mathematics achievement (Mohamed & Waheed, 2011). Number of past findings indicated positive relationship between attitudes towards mathematics and achievement in mathematics (Bakar, Tarmizi, Mahyuddin, Elias, Wong, & Ayub, 2010; Cheung, 1988). A quantitative study of Philip et al. (2010) found that adolescents’ mathematics attitudes was significantly correlated with mathematics achievement with strong positive correlation ($r = 0.863$). Cheung (1988) in his correlational and commonality analysis revealed positive correlations between attitudes towards mathematics and mathematics achievement; students with more positive attitudes gain better achievement in mathematics (Cheung, 1988). He (2007) in his comparative study adolescents’ attitudes towards mathematics found to be a significant predictor for their perception of their own mathematics anxiety for European-American adolescents.

From the review, we can see that attitudes toward mathematics influence students’ mathematics achievement in multiple ways; such as: affect level of understanding (Goodykoontz, 2009), affect cognitive processing like self-efficacy and self-confidence (Nicolaidou & Philippou, 2003). These influences were significantly correlated with students’ cognitive ability in mathematics learning. Therefore, positive attitudes toward mathematics would support students’ mathematics learning, while negative attitudes toward mathematics may become obstacles in mathematics learning. However, the relationship with attitudes toward mathematics and mathematics achievement still not definite as there were some researches findings that indicate contradict results. For example: a correlational and comparative research of Chua, Hong, Law, Ting, and Othman
(2010) found that there was no significant relationship between attitudes toward mathematics and mathematics performance.

As mention before, attitudes would change through the gain of experience and knowledge, and this explain the situation of students may perform well in lower grade but unable to perform the same as the situation change (math getting more and more difficult to be learn). The changes of attitudes towards mathematics also found the meta-analysis research of Ma and Kishor (1997), where from one hundred and thirteen studies, number of studies shows that there were more positive attitudes toward mathematics found among the students in early schooling (lower education level); but the positivity of attitudes tend to become less positive and more negative at higher level of education.Similar findings also found in Wikins and Ma (2003) research on modeling change in student’s attitudes towards and beliefs about mathematics with the use of longitudinal data which involve students from Grade 7 until Grade 12 for six years. They found that, students were increasingly less positive in their attitudes toward mathematics and beliefs of social importance of mathematics.

Numbers of research papers revealed the correlation between mathematics anxiety and attitudes toward mathematics. According to Akin and Kurbanoglu (2011), in their research involving three hundred and seventy-two students, results indicated that mathematics anxiety was negatively correlated with positive attitudes towards mathematics but positively correlated with negative attitudes toward mathematics. They also claim that attitudes toward mathematics is one of the determinants or as a predictor of mathematics anxiety level. Past research also found that students with more negative attitudes toward mathematics would likely
to experience high level of mathematics anxiety (Hembree, 1990). The relationship between mathematics anxiety and attitudes toward mathematics was reciprocal. As discussed in the literature on mathematics anxiety, mathematics anxiety may affect students’ positivity or negativity on their attitudes toward mathematics and negative attitudes toward mathematics may contribute to higher level of mathematics anxiety. The literature also showed that attitudes towards mathematics is an essential component in mathematics learning as it has direct influence on students’ mathematics achievement and significantly correlate with mathematics anxiety.

2.3.1 Measurement of Attitudes toward Mathematics

There are various types of instruments for measuring learners’ attitudes toward mathematics. The first instrument was the Dutton Scale developed in 1954 by Dutton, an instrument that focusing on “feeling” towards arithmetic. This instrument sparked the development of other instruments with different or similar factor(s) analysis (Tapia & Marsh, 2004). Examples of recognized instruments developed include an instrument for measuring enjoyment and value of mathematics by Aiken (1974); Fennema-Sherman Mathematics Attitude Scales developed by Fennema and Sherman in 1976 with nine instruments: Attitude Toward Success in Mathematics Scale, Mathematics as a Male Domain Scale, Mother Scale, Father Scale, Teacher Scale, Confidence in Learning Mathematics Scale, Mathematics Anxiety Scale, Effectance Motivation Scale in Mathematics, and Mathematics Usefulness Scale (Tapia & Marsh, 2004); and Attitudes toward Mathematics Inventory (ATMI) developed by Tapia in 1996 with four factors:
self-confidence; value of mathematics; enjoyment of mathematics; and motivation (He, 2007). Among these developed instruments, Attitudes toward Mathematics Inventory (ATMI) is an instrument widely used in measuring students’ attitudes toward mathematics (He, 2007).

The development of measurement instrument continues. This was due to concerns that some instruments items may not fit the intention of gauging attitudes toward mathematics and the time involved due to large number of items that need to be administered (Tapia & Marsh, 2004). The development of attitudes instrument continues with the objectives of achieving better technical characteristics, more straightforward factor structure, important and meaningful dimensions of attitudes; and minimum time for administration. Tapia and Marsh declared that the revised of ATMI fit these objectives yet is valid and reliable to measure attitudes toward mathematics.

Originally ATMI had 49-item scale with six factors: confidence, anxiety, value, enjoyment, motivation, and parent/teacher expectations. Reconstruction of ATMI was mainly due to the need for a shorter instrument with a factor structure that is more straightforward. Tapia and Marsh in revising the 49-item of ATMI, eliminated one variable; parent/teacher expectations, due to low correlation; and the variables of anxiety and confidence were combined as self-confidence factor to increase the item-to-total correlation. Therefore, the revised ATMI had four essential factors of attitudes toward mathematics: self-confidence, value, enjoyment and motivation. This revised ATMI contains 40 items which contributed to the item-to-total correlation of above 0.50 and the highest being 0.82. This instrument was highly reliable with total Cronbach alpha of 0.90 and for
each factor: the Cronbach alpha was 0.95 for self-confidence factor; 0.89 for value of mathematics; 0.89 for enjoyment of mathematics; and 0.88 for motivation factor. The test-retest reliability for the revised ATMI was 0.89. Besides that, the items involved also showed good internal reliability as they were closely related to the factors of attitudes toward mathematics and supported students’ different interpretations. In addition, this instrument needs only 10 to 20 minutes to administer (Tapia & Marsh, 2004).

As a conclusion, the revised 40-item ATMI by Tapia and Marsh was an efficient and effective instrument for measuring attitudes toward mathematics measurement, with high content validity, high reliable factor scores, reliable for test-retest, and minimum cost of time.

2.4 Parental Influences

In the literature, a number of researchers and educators recognized the significance of parental influences toward adolescents’ academic performance. For example, Poffenberger and Norton (1959, cited in Aiken, 1970), stated that parents’ expectations, encouragements and their attitudes will affect children’s attitude and academic performance. Adolescents expose to many other social relationships besides family members, for example peers and friends relationship, nevertheless family (parents) still act as the base and core values that continue to have significant influence on adolescents (Cohen, n.d.). Jabor, Machtmes, Kungu, and Buntat (2011) stated that, parents play essential role in children’s learning where they serve as model of learning and the ones who provide the first learning environment to their children. For example, parents play a key role in shaping
children’s attitudes and motivation toward a subject (Bicer, Capraro, & Capraro, 2013).

There are different forms of parental influences on adolescents’ academic performance; such as: parental expectations, parental encouragement, parental attitudes and parental beliefs (Kleanthous & Williams, 2010; Philip et al., 2010; Phillipson, 2010; Pritchard, 2004; Wong, Hong, Law & Ting, 2010). These parental influences serve under the group of affective factors or emotional factors (e.g. attitudes) (British Council, 2012). In mathematics learning, parental affective influence has significant impact on adolescents’ attitudes toward mathematics and mathematics performances (Kleanthous & Williams, 2010). Kleanthous and Williams also further explained indirect parental influence such as parents’ attitudes toward mathematics have significant influence on adolescents’ attitudes toward mathematics. In addition, results of their study indicated that even though parents aspiration did not have significant effect on students’ mathematics achievement but it statistically has significant impact on students’ values and interests of mathematics learning. This finding was supported by another research which looked at adolescents’ perceptions on their parents’ attitudes toward mathematics (Philip et al., 2010). It indicated that parental attitudes toward mathematics positively correlated with adolescents’ attitudes toward mathematics and mathematics achievement. This support the idea of parental attitudes toward mathematics serving as one of the important source for adolescents’ attitudes toward mathematics and mathematics achievement; where adolescents tend to adopt similar attitudes toward mathematics as their parents (Philip et al., 2010). Furthermore, their past research also shows that parental affective factors were
one of the significant predictor of students’ achievement in mathematics (Phillipson, 2010; Pritchard, 2004).

Parsons, Adler and Kaczala (1982) stated that parents’ beliefs had direct influence toward students’ self-concepts; students with parents who had higher negative beliefs will developed low self-concept and self-esteem in their mathematics ability and future mathematics performance. Parental influence might cause a long-term issue in children mathematics learning, as self-concept and self-esteem are the identity of an individual recognized or accepted. And this identity shape one's behaviors, interests and character which may imply to their academic performance and future planning (Cohen, n.d.). For example in the case of gender differences in mathematics learning, the beliefs of gender stereotypes of mathematics learning among the parents will contribute to gender differences in mathematics learning through the judgment or expectation on children mathematics ability, subject difficulty and the value of mathematics subject with respect to gender identity (Gunderson, Ramirez, Levine, & Beilock, 2011; Parsons et al., 1982).

Moreover, parents’ pressures, negative beliefs and expectations also contribute to students’ anxiety negative emotion, mathematics anxiety (Philip et al., 2010; Yuksel-Sahin, 2008). In addition, as explained in the review of mathematics anxiety previously; parents are one of the characters who can be a source of their children’s mathematics anxiety through mathematics anxiety cycle (Bekdemir, 2010). Parents who experience mathematics anxiety themselves would set a negative role model to their children and projecting their own fears of mathematics to their children, and this had direct negative effect on children’s
mathematics identity (Heydari et al., 2013; Sun, 2009; Usop et al., 2009; Yuksel-Sahin, 2008). Parents’ own mathematics anxiety also proved to had significant affect on children’s attitudes towards mathematics (Gunderson et al., 2011). He’s paper comparing eighty Mainland-Chinese adolescents with fifty-four European-American adolescents, with the use of multiple regressions analysis showed adolescents’ perceptions of parents’ mathematics anxiety significantly predicted adolescents’ mathematics anxiety for adolescents of both countries’ adolescents (2007). As for the variable of attitudes toward mathematics, the results indicated Mainland-Chinese adolescents’ attitudes toward mathematics was significantly predicted by their perceptions of their parental attitudes toward mathematics. However, contradiction results were found for European-American adolescents for attitudes toward mathematics. In addition, Mainland-Chinese adolescents’ perception of parents’ mathematics anxiety was also found to be a significant predictor for adolescents’ mathematics achievements, but adolescents’ perception of parents’ attitudes towards mathematics was not a predictor.

Thus, generally, the literature showed the significant influence of parental affective factors such as attitudes toward mathematics on students’ academic performance and attitudes in learning. However, most of the researches on parental affective factors were more to parental expectation and attitudes toward children’s mathematics ability (Hoover-Dempsey & Sandler, 1995; Jacobs & Harvey, 2005; Parsons et al., 1982; Phillipson, 2010), rather than studying parents’ own attitudes toward mathematics with students’ attitudes toward mathematics and mathematics achievement. The evidence and findings on the influence of parental affective factors toward students’ attitudes and performance

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focusing on mathematics is still lacking and insufficient especially when it relate to societal culture, as every students in different culture respond to the influence differently (Lavinia, 2012). The research of parental influences is significant as the parental affective factors can be direct or indirect and parents may not aware of their influences on their children’s academic attitudes, academic performance and even future career choices (Jacobs, 1991).

2.5 Peers’ Influences

Peer is the second character after family members (e.g. parents) that play an essential role in the transitions of childhood to adolescence (Lee, 2002). Peer also play critical role in adolescents’ development of self-identity and academic performance (Lee, 2002; Magdol, 1992). As stated by the American Psychological Association (2002), during adolescents’ identity development period, peer group serve as a temporary reference point and their acceptance has important implication on adjustment during adolescence. Furthermore, desire of being accepted by peers emerges strongly during adolescent for the sense of belonging (Department of Education, 2014). Previous study indicated that, peers play multiple roles during adolescence; which include opponent, motivator, supporter, and as a model (Lee, 2002); and peers’ attitudes, aspirations, expectations, and standards are found to be significantly correlate with adolescents’ learning effort and school achievement (Magdol, 1992).

In Lee’s (2002) research, results indicated that for a relation to be formed between adolescents and their peers, it is significant to have shared common characteristics which could be in the form of interest, beliefs, knowledge, or
attitudes. Therefore, in order to be accepted in peer group, an individual will tend to adopt similar interests or characteristics of the peer group; either positive or negative characteristics (Philip et al., 2010). Ryan’s research finding showed that peer group context have potential to affect adolescents’ academic beliefs, behaviors, and achievements (2001). In terms of social reinforcement, adolescents are always affected by peer and social value. For example, when peers believe that learning mathematics is insignificant and valueless, the same beliefs would likely to be found in adolescents’ individual concept. The potential of peers’ influences may also due to the significant time that adolescents spend with their peers (He, 2007), where adolescents tend to spend more time with peers outside of home environment (Lee, 2002). However, there are differences in terms of types of value influenced. For example, Ryan (2001) found that, students’ intrinsic value would be more likely to be affected by peers’ value but not for utility value of schooling, with the argument that utility value maybe more influenced by parents and teachers rather than peers. Lee (2002) on the other hand claimed that positive peer relationships are able to support adolescents’ academic performance. But on the other hand, negative peer relationship would negatively affect adolescents’ academic performance (Ryan, 2001). For example, extreme peer pressure may lead to adolescents’ mathematics anxiety.

With regards to mathematics learning, past research findings indicated the influence of peers’ factors on adolescents’ mathematics anxiety, attitudes toward mathematics and achievement in mathematics. In Philip et al.’s (2010) research of one hundred and twenty students controlling for gender and ethnic variables, the results of correlational analyses indicated that adolescents’ perceptions of peers’
attitudes toward mathematics were significantly related to adolescents’ mathematics achievement. Another comparative research finding by He (2007) also showed significant peers’ influences toward adolescents’ mathematics learning. He’s study results found that adolescents’ mathematics anxiety for both country of China and United-States were significantly predicted by adolescents’ perceptions of their peers’ mathematics anxiety. In terms of attitudes toward mathematics, Mainland-Chinese adolescents’ attitudes toward mathematics were found to be correlated with their perceptions of peers’ attitudes toward mathematics, but contradictory result were found for European-American adolescents. In addition, results also showed that adolescents’ perceptions of their own achievement in mathematics were significantly predicted by their perceptions of peers’ mathematics anxiety and attitudes toward mathematics. This condition was only found among Mainland-Chinese adolescents and not European-American adolescents.

Even though peers are recognized to have a critical role in affecting adolescents’ learning process, there are only a few number of studies on peers’ influence on adolescents’ mathematics learning. More attentions need to be paid in the possible influence of peers’ factors on mathematics learning as it may significantly affect adolescents’ mathematics learning process and mathematics achievements.

2.6 Gender Differences

Many past research indicate gender as a significant moderator variable in educational study (Aiken, 1970). Gender-based differences in mathematics
learning studies been studied for the past four decades but findings remain inconsistent (Devine et al., 2012; Schram, 1996); for mathematics anxiety, attitudes toward mathematics and mathematics achievement. In mathematics learning, questions remained on male and female abilities to learn mathematics. Society expect female students to have lower achievement for mathematics subject, higher mathematics anxiety level, and more negative attitudes toward mathematics compared to male students (Eccles et al., 1993; Farooq & Shah, 2008; Gunderson et al., 2012; Parsons et al., 1982). Such beliefs are categorized as gender stereotypes where society believes that boys are more capable in learning and mastering mathematics skills and cast doubts on girls’ mathematics ability.

A number of previous researches reported significant gender differences in mathematics. For example there was significant gender differences in Devine et al. (2012) and Adamu (2014) research on students’ mathematics anxiety level based on gender; and in Arslan, Canh and Sabo (2012) study in terms of mathematics achievement and attitudes toward mathematics. However, there are contradictory findings and arguments on gender differences in mathematics learning. Some examples are insignificant gender differences reported in Schram’s (1996) study on mathematics performance; Gierl and Bisanz’s (1995), and Yuksel-Sahin’s (2008) studies on mathematics anxiety; and Mohamed and Waheed’s (2011), and Farooq and Shah’s (2008) studies on attitudes toward mathematics.

In Campbell’s (1994) paper about myths, stereotypes and gender differences, she argued that gender may not be a good predictor of an individual’s academic performance. On mathematics related skills, data showed that male and
female performances in mathematics were similar and not much difference found (Campbell, 1994), as shown in Figure 2.1.

![Graph of summary of hundreds of mathematics studies comparing male and female mathematics related skills](image)

*Figure 2. Graph of summary of hundreds of mathematics studies comparing male and female mathematics related skills (Campbell, 1994).*

To Campbell, gender differences in mathematics learning is a myth rather than an actual fact to be accepted, which persist due to society common belief on male and female gender-role. She also further explained that one of the reasons why gender stereotypes continue was due to research focusing on gender differences issue. In fact, gender stereotypes are reinforces and encouraged by findings of gender-differences studies, which lead to continues beliefs of gender differences in the society (Campbell, 1994; Lavinia, 2012). Stereotypes of gender differences deeply link with society beliefs and culture patterns (Lavinia, 2012).

According to Lavinia (2012), gender differences beliefs are due to social environmental perceptions, considerations and concepts carried by social agents, such as parents and teachers. Parents’ beliefs of gender stereotypes affect their
expectations and attitudes toward their children’s mathematics ability and mathematics performance (Gunderson et al., 2012; Lavinia, 2012; Parsons et al., 1982). According to Parsons et al. (1982), parents may contribute to perceptions on students’ gender differences through conveying messages of their beliefs of sex differences in mathematics performance or ability, directly or indirectly through their interactions with their children. Due to these beliefs and stereotypes, female adolescents build recognition of a lack of intelligence to perform mathematics compared to male adolescents, and develop negative attitudes toward mathematics learning and negative concepts of their mathematics ability (Farooq & Shah, 2008; Parsons et al., 1982), where people always have doubts about female ability in mathematics (Farooq & Shah, 2008) and they are often discouraged from high mathematics requirement occupation (a guy job) (Farooq & Shah, 2008). Furthermore, negative experience in performing mathematics reinforce development of the concept of gender stereotypes, with female being more likely to be affected by others’ perceptions, beliefs and opinions (Fraser, 1994). Mathematics identity with negative recognitions or perceptions could potentially lead to mathematics anxiety, low self-esteem, negative attitudes, and low confidence, and also problems of mathematics avoidance which results in female adolescent avoiding courses that require high mathematics ability and limit their occupation option (Farooq & Shah, 2008). In addition each individual’s behaviors and beliefs differ with regards to social beliefs and cultural practice (Lavinia, 2012).

In addition, there are other issues related to gender differences, such as the level of education and sample size of the study in examine of gender difference.
In Fennema’s (1974) paper reviewing thirty-six studies on gender differences in mathematics learning; no significant differences were found for lower educational level, elementary school and during early high school, but differences started to occur among high school students. Similar situation was reported in Arslan et al.’s (2012) study of attitudes, achievement and gender on mathematics education. In terms of mathematics performance, there was no significant gender differences for 6th grade students, but differences occurred in higher educational level of 7th and 8th grade students. In the aspect of mathematics attitudes, no significant gender difference were detected in 6th and 7th grade students but significant differences occurred among 8th grade students according to gender. A meta-analysis study by Ma and Kishor (1974), indicated another issue of research of gender differences namely; sample size has impact on the result of gender differences. From one hundred and thirteen studies, Ma and Kishor discovered that research with sample size less than 300 tend to report statistically significant gender differences while no significant differences were more common for research with sample size larger than 300.

2.7 Summary

The literature reviewed discussed on the significant role and affects of various factors in mathematics learning. Adolescence is seem as second period of human development and also a period where they face more difficulties in mathematics leaning in relation to formation of mathematics anxiety and development of positive or negative attitudes toward mathematics. The discussions also focus on the influences of mathematics anxiety on an individual,
learning aspect and society. Attitudes are shown to be correlated with mathematics learning and impacted on mathematics achievement. There are also possible negative correlations between attitudes toward mathematics and mathematics anxiety, and mathematics achievement. The literature also indicated possible influence of parents and peers on adolescents’ mathematics anxiety, and attitudes toward mathematics. Gender differences findings on mathematics anxiety, attitudes toward mathematics and mathematics achievements showed contradictory results. The literature review showed the need for further investigation on this research topic.
CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction

The main focus of this chapter is to present the research methodology used in this study, and it discusses the research design, population, sample and sampling procedures, research instrument, reliability of the research instrument, ethics of research, procedures of data collection and procedures of data analysis.
3.1 Research Design

The research design of this study was a cross-sectional survey with correlational and comparative design which constituted a non-experimental quantitative research. Non experimental quantitative is a systematic empirical inquiry in which the researcher does not have direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulate-able (Johnson & Christensen, 2000). Cross-sectional survey is a type of non-experimental quantitative study mainly for descriptive purpose (Levin, 2006) with type of data that disclose little change in a short period of time (Weerasekera, 2014). Generally it involves description of the data’s frequency, like which the data involve in this study where data in form of frequency and is used to further look for the relationships and for the purpose of comparisons.

This research design was suitable according to the goals and objectives of the research study. Cross-sectional survey fulfills the need for describing the data. Correlational research design was chosen since this study included the interest to determine the extent to which the variables were related to other variables. This research design was used to measure the relationships between variables, such as the relationships between adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement with their perceptions of their parents’ and peers’ mathematics anxiety and attitudes toward mathematics. Comparative research design was used for the purpose of comparing two groups on a variable. In this case, it was used to determine whether there were any significant
differences in students’ mathematics anxiety, attitudes toward mathematics and mathematics achievements based on the adolescents’ gender.

Levine (2006) also claims that, with cross-sectional survey design many factors can be assessed in a time and it is less time consuming. However, every design has its own weaknesses. For this research design, the main difficulty would be difficulty in defining causal inferences between the variables.

3.2 Population, Sample & Sampling Procedures

3.2.1 Population

The main target population of this study was Form Four secondary schools level students in Bau and Samarahan areas. All six schools were located at rural area.

3.2.2 Sample

The sample of the study was Form Four students from six secondary schools in Bau and Samarahan areas. From these six secondary schools, 480 Form Four students were selected. The sample size was determined through the number of variables involved with multiplied 60 (8 × 60 = 480) (Gray, 2014).

3.2.3 Sampling Procedures

The sampling method in this study was systematic random sampling. It is a type of probability sampling methods, a method where each of the samples has the same probability to be selected for the survey. This type of sampling method takes the whole population into consideration in sampling selections. The major
part of systematic random sampling is the selection of the starting point or the first sample of the sample (Daniel, 2012; Latham, 2007). Randomization of the sampling only occurs at the selection of the first sample.

The first step of systematic random sampling was determined by the target population and sample size of the study. Based on the number of variables, the sample size were decided to be 480 samples in total; selected from six Form Four secondary schools in Bau and Samarahan areas. The secondary schools were randomly selected. Then the interval value was determined. To determine the interval value \( i \), the population size \( N \approx 1500 \) were divided by the desired sample size \( 480 \). Then, the first sample \( n \) will be randomly determined between ‘1’ to the ‘\( i \)’.

After deciding on the first sample, the second and following samples will be selected systematically according to the list of students. As shown in the 5th step, the selected samples will be based on the first sample, \( n \) and the interval value, \( i \). The selections continue until it fulfills the sample size of 480 samples.

Systematic Random Sampling Step:

1. Decide target population of Form Four students of secondary schools in Bau and Samarahan areas (1500).

2. Determine desired sample size, 480 participants.

3. Calculate sampling interval with total Form Four students \( N \) from all three selected schools divided by 480 and gain an integer \( i \); \( N \div 480 \) \((1500 \div 480) = i (3)\).

4. Random select a number, ‘\( n = 2 \)’, in between integer ‘1’ to ‘\( i = 3 \)’.
5. The sample then starts from sample \( n \), and continue with \( n + i \) \((2 + 3 = 5)\), \( n + 2i \) \((2 + 6 = 8)\), \( n + 3i \) \((2 + 9 = 11)\), \( n + 4i \) \((2 + 12 = 14)\) … until achieving 480 samples.

There were few weaknesses of the systematic random sampling, where one of it was samples have different possibility to be selected according to the interval value determined in the first place (Daniel, 2012). In worst case there will be samples that have zero possibility to be selected (Daniel, 2012). It was used in this study based on the determinations of suitability of the sampling method to the study, research design and the benefits of the method. This sampling method was easier to perform and much more convenient as the selection process can be performed manually and the random selection only involved the selection of the starting number and systematically following the interval value; which make it less cost and time consuming (Daniel, 2012).

Even though the random selection only at starting point, but it still able to yield adequate result (Daniel, 2012) as the students were randomly located with minimum classification and order. Daniel (2012), also points out that systematic sampling is able to avoid possibility of autocorrelation which may cause bias to the findings. Furthermore, this kind of method also ensure the selection of sample spread across the population (Daniel, 2012) as it takes the whole target population into calculation for the sample selection. This situation increases the possibility of generalizing the findings of the sample to the population.
3.3 Research Instruments

The questionnaire for this study had three sections (Refer to Appendix C for the questionnaire). The first section collected demographic information and information on mathematics achievement. The demographic information gathered include: adolescents’ gender and age. For mathematics achievement, it is measured in Likert-scale form which was self-reported by the respondents; where 1 = “Extremely Low Achievement” to 5 = “High Achievement”. The second is mathematics anxiety survey on adolescents’ and their perceptions of their parents’ and peers’ mathematics anxiety. The third section surveyed the adolescents’ attitudes toward mathematics and their perceptions of their parents’ and peers’ attitudes toward mathematics. The second section of the questionnaire was the revised model of Mathematics Anxiety Rating Scale-Revised (MARS-R) and the third section comprised of the Attitude toward Mathematics Inventory (ATMI).

The MARS-R is an instrument consisting of twenty-four items with two sub-scales: learning mathematics anxiety (LMA) and mathematics evaluation anxiety (MEA) (He, 2007). The revised model of MARS-R only consists of twelve items; eight items in LMA subscale and four items in MEA subscale. Examples of items in the revised model MARS-R in LMA subscale are: “Having to use the tables in the back of a math book” and “Reading and interpreting graphs or charts”. While for MEA subscale, examples are: “Thinking about an upcoming math test one day before” and “Taking an examination in a math course”. The items were constructed in the Likert-scale format, where: 1 = “No Anxiety”, 2 = “Low Anxiety”, 3 = “Neutral”, 4 = “Anxiety”, and 5 = “High Anxiety”. This instrument was used to measure adolescents’ mathematics anxiety level and his or
her perceptions of parents’ and peers’ mathematics anxiety. Section B measuring mathematics anxiety had four columns, the first column presented the items, second column for individual’s rating of their own mathematics anxiety; the third and fourth column each were parents’ and peers’ mathematics anxiety rate according to adolescents’ perceptions. For the category of mathematics anxiety level, it is categorized according to the mean of mathematics anxiety score, where: 1.00 – 1.64 = Low mathematics anxiety; 1.65 – 3.35 = Moderate mathematics anxiety; 3.36 – 5.00 = High mathematics anxiety (Ajogbeje, Borisade, Aladesaye, & Ayodele, 2013).

The ATMI instrument consists of forty items with four main factors which include self-confidence, value of mathematics, enjoyment of mathematics, and motivation (Tapia & Marsh, 2004). The items were constructed in the Likert-scale format where: 1 = “Strongly Disagree”, 2 = “Disagree”, 3 = “Neutral”, 4 = “Agree”, and 5 = “Strongly Agree”. This study only used ten items out of forty items of ATMI which focused on the value of mathematics. Examples of the value scale of AMTI are: “Mathematics is very worthwhile and necessary subject” and “Mathematics is one of most important subjects for people to study”. In Section C of the questionnaire, there were four columns with first for the instrument items; second column for individual rating on the attitudes toward mathematics; third and fourth columns for parents’ and peers’ attitudes toward mathematics respectively according to the adolescents’ perceptions. As for categorization of adolescents’ attitudes toward mathematics, it could be classified through the mean of attitudes score. As listed in Schenkel’s (2009) paper: 1.00 – 1.64 = Negative
attitudes toward mathematics; 1.65 – 3.35 = Moderate attitudes toward mathematics; 3.36 – 5.00 = Positive attitudes toward mathematics.

Participants were expected to complete the questionnaire in the range of time of 15 to 20 minutes.

3.3.1 Reliability of the Research Instrument

The literature has shown that the revised model of MARS-R is a reliable instrument to use for measuring students’ mathematics anxiety. He (2007) stated that, the items in the revised model of MARS-R were highly correlated with item-to-total correlation achieving 0.97. The Cronbach alpha of reliability coefficients based on the subscale of LMA and MEA were 0.87 and 0.85 respectively (He, 2007).

According to Tapia and Marsh (2004), all forty items of ATMI had item-to-total correlation above 0.50 and the highest achieved 0.82, which shows that these forty items contributed significantly to the instrument. For reliability of ATMI, in total the Cronbach alpha achieve 0.95, while the value of mathematics scale with ten items had a Cronbach alpha of 0.89 which can be considered as highly reliable (Tapia & Marsh, 2004).

3.4 Research Ethics

The first ethical issue is the informed consent of the participation of respondent in the study (Fouka & Mantzorou, 2011). In the informed consent section of the questionnaire, it was clearly explained what was the study all about, the purpose, and the objectives of the study. It was also clearly stated on their
right to make decision on whether or not to participate in the study according to individual willingness without any forceful action or threat from the researcher. They were allowed to leave this study at any point if they felt uncomfortable about it. All target samples was briefed in detail about the study and students were allowed to ask any questions related to the study. This was to make sure the participants understand the study and the performance required in the study before they make any decision (Chua, 2006). In this study, the students are voluntary and they were not forced to answer the questionnaire in anyway.

Another major ethical issue in the research is the confidentiality of the information collected especially personal information of the study’s respondents (Economic and Social Research Council, 2009). In this study, the identity and the personal information were not given to third party for any purposes. The related information collected from the respondents was confidential to protect participants from any unwanted issue that might affect their life and living. In every part of the research, no matter in report or oral presentation the respondents remain anonymous. This research does not involve any intrusive interventions, such as the use of drugs, vigorous physical exercise, extreme psychological stress or any other actions that will cause pain or harm. It only required respondent to respond and fill in the questionnaire, which content only focus on the aspect of mathematics and attitudes towards mathematics.

3.5 Data Collection Procedures

As the study involved students at government secondary schools, the initial step was the application for permissions to carry out the study at targeted
schools from Kementerian Pelajaran Malaysia and Jabatan Pendidikan Negeri Sarawak. Only with the approvals from these two departments, the research was carried out at the government secondary schools. After the application was approved, the researcher gathered information on the target population; the number of students of Form Four students at the targeted six schools would be randomly selected. After determining of the population size \((N \approx 1500)\) and the desired sample size \((480)\), interval value \((i \approx 3)\), the sample was selected using systematic sampling method. The first sample was randomly selected and the following samples were selected systematically with interval value with respect to the first sample selected.

The principals from the six secondary schools were contacted and briefed about the study, asked for permission and made arrangement to distribute the questionnaires. Questionnaires were distributed during regular class time according to the time schedule approved by teachers whose classes were involved in this study. Students spent around 15 to 25 minutes on the questionnaire and immediately returned it to the researcher or teachers-in-charged.

### 3.6 Data Analysis Procedures

The data collected were analyzed statistically using the statistics software of Statistical Package for Social Science (SPSS) software version 16\(^{th}\). The analyses of data were divided into two main parts; one for descriptive analyses and another part for hypotheses testing. In these two parts of analyses, it involved three major statistics analyses, which were: descriptive statistics, and second part correlational analyses and comparative analyses. Statistic test for correlational
analyses is Pearson Moment Correlation analysis and Independent Sample t-Test for examine gender differences. The classification of correlational strength being classified according to $r$ value: $r \leq 0.35 = \text{low or weak positive correlation}$; $0.36 \leq r \leq 0.67 = \text{moderately positive correlation}$; $r > 0.67 = \text{strong or high positive correlation}$; $r \leq -0.35 = \text{low or weak negative correlation}$; $-0.36 \leq r \leq -0.67 = \text{moderately negative correlation}$; $r > -0.67 = \text{strong or high negative correlation}$ (Taylor, 1990). Table 3.1 below shows the statistical analyses used in the study.

Table 3.1

Statistical analyses used in the study

<table>
<thead>
<tr>
<th>Research hypothesis</th>
<th>Data Source</th>
<th>Statistical analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0$ 1  There were no significant relationships between adolescents’ mathematics anxiety with parents’ and peers’ mathematics anxiety.</td>
<td>MARS-R</td>
<td>Pearson Moment Correlation</td>
</tr>
<tr>
<td>$H_0$ 2  There were no significant relationships between adolescents’ attitudes toward mathematics with parents’ and peers’ attitudes toward mathematics.</td>
<td>ATMI</td>
<td>Pearson Moment Correlation</td>
</tr>
<tr>
<td>$H_0$ 3  There were no significant relationships between adolescents’ mathematics achievements, mathematics anxiety and attitudes toward mathematics.</td>
<td>MARS-R, ATMI and mathematics achievement</td>
<td>Pearson Moment Correlation</td>
</tr>
<tr>
<td>$H_0$ 4  There were no significant relationships between adolescents’ mathematics achievements with parents’ mathematics anxiety and attitudes toward mathematics.</td>
<td>MARS-R, ATMI and mathematics achievement</td>
<td>Pearson Moment Correlation</td>
</tr>
<tr>
<td>H₀ 5</td>
<td>There were no significant relationships between adolescents’ mathematics achievements with peers’ mathematics anxiety and attitudes toward mathematics.</td>
<td>MARS-R, ATMI and mathematics achievement</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>H₀ 6</td>
<td>There were no significant differences between adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievements based on gender.</td>
<td>MARS-R, ATMI, mathematics achievement, and demographic information (gender)</td>
</tr>
</tbody>
</table>

### 3.7 Summary

This study was a non experimental quantitative research involving cross-sectional survey with correlational and comparative design. Samples were chosen from Form Four secondary school students, from six secondary schools using systematic random sampling technique. Instrument used in this study was a questionnaire which consisted of three main parts, which were: background information, MARS-R and ATMI. Descriptive statistics, Pearson Moment Correlation, and Independent Samples t-Test were used in data analyses.
CHAPTER FOUR

RESULTS

4.0 Introduction

There were three main goals in this study. Firstly, the study investigated the possible relationships between adolescents’, parents, and peers’ mathematics anxiety and attitudes toward mathematics. Secondly, it looked at the correlation between adolescents’ mathematics anxiety, attitudes toward mathematics, and self-report mathematics achievement. The third aim was to identify whether significant differences exist in terms of adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on gender.
The first part of this chapter presents the descriptive analysis of all the variables measured in this study. The second part reports the results of six hypotheses testing with two types of statistics tests, Pearson Moment Correlation analysis and Independent Samples t-Test. This chapter concludes with a summary of the main findings of the study.

4.1 Descriptive Findings on the Main Variables

Table 4.1 below presents the means and standard deviations for all variables in this study. Overall, there were 480 respondents from six rural area secondary schools; with 209 male adolescents and 271 female adolescents. On average adolescents had moderate levels of mathematics anxiety ($M = 3.35$, $SD = 0.687$), positive attitudes toward mathematics ($M = 3.94$, $SD = 0.835$), and moderate levels mathematics achievements ($M = 3.22$, $SD = 0.852$). Adolescents also perceived similar levels of mathematics anxiety and attitudes toward mathematics for both parents and their peers. From adolescents’ perceptions, both parents and peers had moderate levels of mathematics anxiety, with peers’ mathematics anxiety level slightly higher ($M = 3.32$, $SD = 0.642$) than parents’ mathematics anxiety level ($M = 3.04$, $SD = 0.751$). The adolescents’ also perceived their parents ($M = 3.87$, $SD = 0.852$) and peers ($M = 3.83$, $SD = 0.852$) had positive attitudes toward mathematics.
Table 4.1

Descriptive analysis of dependent and independent variables.

<table>
<thead>
<tr>
<th>Measures</th>
<th>Mean</th>
<th>Std Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescents’ Mathematics Anxiety</td>
<td>3.35</td>
<td>0.687</td>
</tr>
<tr>
<td>Adolescents’ Attitudes toward Mathematics</td>
<td>3.94</td>
<td>0.835</td>
</tr>
<tr>
<td>Adolescents’ Mathematics Achievement</td>
<td>3.22</td>
<td>0.852</td>
</tr>
<tr>
<td>Parents’ Mathematics Anxiety</td>
<td>3.04</td>
<td>0.751</td>
</tr>
<tr>
<td>Parents’ Attitudes toward Mathematics</td>
<td>3.87</td>
<td>0.819</td>
</tr>
<tr>
<td>Peers’ Mathematics Anxiety</td>
<td>3.32</td>
<td>0.642</td>
</tr>
<tr>
<td>Peers’ Attitudes toward Mathematics</td>
<td>3.83</td>
<td>0.793</td>
</tr>
</tbody>
</table>

Note. n = 480; Male adolescents = 209; Female adolescents = 271
Mathematics Anxiety Level: 1 = “No Anxiety”, 2 = “Low Anxiety”, 3 = “Neutral”, 4 = “Anxiety”, and 5 = “High Anxiety”
Mean: 1.00 – 1.64 (< 33%) = Low mathematics anxiety; 1.65 – 3.35 (33% - 67%) = Moderate mathematics anxiety; 3.36 – 5.00 (> 67%) = High mathematics anxiety
(Ajogbeje et al., 2013)
Attitudes toward Mathematics Category: 1 = “Strongly Disagree”, 2 = “Disagree”, 3 = “Neutral”, 4 = “Agree”, and 5 = “Strongly Agree”
Mean: 1.00 – 1.64 (< 33%) = Negative attitudes toward mathematics; 1.65 – 3.35 (33% - 67%) = Moderate attitudes toward mathematics; 3.36 – 5.00 (> 67%) = Positive attitudes toward mathematics
(Schenkel, 2009)
Mathematics Achievement level(Self-report): 1 = “Extremely Low Achievement” till 5 = “High Achievement”
Mean: 1.00 – 1.99 (<40%) = Low achievement; 2.00 – 3.50 (40% - 70%) = Moderate achievement; 3.51 – 5.00 (> 70%) = High achievement

4.2 Adolescents’ mathematics anxiety with parents’ and peers’ mathematics anxiety.

Table 4.2 shows the correlation results of adolescents’ own mathematics anxiety and their perceptions on parents’ and peers’ mathematics anxiety. There were significant and moderate strong positive relationships between adolescents’ own mathematics anxiety with their perceptions of their parents’ mathematics anxiety ($r = 0.534, p < 0.005$), and their perceptions of their peers’ mathematics anxiety ($r = 0.625, p < 0.005$). If the adolescents perceived high level of
mathematics anxiety among their parents and peers, they themselves also faced with high mathematics anxiety level.

Table 4.2

*Correlations of adolescents’ mathematics anxiety with parents’ and peers’ mathematics anxiety.*

<table>
<thead>
<tr>
<th></th>
<th>Adolescents’ Anxiety</th>
<th>Parents’ Anxiety</th>
<th>Peers’ Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescents’ Anxiety</td>
<td>1</td>
<td>0.534**</td>
<td>0.625**</td>
</tr>
<tr>
<td>Parents’ Anxiety</td>
<td>0.534**</td>
<td>1</td>
<td>0.433**</td>
</tr>
<tr>
<td>Peers’ Anxiety</td>
<td>0.625**</td>
<td>0.433**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. *p < 0.05 **p < 0.01

Correlation strength: $r \leq 0.35 =$ low or weak positive correlation;
$r > 0.67 =$ strong or high positive correlation;
$r \leq -0.35 =$ low or weak negative correlation;
$-0.36 \leq r \leq -0.67 =$ moderately negative correlation;
$r > -0.67 =$ strong or high negative correlation

(Taylor, 1990)

4.3 Adolescents’ attitudes toward mathematics with parents’ and peers’ attitudes towards mathematics.

Table 4.3 shows the correlation results of adolescents’ attitudes toward mathematics and their perceptions on parents’ and peers’ attitudes toward mathematics. From the table, the results showed that there were significant strong positive relationship between adolescents’ attitudes toward mathematics with their perceptions of their parents’ attitudes toward mathematics ($r = 0.799, p < 0.005$), and their perceptions of their peers’ attitudes toward mathematics ($r = 0.814, p < 0.005$). When adolescents perceived their parents and peers to have positive attitudes toward mathematics, most likely they also have positive attitudes.
towards mathematics. Besides, as can be seen from the results, peers might have stronger influence on adolescents’ attitudes toward mathematics compared to adolescents’ parents.

Table 4.3

*Correlations of adolescents’ attitudes toward mathematics with parents’ and peers’ attitudes toward mathematics.*

<table>
<thead>
<tr>
<th></th>
<th>Adolescents’ Attitudes</th>
<th>Parents’ Attitudes</th>
<th>Peers’ Attitudes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescents’ Attitudes</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parents’ Attitudes</td>
<td>0.799**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peers’ Attitudes</td>
<td>0.814**</td>
<td>0.799**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. * p < 0.05 ** p < 0.01

4.4 Adolescents’ mathematics achievement, mathematics anxiety and attitudes toward mathematics.

Table 4.4 presents the correlation results of adolescents’ self-report mathematics achievement, mathematics anxiety and attitudes toward mathematics. Referring to Table 4.4, there were significant relationships between adolescents’ mathematics achievement and mathematics anxiety (r = - 0.303, p < 0.005); attitudes toward mathematics (r = 0.524, p < 0.005); and attitudes toward mathematics (r = - 0.118, p = 0.010). The r-values indicated weak negative relationships. On the other hand, the relationship between adolescents’ mathematics achievement and attitudes toward mathematics (r = 0.524) found to be moderately positive correlated. Students with high mathematics anxiety level have negative attitudes toward mathematics and gain low mathematics
achievement. Adolescents with more positive attitudes toward mathematics learning were most likely to perform better in mathematics learning.

Table 4.4

*Correlations of adolescents’ mathematics achievement, mathematics anxiety and attitudes toward mathematics.*

<table>
<thead>
<tr>
<th></th>
<th>Adolescents’ Achievement</th>
<th>Adolescents’ Anxiety</th>
<th>Adolescents’ Attitudes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescent Achievement</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adolescents’ Anxiety</td>
<td>-0.303**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Adolescents’ Attitudes</td>
<td>0.524**</td>
<td>-0.118**</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note. *p < 0.05 **p < 0.01

4.5 Adolescents’ mathematics achievement with parents’ mathematics anxiety and attitudes toward mathematics.

Table 4.5 shows the correlation results between adolescents’ self-report mathematics achievement with their perception of their parents’ mathematics anxiety and attitudes toward mathematics. There were significant relationships between adolescents’ mathematics achievement and their perceptions of parents’ mathematics anxiety ($r = -0.252, p < 0.005$), and with their perception of their parents’ attitudes toward mathematics ($r = 0.382, p < 0.005$). From the $r$-values, the negative relationship between adolescents’ mathematics achievement and their perceptions of parents’ mathematics anxiety was weak; while the positive relationship between adolescents’ mathematics achievement and their perception of their parents’ attitudes toward mathematics was moderately strong. Adolescents, whose parents have high mathematics anxiety, tend to have low mathematics
achievement. On the other hand, adolescents whose parental attitudes toward mathematics were positive would likely to achieve better in mathematics.

Table 4.5

Correlations of adolescents’ mathematics achievement with parents’ mathematics anxiety and attitudes toward mathematics.

<table>
<thead>
<tr>
<th></th>
<th>Adolescents’ Achievement</th>
<th>Parents’ Anxiety</th>
<th>Parents’ Attitudes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescents’ Achievement</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parents’ Anxiety</td>
<td>-0.252**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Parents’ Attitudes</td>
<td>0.382**</td>
<td>-0.044**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. * p < 0.05 ** p < 0.01

4.6 Adolescents’ mathematics achievement with peers’ mathematics anxiety and attitudes toward mathematics.

Table 4.6 shows the correlation results between adolescents’ self-report mathematics achievement with peers’ mathematics anxiety and attitudes toward mathematics. There were significant relationships between adolescents’ mathematics achievement and their perceptions of peers’ mathematics anxiety \((r = -0.201, p < 0.005)\), and their perceptions of their peers’ attitudes toward mathematics \((r = 0.415, p < 0.005)\). The negative relationship between adolescents’ mathematics achievement and their perceptions of peers’ mathematics anxiety was weak. The positive relationship between adolescents’ mathematics achievements and their perception of their peers’ attitudes toward mathematics was moderately strong. Adolescents, whose peers have high
mathematics anxiety, would tend to have lower mathematics achievements. Adolescents, whose peers’ attitudes toward mathematics were positives, were more likely to achieve better in mathematics.

Table 4.6

*Correlations of adolescents’ mathematics achievement with peers’ mathematics anxiety and attitudes toward mathematics.*

<table>
<thead>
<tr>
<th></th>
<th>Adolescent Achievement</th>
<th>Peer Anxiety</th>
<th>Peer Attitudes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescent Achievement</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peer Anxiety</td>
<td>-0.201**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peer Attitudes</td>
<td>0.415**</td>
<td>-0.018**</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note. *p* < 0.05 **p* < 0.01

4.7 Adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement by gender.

Table 4.7 shows the results of independent t-tests for the differences in adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievements based on gender. The results showed that there were no significant differences in adolescents’ mathematics anxiety (*t* (478) = -1.261, *p* = 0.208), attitudes towards mathematics (*t* (478) = -0.895, *p* = 0.371), and mathematics achievement (*t* (478) = 0.726, *p* = 0.468) between male and female adolescents.
Table 4.7

*Independent t–test for differences in adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on gender.*

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adolescents’ Anxiety</td>
<td>Male</td>
<td>209</td>
<td>3.307</td>
<td>0.711</td>
<td>-1.261</td>
<td>478</td>
<td>0.208</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>271</td>
<td>3.387</td>
<td>0.667</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adolescents’ Attitudes</td>
<td>Male</td>
<td>209</td>
<td>3.904</td>
<td>0.811</td>
<td>-0.895</td>
<td>478</td>
<td>0.371</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>271</td>
<td>3.972</td>
<td>0.854</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adolescents’ Achievement</td>
<td>Male</td>
<td>209</td>
<td>3.250</td>
<td>0.917</td>
<td>0.726</td>
<td>478</td>
<td>0.468</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>271</td>
<td>3.190</td>
<td>0.798</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. \( n = 480 \)

4.8 Summary

This chapter reported the findings of the study based on the research objectives and hypotheses stated in Chapter One. The following chapter discusses the findings and provides the implications of the findings.
CHAPTER FIVE
DISCUSSION AND CONCLUSION

5.0 Introduction

There are six sections in this chapter. The first section presents the summary of the study, briefly explaining what the research is about. The second section provides the summary of the research findings. The third section discusses the research findings in relating to theories and past-research findings. The following section looks at possible implications arising from the findings. The fifth section provides recommendations for future research and the sixth section of this chapter.
5.1 Summary of the Study

This study investigated the influence of adolescents’ perceptions of parents’ and peers’ mathematics anxiety and attitudes toward mathematics on their mathematics anxiety, attitudes toward mathematics, and mathematics achievement. Specifically, research aimed to examine five relationships between the variables of interest in the study. These relationships were: relationships between adolescents’ mathematics anxiety and their perception of their parents’ and peers’ mathematics anxiety; relationships between adolescents’ attitudes toward mathematics and their perception of their parents’ and peers’ attitudes toward mathematics; relationships between adolescents’ mathematics anxiety, attitudes toward mathematics, and mathematics achievement; relationships between adolescents’ mathematics achievement and their perception of their parents’ mathematics anxiety and attitudes toward mathematics; and relationships between adolescents’ mathematics achievement and their perception of their peers’ mathematics anxiety and attitudes toward mathematics. This study also looks for the existence of differences in adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on gender.

The design of the study was a cross-sectional survey with correlational and comparative design. It was a one-time non-experimental quantitative study, with the use of a questionnaire as the main data collection instrument. The correlational design was for determining the correlations between the dependent variables and independent variables. The comparative design was used for determining gender differences in the dependent variables. Respondents of this study were 480 Form Four students selected through systematic random sampling method from six rural
secondary schools. The questionnaire consisted of three sections: Section A for demographic information and rating for respondents’ perception of their own mathematics achievement; Section B for mathematics anxiety rating using the Mathematics Anxiety Rating Scale-Revised (MARS-R); and Section C for attitudes toward mathematics rating, Attitudes toward Mathematics Inventory (ATMI). Ratings of mathematics anxiety, attitudes toward mathematics and mathematics achievement were in Likert-scale form. The questionnaires were distributed during regular class time with the assistance from teachers of classes that involved in the study.

Collected data were analyzed using statistics analyses. Pearson Moment Correlations analyses were used to examine the relationships between the dependent and independent variables: relationships between adolescents’ mathematics anxiety and their perception of their parents’ and peers’ mathematics anxiety; relationships between adolescents’ attitudes toward mathematics and their perception of their parents’ and peers’ attitudes toward mathematics. Independent Samples t-Tests were used to examine gender differences in adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on gender.

5.2 Summary of the Research Findings

Based on the findings presented in Chapter 4, the adolescents had moderate level of mathematics anxiety, positive attitudes toward mathematics, and moderate level of mathematics achievement. Adolescents’ perceived their
parents’ and peers’ mathematics anxiety as moderate and attitudes toward mathematics as positive.

There were significant and strong positive relationships between adolescents’ own mathematics anxiety with their perception of their parents’ and peers’ mathematics anxiety. There were significant and strong positive relationships between adolescents’ own attitudes toward mathematics and their perceptions of their parents’ and peers’ attitudes toward mathematics. The results also indicated the significant relationships between adolescents’ perceptions of their own mathematics achievements with their mathematics anxiety level and attitudes toward mathematics. Adolescents’ perceptions of their own mathematics achievement had achieved negative correlation with their mathematics anxiety level and a strong positive correlation with their attitudes toward mathematics.

There were significant relationships between adolescents’ perceptions of their own mathematics achievement with their perception of their parents’ and peers’ mathematics anxiety and attitudes. The adolescents’ mathematics achievement was negatively correlated with their parents’ and peers’ mathematics anxiety weakly. On the other hand, the adolescents’ mathematics achievement was positively and moderately correlated with their parents’ and peers’ mathematics anxiety. The Independent Samples t-Tests indicated that there were no significant gender differences in the adolescents’ mathematics anxiety, attitudes toward mathematics, and mathematics achievement.
5.3 Discussions of Research Findings

5.3.1 Relationships between adolescents’ mathematics anxiety with parents’ and peers’ mathematics anxiety.

With the use of the Mathematics Anxiety Rating Scale-Revised (MARS-R), the present study found moderate mathematics anxiety level for adolescents’ mathematics anxiety, and their parents’ and peers’ mathematics anxiety as perceived by adolescents. Adolescents’ mathematics anxiety was found to be significantly and positively correlated with their perceptions of their parents’ mathematics anxiety. This finding was supported by He’s (2007) comparative study on Mainland-Chinese adolescents with European-American adolescents, which reported findings indicating that adolescents’ perceptions of parents’ mathematics anxiety was a significant predictor of adolescents’ mathematics anxiety for both countries. Sun (2009), Usop et al. (2009), and Yuksel-Sahin (2008), claimed that parents own mathematics anxiety would influence and contribute to their children’s mathematics anxiety, through projection of their own mathematics anxiety to their children or expression of their negative emotions on mathematics through their behavior. Even though at the adolescence stage adolescents are said to be shifting their relationship closer to other social agents such as peers, parents still the core role model of adolescents to refer with (Jabor et al., 2011; Ryan, 2001). Bekdemir (2010) also stated that parent is one of the social agents who pass their own mathematics anxiety to and cause children’s mathematics anxiety through the mathematics anxiety cycle.

There was also significant and positive relationship between adolescents’ mathematics anxiety and their perception of their peers’ mathematics anxiety.
He’s (2007) study also indicated that adolescents’ perceptions of their peers’ mathematics anxiety as one of the predictors of their own mathematics anxiety for both Mainland-Chinese and European-American adolescents. The American Psychological Association (2002) indicated that peers serve as reference point during adolescence, and Bakar et al. (2010) pointed out high peer influence in students’ learning based on their self-report rating. It is commonly known that adolescents always seek acceptance from their peers and one way to do that is through adoption of similar or same characteristics with their peers including negative characteristics (Philip et al., 2010). In Ryan’s (2001) research findings, peer group context was found to affect adolescents’ academic beliefs and behaviours. Thus, if most of the peers are anxious towards mathematics, it would influence adolescents’ emotional elements of mathematics concept which might result in the formation of mathematics anxiety in association with other factors such as negative experiences in mathematics learning.

5.3.2 Relationships between adolescents’ attitudes toward mathematics with parents’ and peers’ attitudes toward mathematics.

The present study indicated positive attitudes toward mathematics in adolescents and they also perceived their parents and peers as also having similar attitudes. There were significant and positive relationship between adolescents’ attitudes toward mathematics and their perceptions of their parents’ attitudes toward mathematics. Philip et al.’s (2010) research finding showed positive correlation between parental attitudes toward mathematics and adolescents’ attitudes toward mathematics. According to Kleanthous and Williams (2010),
parental affective influence such as parents’ attitudes toward mathematics had a significant impact on adolescents’ attitudes toward mathematics. Philip et al. (2010) reported that adolescents tend to adopt their parents’ attitudes toward mathematics and according to social learning theory, adolescents learn from environment including social agents such as parents in self-identity development. Adolescents refer to and learn from their parents’ attitudes toward mathematics and along with their own learning experiences form their own attitudes toward mathematics. If adolescents perceived more negative attitudes from their parents, this perception would affect their own formation of attitudes toward mathematics.

This study’s findings also indicated significant relationship between adolescents’ attitudes toward mathematics with their perceptions of their peers’ attitudes toward mathematics. This finding was supported by past finding indicating peers’ attitudes toward mathematics as one of the significant predictors toward adolescents’ attitudes toward mathematics (He, 2007). Adolescents would adopt similar characteristics from their peers for the desire to be accepted by their peers. Lee (2002) found that adolescents shared common attitudes with their peers in his research.

By comparing these two relationships, the correlational value of the relationship of adolescents’ attitudes toward mathematics with their perceptions of their parents’ attitudes toward mathematics ($r = 0.799$), and the relationship with their perceptions of their peers’ attitudes toward mathematics ($r = 0.814$), it appeared that the adolescents’ attitudes toward mathematics tend to be more strongly correlated with their peers’ rather than with parents’ attitudes toward
mathematics, which could be attributed by the value of time adolescents spend with their peers compared with their parents (Philip et al., 2010).

5.3.3 Relationships between adolescents’ mathematics achievement, mathematics anxiety and attitudes toward mathematics.

In this study, adolescents’ mathematics achievements, mathematics anxiety and attitudes toward mathematics were found to be significantly correlated with each other. Mathematics anxiety was negatively correlated with mathematics adolescents’ achievement. Adolescents with higher mathematics anxiety level would most likely perceived themselves to had lower achievement in mathematics. This pattern of relationship was supported by several past researches in different research designs and methods. Such as the quasi-experimental research by Daneshamooz et al. (2012); meta-analysis of one hundred and fifty-one studies on mathematics anxiety related researches by Hembree (1990); and a comparative study between Tanzania and Malaysia on the effects of mathematics anxiety on mathematics learning by Mohamed and Tarmizi (2010).

The relationship between adolescents’ mathematics achievement and mathematics anxiety could happen in two ways. Mathematics anxiety is influenced by mathematics achievement or vice versa; mathematics achievement is impacted by mathematics anxiety. Arem (2010), Bekdemir (2010), Clark (2013), and Rossnan (2006) stated that negative experiences in mathematics are one of the main causes of mathematics anxiety formation. The main negative experiences would be frequent failures in performing mathematics related activities such as failing in solving mathematics problems and achieving poor mathematics results.
The more negative experiences gained by students, the more negative emotions would be formed, and the increase in negative emotions contributed to mathematics anxiety (Arem, 2010; Bekdemir, 2010; Clark, 2013; Rossnan, 2006). The consequences of mathematics anxiety towards students’ mathematics achievement would happen through the impacts on the cognitive and affective aspects of mathematics learning. Mathematics anxiety claims to be negatively affects cognitive operation and numerical processing as the negative emotions towards mathematics takes up a major portion of the brain’s activities and reduces capacity of working memory which is crucial as a source of variance in mathematics cognition (Ashcraft, 2002; Ashcraft & Krause, 2007; LeFevere et al., 2005; Maloney & Beilock, 2012). On the other hand, the effects of mathematics anxiety also impact on affective factors of mathematics learning which lead to wrong-judgment of mathematics ability, low motivation and poor attitudes toward mathematics influencing one’s willingness and efforts in mathematics learning (Akin & Kurbanoglu, 2011; Clark, 2013; Jafari et al., 2013; Kamiri & Venkatesan, 2000; Usop et al. 2009; Zakaria & Nordin 2008). When one is lacking in willingness to learn and to face with challenges and motivation to learn and perform, he or she would not able to achieve good mathematics achievement.

Meanwhile, adolescents’ perceptions of their own mathematics achievement was significantly and positively correlated with their attitudes toward mathematics. This finding is consistent with Philip et al.’s (2010) study which indicated significant strong positive correlation between adolescents’ attitudes toward mathematics with mathematics achievement, and He’s (2007) paper which indicated that adolescents’ attitudes toward mathematics was one of the
significant predictor of adolescents’ perception of their own mathematics achievement. Attitudes toward mathematics as one of the affective domains in mathematics learning affects how one would perform in mathematics and thus indicated his or her achievement in mathematics (Palacios et al., 2014). Attitudes toward mathematics include key factors associate in mathematics learning; such as: self-confidence, value of mathematics, enjoyment of mathematics, and motivation (Tapia & Marsh, 2004). These factors in attitudes toward mathematics determine the effort, engagement, willingness and motivation in mathematics learning which are closely related to mathematics achievements (He, 2007). Culberson (1968), Marchis (2011), and Pickens (2005) explained that, attitudes contain emotional response that influence evaluation of a subject and the emotional evaluation set one’s beliefs regarding the subject, and these beliefs influence how one behave or act toward the subject.

The present research also found significant negative correlation between adolescents’ mathematics anxiety and attitudes toward mathematics. This finding is in line with Akin and Kurbanoglu’s (2011) research which indicated negative correlation between mathematics anxiety and positive attitudes toward mathematics, and also with the findings found in Hembree’s (1990) meta-analysis study which revealed negative relationships between students’ mathematics anxiety with positive attitudes toward mathematics. Mathematics anxiety contributes to the formation of negative attitudes toward mathematics, and attitudes toward mathematics with more negative emotions contribute to mathematics anxiety formation (Akin & Kurbanoglu, 2011). The relationship between mathematics anxiety and attitudes toward mathematics could be
explained through the concepts of emotions and behaviour. Negative emotions of mathematics anxiety (e.g. extreme anxiety) will lead to negative beliefs of mathematics (e.g. mathematics is too difficult to learn or mathematics is just not worth to be learned), which then lead to negative behaviours towards mathematics (e.g. less effort in learning mathematics and avoiding mathematics courses). Negative experiences in mathematics learning are one of the major causes of mathematics anxiety (Arem, 2010; Bekdemir, 2010; Clark, 2013; Rossnan, 2006) and attitudes toward mathematics (Marchis, 2011; Pickens, 2005).

Mathematics anxiety and attitudes toward mathematics are part of the adolescents’ mathematics identity which deeply influences their mathematics learning; performances and achievements. According to Cohen (n.d.), recognition and development of adolescents’ identity includes formations of attitudes to target subject (e.g. positive or negative attitudes toward mathematics), build recognized emotions (e.g. less or extreme anxious toward mathematics), and form learning behaviour (e.g. excellent or poor mathematics performance).

5.3.4 Relationships between adolescents’ mathematics achievement with parents’ mathematics anxiety and attitudes toward mathematics.

The findings in this study showed significant negative correlation between adolescents’ mathematics achievement and their perceptions of their parents’ mathematics anxiety. This result supported He’s study findings which indicated parents’ mathematics anxiety as one of the predictor of adolescents’ perceptions of their own mathematics achievement. The findings also indicated that a significant positive correlation between adolescents’ mathematics achievements
and their perceptions of their parents’ attitudes towards mathematics, consistent with Philip et al.’s (2010) study.

The correlations between parental mathematics anxiety and attitudes toward mathematics with adolescents’ mathematics achievement support the claims of parental influence on students’ mathematics learning. As stated by various researchers and educators, parental factor do influence adolescents’ academic performance which include parental attitudes, parental beliefs and parental behaviours (Kleanthous & Williams, 2010; Philip et al., 2010; Phillipson, 2010; Pritchard, 2004; Wong et al., 2010). Kleanthous and Williams pointed out that parental affective influence has significant impact on adolescents’ mathematics performance (2010), and their statement was in line with Phillipson’s (2010) and Pritchard’s (2004) claims that parental affective factors is a significant predictor of students’ mathematics achievement. In addition, parental factor play significant role in adolescents’ mathematics identity development which will directly or indirectly affect their mathematics performance and achievements. Adolescents would imply similar beliefs and attitudes from parents, as parents are one of the main references for adolescents during the process of searching, recognizing and establishing their identity.

5.3.5 Relationships between adolescents’ mathematics achievement with peers’ mathematics anxiety and attitudes toward mathematics.

The relationships between adolescents’ perceptions of their own mathematics achievement with their perceptions of their peers’ mathematics anxiety and attitudes toward mathematics was found to be significantly correlated.
Adolescents’ perception of their mathematics achievements was negatively correlated with their perceptions of their peers’ mathematics anxiety. Similarly, He (2007) reported a relationship between adolescents’ perceptions of their own mathematics achievement with their perception of their peers’ mathematics anxiety. On the other hand, the study also found that adolescents’ perception of their own mathematics achievement was positively correlated with their perception of their peers’ attitudes toward mathematics. This finding was supported by the results in Philip et al.’s (2010) study which showed significant correlation between students’ perceptions of their peers’ attitudes toward mathematics with their mathematics achievement.

As mentioned in the discussion of relationships between adolescents’ and peers’ mathematics anxiety and attitudes toward mathematics above, involvement of peers in adolescents’ mathematics could be explained through the concept of identity seeking and the relationship between adolescents and peers. If peers show high mathematics anxiety adolescents would most likely face high mathematics anxiety which lead to issue of poor mathematics performance and achievement. While for attitudes variable, adolescents with peers’ having more positive attitudes toward mathematics are more likely to achieve better mathematics learning. According to Brown (2009) the close relationship with peers is another explanation of the possibility of peers’ influence towards adolescents. Adolescents’ concept development is likely to reflect on people who have close relationship with them. The relation between adolescents with peers reinforces common characteristics sharing between them.
5.3.6 Differences between adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement based on gender.

The present study revealed that there were no significant gender differences in adolescents’ mathematics anxiety, attitudes toward mathematics, and their perception of their own mathematics achievement. This result was consistent with the findings in Gierl and Bisanz’s (1995) and Yuksel-Sahin’s (2008) study which showed no significant differences in mathematics anxiety based on gender; findings in Mohamed and Waheed (2011), and Farooq and Shah’s (2008) study which indicated no significant gender differences in attitudes toward mathematics; and in the findings of Schram’s (1996) study which revealed no significant gender differences in mathematics achievement. However, findings were contradicted with the results found in Devine et al.’s (2012) and Adamu’s (2014) studies which showed significant gender differences in students’ mathematics anxiety; and findings in Arslan et al. (2012) research which indicated significant gender differences in students’ attitudes toward mathematics and mathematics achievement.

Gender differences in mathematics are linked with the concept that female tend to have higher mathematics anxiety, more negative attitudes toward mathematics and lower mathematics achievement; in other word, females perform poorly in mathematics compared to male students (Eccles et al., 1993; Farooq & Shah, 2008; Gunderson et al., 2012; Parsons et al., 1982). These concepts or beliefs of differences in males’ and females’ ability, skill, and intelligence in learning mathematics can be explained as gender stereotypes of mathematics learning. According to Campbell (2012), the gender stereotype is a myth believed
by the society based on society common beliefs on male and female gender-role. Her arguments was further support in Lavinia’s (2012) writing which claims that gender differences was mainly due to social environmental perceptions, consideration and concepts.

The formation of gender differences is highly associated with the level of strength a society hold on gender stereotypes (Gunderson et al., 2012). When one start to carry different beliefs on his or her mathematics abilities according to gender, most likely he or she will develop beliefs about own mathematics abilities based on gender (Parsons et al., 1982). But when the society does not or weakly hold on the belief of gender differences concept, boys and girls would not affected by these concepts and possibility of gender-based gap would be lower. This would be the possible explanation of the finding which indicated no significant gender differences in the mathematics learning related variables. The belief of gender difference was strongly link with society beliefs and cultural patterns; and every individual’s beliefs of concepts differ according to society beliefs and cultural patterns (Kilic & Askin, 2013; Lavinia, 2012). Existence of strong recognition of gender stereotypes would reinforce formation and persistence of gender difference concept; but if it does not exist or weakly being recognized in the cultural practices, the existence of the gender differences would be weak. Furthermore, the research location of rural areas in present study also contributed to the findings explanation. Lavinia (2012) stated that gender-based difference was less common in rural areas as compared to urban area.

The findings of insignificant gender differences may also due to the sample size involved in this study. Ma and Kishor’s (1974) meta-analysis on the
relationship between attitude toward mathematics and achievement in mathematics indicated that, sample size could affect the results of significant differences. From one hundred and thirteen studies, they found that studies with sample size less than 300 participants or respondents tend to reported statistically significant gender differences. On the other hand, researches with sample size larger than 300 reported no significant gender differences. The number of respondents involved in present study was 480 adolescents which is more than the sample size of 300, with findings of no significant gender differences for adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement.

Many past researches (e.g. Arslan et al., 2012; Fennema, 1974) tend to report significant gender difference at higher schooling levels, but the present study involving higher secondary education level found contradictory findings, which could be attributed to differences in societal and cultural practices as the past studies are mostly Western-based. Fennema (1974) also stated that, the indications of differences based on gender are not always consistence.

5.4 Implications of the Study

Findings of the present study had some implications to academic stakeholders: parents, teachers and students. It is important for parents to realize and understand their influence towards children’s mathematics learning. Parents should understand that their expectations of their children’s mathematics performance and achievement, beliefs of their children’s ability, beliefs of gender stereotypes, and their values of mathematics learning may influence how their
children perceive the beliefs and values related to mathematics. Parents should be careful of what message or information they convey to their children. Parents might not intend to convey negative messages to their children but their beliefs and attitudes can be perceived by children through interactions and observations. Their behaviours and actions may also convey their beliefs and attitudes toward mathematics.

Academic stakeholders need to understand the importance of developing positive attitudes toward mathematics among the students. Teachers should recognize their students’ attitudes toward mathematics and mathematics anxiety level, and work towards improving students’ attitudes toward mathematics and mitigate mathematics anxiety. Teachers could increase students’ positive attitudes and reduce their mathematics anxiety through the use of suitable instructional methods that can increase students curiosity, interest and motivation to learn mathematics. Parents should cooperate with teachers to improve their children’s mathematics performance. Both teachers and parents also need to be careful with the message they delivery to students, especially regarding mathematics ability and gender stereotypes in learning mathematics.

As for students, they should enhance and improve their cognitive ability which is associated with mathematics learning and to find out the factor affecting their performance in learning mathematics. Here, metacognition plays significant role for students to “know” themselves; to “know” what they “know” and what they “do not know”, to make accurate judgement, evaluation, and decision. Also, helps in developing adolescents’ identity, including ability to perform mathematics. Rather than directly believe or accept concept delivered such as
“Girls are not intelligent enough to learn mathematics” or “Mathematics is just not meant for you”, one should make own judgement on his or her ability. Students need to clearly understand what kind of problems they face with and work with others to mitigate the problems and improve their mathematics learning. They should also understand that when they avoid mathematics learning, it would limit their learning opportunities and future career choices.

5.5 Recommendations for Future Research

There are several recommendations for future research work based on the findings from this research study. These recommendations are mostly related to the research content and the methodology of the study. From the aspect of methodology issue, this study only involved self-report data through Likert-scale form in questionnaire. Furthermore, the data on the adolescents, parents, and peers were only obtained from the adolescents. Therefore, to increase the accuracy of the data gained, future research can consider multiple measures other than only focusing on Likert-scale data. For example, consider using qualitative data collection techniques such as having open ended questions in the questionnaire or include interviews to gain more information. Addition of qualitative methods would enable researcher to investigate further what adolescents really think of their parents’ and peers’ mathematics anxiety and attitudes toward mathematics; how and why they perceived in a certain manner; and what is or are affected due to the perception. Furthermore, study of causal relationship could be performed with control treatments conditions.
In addition, future studies can consider involving parents and peers to gain information that may not be available through adolescents’ perception, will avoiding the influence of adolescent personal bias, which may and affect their perceptions of their parents and peers. Moreover, further research probably can investigate parents individually (father and mother) rather than studying parents as one. The influence of father towards children’s learning may be different compared with the influence of mother towards children’s learning (Jacobs, 1991; Parsons et al., 1982). Parents may treat their daughter and son differently, and children may treat parents’ influence differently (Jacobs, 1991) For example, father or mother may have greater influence on children’s mathematics learning and with gender control, father may has greater influence toward boys compared with girls or girls would more likely to be affected by mother.

Furthermore, future research should also look at cultural issues with regards to gender differences in mathematics learning, whether cultural beliefs and values significantly influences gender differences. Studies on gender differences in relations to social cultural beliefs should include comparing the locations (e.g. urban, sub-urban, and rural areas) of the schools. In addition, instructional methods for mathematics teaching and learning should also be studied, as it is closely related to the learning processes and in creating a conducive learning environment which may reduce learning anxiety and enhance attitudes toward mathematics.
5.6 Conclusions of the Study

The findings of the present study indicated the importance of considering parents’ and peers’ mathematics anxiety and attitudes toward mathematics in enhancing adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement. Students should also realize what and how mathematics anxiety and attitudes toward mathematics impact on their mathematics performances and achievement in mathematics learning. The findings also showed the significance of parents’ awareness of how they could affect their children’s identity developments and mathematics learning. In addition, it was noted that there were no significant gender differences in adolescents’ mathematics anxiety, attitudes toward mathematics and mathematics achievement. These findings have important implications for various stakeholders in the schooling system in their planning of mitigating steps in reducing mathematics avoidances and enhancing adolescents’ mathematics learning. Parents’ and peers’ as influential variables should be taken into consideration in planning steps on enhancing students’ mathematics learning.
REFERENCES


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APPENDIXES

Appendix A: Approval from Kementerian Pendidikan Malaysia (KPM)

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Chong Yung Yung
Pendak Surat 283, 94007 Bau
94000 Kuching
Sarawak

Tuan/puan,

Kelulusan Khas Untuk Menjalankan Kajian Di Sekolah, Institut Perguruan, Jabatan Pendidikan Negeri Dan Bahagian-bahagian Di Bawah Kementerian Pendidikan Malaysia

Adalah saya dengan hormatnya diwakili memaklumkan bahawa permohonan tuan/puan untuk menjalankan kajian bertajuk:

"Adolescents’, Parents’ and Peers’ Mathematics Anxiety, Attitudes toward mathematics and Mathematics Achievement"

diluluskan.


3. Sila tuan/puan kemukakan ke Bahagian ini senashah laporan akhir kajian/laporan dalam bentuk elektronik berformat Pdf di dalam CD bersama naskah hardcopy setelah selesai kelak. Tuan/Puan juga diingatkan supaya mendapat kebenaran terlebih dahulu dari jadwal Bahagian ini seiringnya sebahagian atau sepenuhnya dapatkan kajian tersebut hendak dibentangkan di mana-mana forum atau seminar atau diumumkan kepada media massa.

Sekian untuk maklumat dan tindakan tuan/puan selanjutnya. Terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

(DR HJ ZAINI BIN DARUS)
Ketua Sektor
Sektor Penyelidikan dan Penilaian
b.p. Pengarah
Bahagian Perancangan dan Penyelidikan Dasar Pendidikan
Kementerian Pendidikan Malaysia

---
Appendix B: Approval from Jabatan Pendidikan Negeri (JPN) Sarawak

Chong Yung Yung
Peti Surat 283
94007 Bau
Sarawak

Tuan,

KEBENARAN UNTUK MENJALANKAN KAJIAN DI SEKOLAH-SEKOLAH, INSTITUT-INSTITUT PERGURUAN, JABATAN-JABATAN PENDIDIKAN DAN BAHAGIAN-BAHAGIAN DI BAWAH KEMENTERIAN PENDIDIKAN MALAYSIA

Dengan hormatnya saya diarah merujuk kepada perkara di atas

2. Sukacita dimaklumkan bahawa pada dasarnya Jabatan Pendidikan Negeri Sarawak tiada sebarang halangan untuk membenarkan tuan menjalankan kajian bertajuk:

"Adolescents’, Parents’ and Peers’ Mathematics Anxiety, Attitudes toward mathematics and Mathematics Achievement”


Sekian, terima kasih

"BERKHIDMAT UNTUK NEGARA"

Saya yang menghargai perhatah.

[DEBBIE AK JENGJUT NYELANG]
Sektor Khidmat Pengurusan Dan Pembangunan
bp Pengarah Pendidikan
Sarawak
Appendix C: Questionnaires

QUESTIONNAIRE FORM
FACULTY OF COGNITIVE SCIENCE AND HUMAN DEVELOPMENT
MSC LEARNING SCIENCES

Adolescents’ Perception of Parents’ and Peers’ Mathematics Anxiety and Mathematics Attitude

Researcher: Chong Yung Yung
0146922718
yuny.cg@gmail.com

The purpose of this study is to investigate about adolescents mathematics anxiety and mathematics attitude, also what adolescents feel about their parents’ and peers’ mathematics anxiety and mathematics attitude. This survey will take about 15 to 30 minutes to complete. The answer given in the study is strictly CONFIDENTIAL and is used for academic purposes only.

If you agree to participate in this study, please sign here: ______________________

Section A: Background Information
Please fill in, select or tick your answer.

Gender: □ Male    □ Female

Age: __________ years old

Please rate your overall mathematics performance from 1 to 5 scale:

1   2   3   4   5
(Extremely low) (High)
**Section B: Mathematics Anxiety**

Please read the following items and rate what YOU FEEL about mathematics anxiety and circle your answer accordingly, where ‘1’ for no anxiety to ‘5’ for high anxiety. Then rate your perception of YOUR PARENTS’ and FRIENDS’ mathematics anxiety.

<table>
<thead>
<tr>
<th>No</th>
<th>Items</th>
<th>Yourself</th>
<th>Parents</th>
<th>Friends</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No Anxiety</td>
<td>Neutral</td>
<td>High Anxiety</td>
</tr>
<tr>
<td>1</td>
<td>Looking through the pages in a math text</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Having to use the tables in the back of a math book</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Thinking about an upcoming math test one day before</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Watching a teacher work an algebraic equation on the blackboard</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Being told how to interpret probability statements</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Picking up a math textbook to begin working on a homework assignment</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Taking an examination in a math course</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Reading and interpreting graphs or charts</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Signing up for course in statistics</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>Waiting to get a math test returned in which you expected to do well</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>Being given a pop quiz in math class</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>Walking on campus and thinking about a math course</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
**Section C: Mathematics Attitude**

Please read the following statements and rate YOUR FEELING with ‘1’ for strongly disagree till ‘5’ for strongly agree. Then rate your perception of YOUR PARENTS’ and FRIENDS’ mathematics attitude.

<table>
<thead>
<tr>
<th>No</th>
<th>Statements</th>
<th>I believe</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mathematics is very worthwhile and necessary subject.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2.</td>
<td>I want to develop my mathematics skills.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
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<tr>
<td>3.</td>
<td>Mathematics helps develop the mind and teaches a person to think.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
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<tr>
<td>4.</td>
<td>Mathematics is important in everyday life.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
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<td></td>
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<tr>
<td>5.</td>
<td>Mathematics is one of most important subjects for people to study.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
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<tr>
<td>6.</td>
<td>Mathematics courses would be very helpful no matter what I decide to study.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
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<tr>
<td>7.</td>
<td>I can think of many ways that I use mathematics outside of the school.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>8.</td>
<td>Mathematics is dull and boring.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
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<tr>
<td>9.</td>
<td>I think studying advanced mathematics is useful.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
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</tr>
<tr>
<td>10.</td>
<td>I believe studying math helps me with problem solving in other areas.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
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</tr>
</tbody>
</table>
Appendix D: Data Normality

*Figure 5.1.* Box plot of adolescents’ perceptions of parents’ mathematics anxiety.

*Figure 5.2.* Q-Q plot of adolescents’ perceptions of parents’ mathematics anxiety.
Figure 5.3. Box plot of adolescents’ perceptions of parents’ attitudes towards mathematics.

Figure 5.4. Q-Q plot of adolescents’ perceptions of parents’ attitudes towards mathematics.
Figure 5.5. Box plot of adolescents’ perceptions of peers’ mathematics anxiety.

Figure 5.6. Q-Q plot of adolescents’ perceptions of peers’ mathematics anxiety.
Figure 5.7. Box plot of adolescents’ perceptions of peers’ attitudes towards mathematics.

Figure 5.8. Q-Q plot of adolescents’ perceptions of peers’ attitudes towards mathematics.
Figure 5.9. Box plot of adolescents’ perceptions of adolescents’ mathematics anxiety.

Figure 5.10. Q-Q plot of adolescents’ perceptions of adolescents’ mathematics anxiety.
Figure 5.11. Box plot of adolescents’ perceptions of adolescents’ attitudes towards mathematics.

Figure 5.12. Q-Q plot of adolescents’ perceptions of adolescents’ attitudes towards mathematics.
Figure 5.13. Box plot of adolescents’ perceptions of adolescents’ perception of own mathematics achievements.

Figure 5.14. Q-Q plot of adolescents’ perceptions of adolescents’ perception of own mathematics achievements.
Appendix E: Scatterplot of Relationships

Figure 6.1. Scatterplot of adolescents’ own mathematics anxiety with their perceptions of their parents’ mathematics anxiety

Figure 6.2. Scatterplot of adolescents’ own mathematics anxiety with their perceptions of their peers’ mathematics anxiety
Figure 6.3. Scatterplot of adolescents’ own attitudes toward mathematics with their perceptions of their parents’ attitudes toward mathematics.

Figure 6.4. Scatterplot of adolescents’ own attitudes toward mathematics with their perceptions of their peers’ attitudes toward mathematics.
Figure 6.5. Scatterplot of adolescents’ mathematics achievements with their own mathematics anxiety

Figure 6.6. Scatterplot of adolescents’ mathematics achievements with their own attitudes toward mathematics
Figure 6.7. Scatterplot of adolescents’ mathematics anxiety with their own attitudes toward mathematics

Figure 6.8. Scatterplot of adolescents’ mathematics achievements with their perceptions of parents’ mathematics anxiety
Figure 6.9. Scatterplot of adolescents’ mathematics achievements with their perceptions of parents’ attitudes toward mathematics.

Figure 6.10. Scatterplot of adolescents’ mathematics achievements with their perceptions of peers’ mathematics anxiety.
Figure 6.11. Scatterplot of adolescents’ mathematics achievements with their perceptions of peers’ attitudes toward mathematics