



# A Study on the Mathematical Anxiety that Affects Mathematical Reasoning Ability on Prior Knowledge of Triangles for Learning Geometric Congruence Grade 8 Students

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## Abstract

*This study aims to study the effect of the Mathematical Anxiety level (MA level) on the Mathematical Reasoning Ability (MRA) of 96 grade 8 students who study in the English Program in the second semester of the academic year 2020. The research instruments used were the Mathematics Anxiety Questionnaires and the test of MRA on the prior knowledge of triangles. The quality of questionnaires achieved a reliability score of 0.84. The quality of the MRA test achieved a validity score of 1.00, difficulty levels of 0.20 to 0.79, discrimination power values was from 0.20 to 0.50, and a reliability score of 0.78. This research was carried out using quantitative and qualitative research methods. The statistics used to analyze the data was simple linear regression. Furthermore, we use content analysis to analyze the completeness of the written solution for giving the right reasons. The study results revealed that: MA was significantly negatively associated with MRA at the level of .05 ( $r = -0.43$ ). Interestingly, considering students in the high MA group, students with high MRA were more numbers than those with low MRA. Moreover, the MA level affects the MRA when viewed from the students' written solution; the students who have low MA can answer the question correctly and explain their reasons better than the students who have high MA.*

**Keywords:** *Mathematical Anxiety, Mathematical Reasoning Ability, Geometric Congruence, Simple Linear Regression*

## 1. Introduction

Mathematics helps us to solve problems in real life. Because mathematics teaches us critical thinking and reasoning skills to use in framing the problem, identifying the knowns and unknowns and taking steps to solve the problem can be a crucial strategy for other life issues [1].

As learning mathematics requires reasoning abilities, students taking mathematics have the opportunity to develop their reasoning skills [2]. Mathematics learning is given at every level of primary and secondary education to use mathematics as a way of reasoning [3]. Moreover, the reasoning process requires analytical thinking and creativity to be gathered information and then linked to the facts. Also, reasoning is an essential tool for students to develop themselves in learning new things that apply to their daily life and work.

Although Thailand has encouraged and promoted math learning activities, Thailand's PISA scores from 2000 to 2018 are still of concern [4]. The mean score of the result of Thailand in mathematics was lower than the Organisation for OECD. Since the PISA is a test and questionnaire intended to measure students' reasoning ability, it can also measure students' mathematical achievement [2]. A summary of trends from the assessment found. That mathematical is still trending lower than in PISA 2000, the mathematical increment only ranged from PISA 2009 to PISA 2012 and PISA 2015 to PISA 2018, and, significantly, in PISA 2000 through PISA 2012, mathematics has the lowest score of the three areas assessed [5].

One factor that affects students' mathematical reasoning is MA [6]. The causes of anxiety are tests, classroom, and numerical anxiety. Moreover, math anxiety experienced in the classroom may also include a sub-facet related to the fear of math teachers [7]. Mathematics anxiety can be treated with direct interventions such as relaxation therapy, or indirectly, with the teaching style and cooperative learning [8].

The main goals of the current study were to study the effects of MA and MRA and study the differences in students' written solutions with high and low MA levels. Therefore, this study will be a guideline for supporting teachers and related persons to improve their mathematics teaching to be more efficient and less anxious in learning mathematics for students.

### 1.1 Research Questions

From the introduction, we are driven by the following research questions.



- To what extent does mathematical anxiety relate to mathematical reasoning ability?
- To what extent does the difference in students' written solutions with high and low mathematical anxiety levels?

### 1.2 Objective of Research

- To study the effect of the mathematical anxiety level on students' mathematical reasoning ability.
- To study the solutions writing performance according to mathematical anxiety levels.

## 2. Methodology

### 2.1 Population, Sample and Sampling Method

The population used in this study was grade 8 students in the second semester of the academic year 2020. The sample group was 96 Thai students who studied in English Program using purposive sampling. Note that the researcher allowed students to answer in Thai or English to prevent the language barrier and get quality data.

### 2.2 Instrumentation

The research instrument was two-part. The first part is the MA questionnaire consist of 14 items from [9]. The MA questionnaire consists of seven items of negative statements and seven items of positive statements. The second part is the MRA test consists of eight items. The MRA test consists of four items of the isosceles triangle and four items of a right triangle. The quality of the research instrument was measured by three experts, which showed that the MRA test achieved a validity score of 1.00. From the quality measuring of instruments, difficulty levels of 0.20 to 0.79, discrimination power values was from 0.20 to 0.50, and reliability with an Alpha Cronbach coefficient of 0.78. The MA questionnaire achieved reliability with Cronbach's Alpha coefficient of 0.84.

## 3. Results

### 3.1 Correlation between mathematical anxiety and mathematical reasoning ability

Fig. 1. illustrates the negative correlation between MA and MRA of all students by using linear regression in the statistical software package.

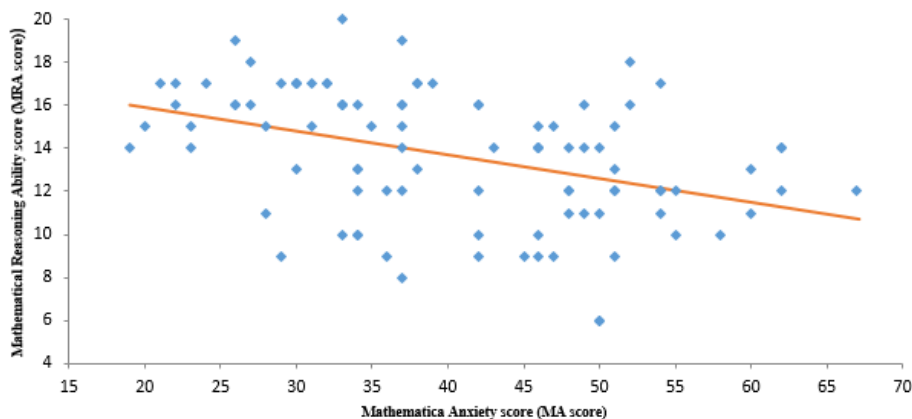


Fig. 1. Mathematical anxiety was significantly and negatively correlated with Mathematical reasoning ability ( $R^2 = .17$ )

### 3.2 Correlation between level of mathematical anxiety and level of mathematical reasoning ability

Table 1. Criteria of MA levels (adjusted from [7])

MA Score	MA Levels
14.00 - 20.00	Very Low
21.00 - 34.00	Low
35.00 - 48.00	Medium
49.00 - 62.00	High
63.00 - 70.00	Very High



The research classify the level of MA (Table 1.) into 2 level; High MA is having a scores of at least 49.00 and Low MA is having a scores of at most 34.00. The MRA level can be classify into 2 level; High MRA is having a scores of at least 16.00 and Low MRA is having a scores of at most 11.00.

Table 2. Number of students in 4 different groups of the MA levels and MRA levels

Group	MA Levels and MRA Levels	Number of students
1	Low MA, Low MRA	5
2	Low MA, High MRA	21
3	High MA, Low MRA	9
4	High MA, High MRA	4

The comparison between levels of MA and levels of MRA can be observe from the Table 2. We found that the students in the High MA group scores low on the MRA test of 9. The students in the Low MA group scores high on the MRA test of 21.

It can be found that the students in group 1 give a short reason since they do not like to explain in lengthy detail. The students in group 2 provide the accurate reason step by step and show how to calculate the remaining angles. The students in group 3 give the reason according to the definition they can remember or the using the evidence in the picture. Although the students in group 4 had a High MRA, their answers were not complete because they did not write their detailed calculated solutions.

#### 4. Discussion

According to the study, the effect of the MA level on the MRA. The results indicated that most students with high MA had low scores on mathematical reasoning ability, and those with low MA had high scores on MRA. MA was negatively correlated with MRA [10].

The students' written solutions found that the students give the reason was not complete because the traditional setting for students in the past was not emphasized on justifying answer to mathematical problems. Therefore, it is not easy to synthesize knowledge which leads to reasonability. Most students answered questions based on the theorems, rules, formulas, definitions that they remember, so often do not write to show the detailed calculation. In other words, the students' mathematical learning behavior according to Bloom's Taxonomy has not reached the analysis level. Most Thai math teachers focus on teaching content and numeracy skills by only telling them how to solve the problem. The provided examples were aimed for students to follow their pattern; students do not have an opportunity for self-study, so it is quite rare to allow students to think critically to solve the solutions to various and constructive problems [11]. Many students are capable of problem-solving, reasoning, communicating or presenting mathematical concepts, linking math content and situations, and creativity. These problems prevent students from effectively applying mathematics knowledge in daily life and further study [4].

#### 5. Conclusion

The preliminary research showed that the higher the MA, the lower the MRA. Afterward, from the analysis of the students' written solutions, we found that students can answer and reason correctly with questions to measure the students' conceptual understanding. If the questions require students to show the solution, their answers were not complete because they did not write their detailed calculated solutions. Finally, the researchers divided the students into four groups according to the MA scores and MRA scores to study each group's written solutions.

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