



**Faculty of Cognitive Sciences and Human Development**

**GENDER COMPARISON OF MATHEMATICS ANXIETY AND  
COGNITIVE REFLECTION**

**Kan See Kei**

**Bachelor of Science with Honours  
(Cognitive Sciences)  
2018**

UNIVERSITI MALAYSIA SARAWAK

Grade:     A    

**Please tick one**

Final Year Project Report

Masters

PhD

**DECLARATION OF ORIGINAL WORK**

This declaration is made on the 12 day of June year 2018.

**Student's Declaration:**

I, KAN SEE KEI , 52099, FACULTY OF COGNITIVE SCIENCES AND HUMAN DEVELOPMENT, hereby declare that the work entitled GENDER COMPARISON OF MATHEMATICS ANXIETY AND COGNITIVE REFLECTION is my original work. I have not copied from any other students' work or from any other sources with the exception where due reference or acknowledgement is made explicitly in the text, nor has any part of the work been written for me by another person.

12 JUNE 2018

  
KAN SEE KEI (52099)

**Supervisor's Declaration:**

I, NUR FATIHAH MAT YUSOFF , hereby certify that the work entitled, GENDER COMPARISON OF MATHEMATICS ANXIETY AND COGNITIVE REFLECTION was prepared by the aforementioned or above mentioned student, and was submitted to the "FACULTY" as a \*partial/full fulfillment for the conferment of BACHELOR OF SCIENCE WITH HONOURS (COGNITIVE SCIENCES), and the aforementioned work, to the best of my knowledge, is the said student's work

Received for examination by: \_\_\_\_\_



Date:     12 JUNE 2018    

(Mdm. Nur Fatihah Mat Yusoff)

I declare this Project/Thesis is classified as (Please tick (√)):

- CONFIDENTIAL** (Contains confidential information under the Official Secret Act 1972)\*
- RESTRICTED** (Contains restricted information as specified by the organisation where research was done)\*
- OPEN ACCESS**

I declare this Project/Thesis is to be submitted to the Centre for Academic Information Services (CAIS) and uploaded into UNIMAS Institutional Repository (UNIMAS IR) (Please tick (√)):

- YES**
- NO**

### Validation of Project/Thesis

I hereby duly affirmed with free consent and willingness declared that this said Project/Thesis shall be placed officially in the Centre for Academic Information Services with the abide interest and rights as follows:

- This Project/Thesis is the sole legal property of Universiti Malaysia Sarawak (UNIMAS).
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis for academic and research purposes only and not for other purposes.
- The Centre for Academic Information Services has the lawful right to digitize the content to be uploaded into Local Content Database.
- The Centre for Academic Information Services has the lawful right to make copies of the Project/Thesis if required for use by other parties for academic purposes or by other Higher Learning Institutes.
- No dispute or any claim shall arise from the student himself / herself neither a third party on this Project/Thesis once it becomes the sole property of UNIMAS.
- This Project/Thesis or any material, data and information related to it shall not be distributed, published or disclosed to any party by the student himself/herself without first obtaining approval from UNIMAS.

Student's signature: \_\_\_\_\_  
Date: 12 June 2018

Supervisor's signature: \_\_\_\_\_  
Date: 12 June 2018

Current Address: C-1 Kampung Baru Gambang,  
Kuantan, Pahang.

Notes: \* If the Project/Thesis is **CONFIDENTIAL** or **RESTRICTED**, please attach together as annexure a letter from the organisation with the date of restriction indicated, and the reasons for the confidentiality and restriction.

The project entitled 'Gender Comparison of Mathematics Anxiety and Cognitive Reflection' was prepared by Kan See Kei and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfillment of the requirements for a Bachelor of Science with Honours (Cognitive Science).

Received for examination by:



-----  
(Nur Fatimah Mat Yusoff)

Date:

12th June 2018  
-----

<p>Grade A</p>
--------------------

## **ACKNOWLEDGMENTS**

First and foremost, I would like to address my greatest gratitude to my beloved supervisor, Madam Nur Fatimah MatYusoff from Universiti Malaysia Sarawak (UNIMAS) for her patients, supports and guidance throughout this whole Final Year Project (FYP). This whole project won't be perfect without her supervision and inspirations.

Besides that, I would also like to extend my gratitude to my family for their endless support throughout my study. Without them, I will not have the chance to further my study into higher education. Thank you for your endless financial support as well as mental support that help me to get through difficult times.

Furthermore, I also want to thank all my coursemates and friends for their support and accompany. Without them, this whole university life would not be this joyful and full of laughter. Thank you for the wonderful experience that we shared together throughout these three years of study. We all might come from different background and races but our bonds are strong and will not break even though we are going on our own path in the future.

Lastly, I wish to express my thanks to all the cognitive sciences students that had participated in this research willingly. I appreciated their time and cooperation. I would also like to take this opportunity to thank UNIMAS, for giving me such valuable chance to conduct a research in the university.

## TABLE OF CONTENTS

LIST OF TABLES.....	v
LIST OF FIGURES.....	vi
CHAPTER ONE: INTRODUCTION.....	1
CHAPTER TWO: LITERATURE REVIEW.....	11
CHAPTER THREE: METHODOLOGY.....	21
CHAPTER FOUR: FINDINGS.....	28
CHAPTER FIVE: DISCUSSION .....	42
REFERENCES.....	49
APPENDIX.....	56

## LIST OF TABLES

Table 1 Descriptive Statistics and Correlations of the Measures in Each Group.....	26
Table 2 Reliability Test.....	28
Table 3 Skewness and kurtosis test of Normality.....	29
Table 4 Distribution of Respondent.....	30
Table 5 Mean and Standard deviation of Mathematics Anxiety.....	34
Table 6 Responses of Participants for CRT items.....	35
Table 7 Participant distribution based on number of correct response on CRT items.....	36
Table 8 Independent T-test: Mathematics Anxiety and Gender.....	37
Table 9 Independent T-test: Cognitive Reflection and Gender.....	39
Table 10 Pearson Correlation: Mathematics Anxiety and Cognitive Reflection.....	40

## LIST OF FIGURES

Figure 1 Research Framework.....	8
Figure 2 Pie Chart of Participants Distribution based on Gender.....	31
Figure 3 Bar Graph Distribution of Participants by Age.....	32
Figure 4 Bar Graph Distribution of Participants by Year of Study.....	33

## ABSTRACT

The aim of this research is to examine differences in dependent variables which are mathematics anxiety and cognitive reflection based on gender. This research also investigated the association between mathematics anxiety and cognitive reflection. A total of 150 Cognitive Sciences undergraduate students from Universiti Malaysia Sarawak (UNIMAS) participated in this correlational and comparative survey research. In data collection, a set of questionnaire in which adapted from Mathematics Anxiety Rating Scale-Short Version (MARS-SV) and Cognitive Reflection Test-Long (CRT-L) was used. Moreover, independent t-test analyses were used to identify the differences in mathematics anxiety and cognitive reflection between male and female students. Additionally, Pearson Correlation was used to determine the relationship between mathematics anxiety and cognitive reflection. This research finding indicated that cognitive reflection was significantly different between male and female students. Male students performed better in CRT than female students. However, mathematics anxiety was not significantly different between male and female students. This research finding also demonstrated that mathematics anxiety was negatively correlated to cognitive reflection. Yet, the relationship was not significant.

## ABSTRAK

Tujuan kajian ini adalah untuk mengkaji perbezaan bagi pembolehubah-pembolehubah iaitu keresahan matematik dan refleksi kognitif berdasarkan jantina. Penyelidikan ini juga mengkaji hubungan antara keresahan matematik dan refleksi kognitif. Seramai 150 pelajar dari pengajian Sains Kognitif di Universiti Malaysia Sarawak (UNIMAS) terlibat dalam kajian ini. Dalam pengumpulan data, borang soal-selidik yang diubahsuai daripada “Mathematics Anxiety Rating Scale-Short Version (MARS-SV)” dan “Cognitive Reflection Test-Long (CRT-L)” telah digunakan. Selain itu, analisis t-ujian bebas digunakan untuk mengenalpasti kewujudan perbezaan dalam keresahan matematik dan refleksi kognitif antara pelajar lelaki dan perempuan. Di samping itu, korelasi Pearson digunakan untuk menentukan hubungan antara kebimbangan matematik dan refleksi kognitif. Hasil kajian menunjukkan bahawa refleksi kognitif mempunyai pembezaan yang signifikan antara pelajar lelaki dan perempuan. Pelajar lelaki mempunyai keputusan yang lebih baik dalam CRT daripada pelajar wanita. Walau bagaimanapun, kebimbangan matematik tiada perbezaan signifikan antara pelajar lelaki dan wanita. Hasil kajian ini juga membuktikan bahawa kebimbangan matematik dikaitkan dengan refleksi kognitif secara negatif. Namun, hubungan tersebut tidak signifikan.

# CHAPTER ONE

## INTRODUCTION

### Background of Study

Mathematics plays an important role in current technological society as well as in our daily life. The nature of Mathematics had discovered the truth of natural world as well as some careful reasoning. Today, mathematics has covered many aspects in different field and it is essential for future technology development. The learning process of mathematics has started ever since childhood and yet plenty of us are still wondering about the purposes of studying mathematics. As emphasized by Mohyuddin and Khalil (2016), people have a great misconception about mathematics. Majority of the students had a bad conception about mathematics that the only thing about mathematics is formulas. That is because memorizing method was applied in Mathematics education in Malaysia. They have no idea the true intention of learning mathematics and had been buried under dozens of mathematical formulas. Hence, the avoidance behavior toward mathematics may develop among students from time to time.

As emphasized by Suárez-Pellicioni, Núñez-Peña, and Colomé (2015), the study of mathematics anxiety was first investigated in 1950s where mathematics anxiety was described in the term of “methamaphobia”. The common issues regarded to mathematics such as causes, consequences and prevention of mathematics anxiety had been studied since then. The discomfort feeling that aroused at the time on dealing with mathematics problems is called mathematics anxiety. These unpleasant experiences of an individual also could affectively harm his or her response to mathematics. However, the intensity level of mathematics anxiety is based on ones’ environment and past experience. The intensity level of mathematics anxiety can range from slight discomfort to a total avoidance of mathematics related classes or courses. In addition, Ashcraft (2002) emphasized the cognitive

consequences of mathematics anxiety. Mathematics anxiety involves the cognitive processing which mentally affects the process of solving mathematics problem. An individual with high level of mathematics anxiety tends to make more errors in mathematical problems. This is because a highly disturbing person would hardly concentrate on problem solving.

For the level of mathematics anxiety measurement, there are plenty of versions available. The first implemented mathematics anxiety measurement tool is the Number Anxiety Scale which was modified from Taylor Manifest Anxiety Scale (Baloğlu & Balgalmış, 2010). Yet, the most frequently used instrument is the Mathematics Anxiety Rating Scale (MARS) which was developed by Richardson and Suinn and it consists of 98 items (Seng, 2015). As time goes by, the alteration of the original Mathematics Anxiety Rating Scale due to the research measurement on different situation and circumstances as the consideration of reliability and validity of the instruments. The adapted version of the MARS includes the revised version of Mathematics Anxiety Rating Scale (MARS-R), Abbreviated version of Mathematics Anxiety Rating Scale (A-MARS) and Short version of Mathematics Anxiety Rating Scale (MARS-SV). Pletzer (as cited in Suinn & Winston, 2003) claimed that the Short version of Mathematics Anxiety Rating Scale has higher reliability and validity which are 0.90 and 0.96 respectively.

Cognitive reflection is the ability that initiates cognitive processes. Cognitive reflection also refers as the “thinking disposition that interacts with knowledge, domain-specific heuristics and characteristics of the environment” (Campitelli & Labollita, 2010) and that it may crucial for decision maker to adapt in different environments and situations. However, the earlier studies had shown that cognitive reflection has close relationship with decision making, numeric ability, mathematics belief, self-confidence and judgment. Frederick (as cited in Sinayev & Peters, 2015) stated that for those who possess low level of cognitive reflection tends to be impatient and less likely to be a risk taker. Thus, for those

who possess the ability to work with numbers in decisions is more distinguishable as decision makers than those who have the capability to do the mathematical problem (Peter & Bjalkebring, 2014).

The issue of gender in mathematics anxiety and cognitive reflection is also important. As emphasized by Primi, Donati, Chiesi, and Morsanyi (2018), gender effect on cognitive reflection was not significant where it is more affectively and numerically affected. A study by Mutodi and Ngirande (2014) reported the significant result between mathematics anxiety and gender that female has a higher level of mathematics anxiety than male. The similar results were found in the study by Hembree and Akgul (as cited in Vitasari, Herawan, Wahab, Othman, & Sinnadurai, 2010) on gender difference issue in mathematics anxiety. This situation points out the issue that female has less confidence level and less motivation toward mathematics as compared to male.

## **Problem Statement**

Although Malaysian students have earlier exposure to mathematics, a lot of students still encounter anxiousness and fear when dealing with mathematical task even with basic mathematics questions in tertiary education. In general, individuals' mathematics anxiety initiates in primary school and develops throughout secondary school. For those who thought mathematics as a complex, tough and difficult courses, they tend to have low performance in mathematics related courses (Núñez-Peña, Suárez-Pellicioni, & Bono, 2013). This might lead to avoidance of taking math-related courses and indirectly influence their career choices and opportunities.

According to the research finding by several Malaysian researchers, students who further their tertiary education in Malaysia have mathematics anxiety in a certain level (Karjanto & Yong, 2013; Vitasari & Wahab, 2010; Vitasari et al., 2010). Having strong mathematics background has become one of the requirements for most job opportunities as mentioned by Tobia (as cited in Wahid, Yusof, & Razak, 2014). By taking the Cognitive Sciences program in University Malaysia Sarawak as an example, mathematics is a compulsory subject where strong backgrounds of mathematics as well as computational skills are needed. Having an excessive level of mathematics anxiety could cause the students to fail in a particular subject or fail to complete their studies.

The construct of mathematics anxiety is not a new notion. This concept has been investigated starting with the research by Richardson and Suinn (1972). Research on mathematics anxiety is often focused on the relationship of mathematics anxiety with individuals' past experiences and the causes that measure mentally as well as physically such as beliefs, self-confidence, attitudes and behaviors ( Smith, 2010). However, the study on the

aspect of cognitive reflection in relation to mathematics anxiety had arisen in the past few years.

Furthermore, study opined negative effect of mathematics anxiety on cognitive ability (Morsanyi, Busdraghi, & Primi, 2014). They reported that highly anxious students tend to respond quickly to numerical problems. The numerical problem solving situation has aroused uncomfortable feeling where the anxious students were trying to avoid. Therefore, students with high level of mathematics anxiety were happened to generate more error responses. The problem on eliminating incorrect solutions was said to have lower ability in cognitive reflection whereby cognitive reflection has the meaning of the ability to detect incorrect solution and generate correct response by engaging further reflection (Morsanyi et al., 2014).

On top of that, some present research had shown the close relationship between mathematics anxiety and performance on cognitive reflection test in which cognitive reflection correlates with essential real-life events. For instance, time preferences, risk taking and rational thinking (Morsanyi & Ireland, 2014). In the earlier studies, it was shown that the negative effect of mathematics anxiety on an individuals' ability in making decision and choices for beneficial outcomes (Morsanyi & Ireland, 2014). This study was supported by Primi, Morsanyi, Chiesi, Donati, and Hamilton (2016), those who have lower performance in cognitive reflection test which indicates lower ability in cognitive reflection prefer smaller and immediate reward rather than larger but hold-up. They are less likely to prevent some perceivable mistakes in reasoning and decision making as they lack of careful consideration. Specifically, an individual with high level of mathematics anxiety would have high possibility lower ability in cognitive reflection.

Studies shown there exists gender effect in mathematics anxiety and cognitive reflection (Karjanto & Yong, 2013; Personal, Archive, & Rodriguez-lara, 2016; Rubinsten, Bialik, & Solar, 2012). Rubinsten, Bialik, and Solar (2012) demonstrated that female

students were being more stressful about mathematics comparing to male students. In practice, females are more emotional than males. However, it was proven the discomfort feelings had involved negative emotional reaction towards mathematics (Ajay, 2016). Thus, this implied that female has high mathematics anxiety level than female. In addition, there exists gender bias in cognitive reflection. The female group was found less reflective than male and hence, generating more incorrect solution (Personal et al., 2016).

In sum, this study is prominent to acquire better understanding on the gender issue regarding mathematics anxiety and cognitive reflection. Additionally, the correlation between mathematics anxiety and cognitive reflection also investigated in this study.

## **Research Objective**

### **General Objectives**

The main purpose of this research is to investigate the gender comparison of mathematics anxiety and cognitive reflection among Cognitive Sciences undergraduate students in University Malaysia Sarawak.

### **Specific Objectives**

- i. To identify the differences in mathematics anxiety based on gender.
- ii. To identify the differences in cognitive reflection based on gender.
- iii. To identify the relationship between mathematics anxiety and cognitive reflection.

### **Research Hypothesis**

**Ho1:** There is no significant difference in mathematics anxiety based on gender.

**Ho2:** There is no significant difference in cognitive reflection based on gender.

**Ho3:** There is no significant relationship between mathematics anxiety and cognitive reflection.

## Research Framework

Figure 1 below shows the variables in the study, namely; demographic variable, independent variable and dependent variable. In line with the objectives of the study, the relationships between the variables used in this study were hypothesized. Gender represented as demographic variable while the independent variable was mathematics anxiety. Lastly, cognitive reflection was the dependent variable.

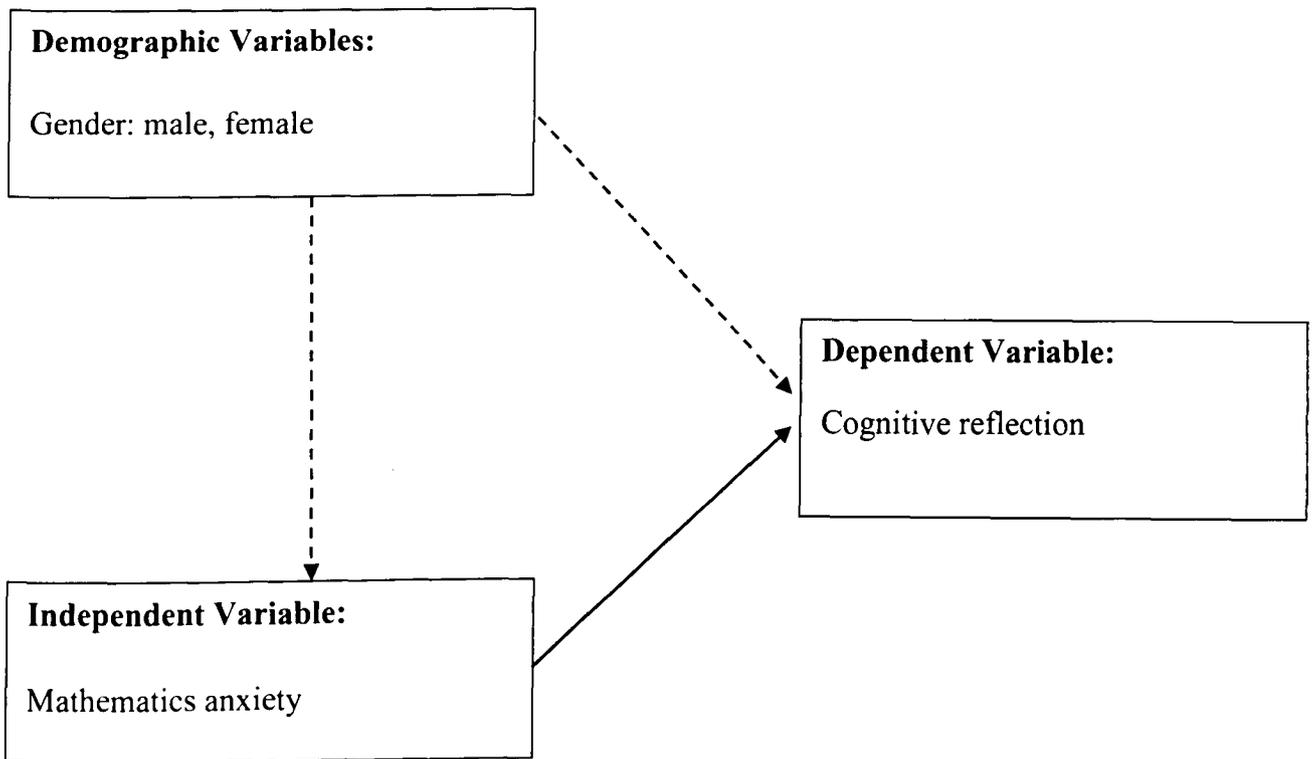


Figure 1: Research Framework

- > indicates Difference
- > indicates Correlation

## **Definition of Terms**

### **Mathematics Anxiety:**

**Conceptual.** Mathematics anxiety is defined as the arousal of discomfort and panic state of feeling that associated with the numbers manipulation and numerical problems solving (Hunsley, 1987). The effect of mathematics anxiety could threat one's self-confidence.

**Operational.** Mathematics anxiety is the negative feelings when people deal with numbers. The negative feelings include helplessness, tension and fear.

### **Cognitive Reflection:**

**Conceptual.** Cognitive reflection is a disposition that enables oneself to inhibit first response and to resist interference from irrelevant stimulation (Campitelli & Labollita, 2010).

**Operational.** Cognitive reflection refers to the ability to hold out against the reaction that first comes to mind.

**Gender:** Gender referred to male and female only in this study.

## **Significance of Study**

The outcome of this study could be a reference for future research in regard to the correlation between students' anxiety toward mathematics and cognitive reflection since the related study is short in number. Similar study also could be done by focusing on other groups of the population. This study could be a guideline for future studies.

This study would contribute to our education system especially in mathematics learning. There are only a few researches that investigate about mathematics anxiety in Malaysia due to lack of awareness of the consequences of mathematics anxiety in learning among students. Thus, this study would raise the awareness on the effect of mathematics anxiety among students besides providing related information on how mathematics anxiety influenced cognitive reflection.

Additionally, gender comparison in students' mathematics anxiety and cognitive reflection would be investigated. Even though there were various researchers that looked deeper into gender issue on mathematics anxiety, however, there was lack of related research on cognitive reflection based on gender in Malaysia. Therefore, this study could yield new findings on this issue in the context of Malaysian.

## CHAPTER TWO

### LITERATURE REVIEW

#### Theory of Cognitive Reflection

**Dual-system Theory.** Dual-system theory was developed by Kahneman (2011) and it is the basis for a lot of behavioral science thinking. Dual-systems theories hold that there is two type of cognitive processing available for cognitive tasks which are intuitive System 1 and deliberative System 2. According to Sinayev and Peters (2015), System 1 processes are faster and effortlessly as compared to System 2 where the processes are slower and controlled. However, System 2 could only be activated when the processing of System 1 is done whereby System 1 makes a quick intuitive response during the early period of decision making. System 2 would check the response from System 1 and go in for further reasoning if an error is detected after checking the response.

Specifically, System 1 process is when people think quickly, intuitively, immediately, almost subconsciously and automatically. For instance, when the simple mathematical question  $2 + 2$  is asked, the answer should automatically come to mind. In addition, an immediate emotional response could be triggered by asking to think of the favorite night out or holiday destination in the last few months. Hence, the thinking process of System 1 happens immediately. In contrast, System 2 is much slower, vigorous, often sort of methodological and controlled. Additionally, System 2 requires effort and it usually happens consciously. If a complex mathematical question was asked for example  $48 \times 159$ , not many people will find the immediate answer. By applying some effort, some calculation in the brain is needed to find the answer.

In summary, System 1 and System 2 are particularly important in our daily life. For System 1, people tend to form quickly and instinctive impressions. Meanwhile, people tend to use System 2 thinking process when the decision is important, highly personal as well as when the decision may have large impact on other people. In Kahnemans' work, it was said that System 2 is required more in numerical thinking before evolving to subconscious System 1 which would eventually turn up to habits or cognitive biases (as cited in Frankish, 2010).

### **Theory of Anxiety**

**Cognitive Theory.** As proposed by Freeman and DiTomasso (2015), there are five aspects of anxiety that described the commonalities of anxiety person in Cognitive Theory. First, an individual with anxiety will encounter a significant level of distressing. Second, the life of those who have anxiety would compromise in some remarkable manner by anxiety. Third, individual with high level of anxiety encountered a series of unpleasant or traumatic past experience. Fourth, individual with certain level of anxiety tend to avoid situation that associated with anxiety. Lastly, the individual perceives a high degree of danger that induced the anxiety in particular situation.

Eysenck (as cited in Strongman, 1995) claimed that cognitive system is important to the understanding of anxiety. In the extent of memory, people who have high and low anxiety stored different information in long-term memory as what they encountered are varying from each other. This memory approach helps to deal with the changes in trait anxiety and the situations where the anxiety induced. This theory also stated that people who have high or low level of anxiety differ in cognitive structure and processes. The mood state and memory content of people in anxiety varies depends on the anxiety level. The memory contents include the unpleasant memory wherein differs in the type and the amount of specific unpleasant memory they have. The people with high level of anxiety has more unpleasant

memory content that those who are low. On top of that, there are two reasons of higher amount of anxiety worry in highly anxious person. First, they possess a frequent and organized set of unpleasant contents in long-term memory. The second reason is the highly anxious memory contents are more susceptible to negative mood states. In conclusion, the role of the cognitive theory in accounting for differences in cognitive functioning.

As emphasized by Clark and Beck (2010), an extreme emotion could be led by the malfunction of our thought based on cognitive theory. However, the effect of extreme emotion in turn causes negative effect on behavior. By taking a test preparation as an example, an individual keep thinking he or she could not perform well in the test and having the low expectation towards his or her result. This negative thought induced anxiety which would affect the concentration and amount of effort to put during revision. Eventually, poor test score would strengthen his or her belief that he or she could not do anything right. However, by changing another way of thinking, his or her failure was actually caused by lack of preparation. He or she could acquire higher score by putting more effort in next test. Hence, these two distinct ways of thinking could result in different outcomes.

## **Past Research**

**Mathematics Anxiety.** According to Yeo, Tan, & Lew (2015), anxiety toward mathematics is “ the feeling of tension and anxiety when individuals are interfered with numbers manipulation and mathematical problem solving when they are in ordinary and academic situation ”. Mathematics anxiety is also known as “a state of discomfort that occurs in response to situations involving mathematical tasks that are perceived as threatening to self-esteem” ( Hughes, 2016). In other words, an individual may have encountered fearfulness of the possibility of failing during the process of learning or solving mathematical contents. As stated by Wahid et al. (2014), students who have anxiety toward mathematics tend to have negative attitude toward mathematics in mathematics class, feel hard to concentrate in mathematics class and panic when being asked to solve mathematical questions. It is well-known that the consequence of mathematics anxiety would influence the students academically, yet the consequences also can be seen in the aspect of career options and career opportunities.

On the other hand, the anxiety towards mathematics was first discovered in the late 1950s according to Kumar (2010). Since the discovering of the term “mathematics anxiety”, many researchers from related field had investigated and examined this term in different angles such as cause and effect of mathematics anxiety towards some particular aspects such as mathematics performance, attitudes and self-confidence. Since then, mathematics anxiety has been attracting the attention of many researchers. Mathematics anxiety is the main concern in education as well as in the job field.

A study was investigated by Warwick (2008) to address the mathematics anxiety issue among non-specialist undergraduate students in UK. Based on the finding of this study, the average number of non-specialist students did not have high level of mathematics anxiety in