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The Influence of Pre-University Students' Mathematics Test Anxiety and Numerical Anxiety on Mathematics Achievement

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Abstract

This study examines the relationship between mathematics test anxiety and numerical anxiety on students' mathematics achievement. 140 pre-university students who studied at one of the institutes of higher learning were being investigated. Gender issue pertaining to mathematics anxieties was being addressed besides investigating the magnitude of the variables for mathematics test anxiety and numerical anxiety. The data revealed that there was a positive correlation between mathematics test anxiety and numerical anxiety on students' mathematics achievement. Results of the multiple regressions showed that all the variables of mathematics anxieties were statistically significant on students' mathematics achievement. Non-parametric tests also revealed that mathematics anxiety was statistically significant in measuring students' mathematics achievement.

Keywords: pre-university students, mathematics test anxiety, numerical anxiety and mathematics achievement

1. Introduction

1.1 Introduce the Problem

According to Ashcraft (2002), it was common to perceive mathematics as a difficult subject and some students avoided solving mathematical problems. Many learners experienced mathematics anxiety in their school lives. (Ramirez et al., 2013; Devine et al., 2012; Loong, 2012). Study showed that mathematics anxiety developed during the primary school years affected a notable proportion of students at pre-university levels (Devine et al., 2012). Sheffield and Hunt (2006) revealed that pre-university students who obtained high mathematics anxiety scores performed relatively low in their mathematics tests. Consequently, mathematics anxiety could be a good predictor of students' mathematics performance and overall academic performance (Venkatesh & Karimi, 2010).

Furner and Berman (2003) believed that higher level of mathematical problems involved manipulating of numbers and solving daily mathematical problems. Hence, students became more anxious and lack of confidence in solving these problems. Although negative perceptions of mathematics anxiety towards students' performance have been discussed, but mathematics anxiety of pre-university students have not been studied widely. Studies indicated that anxiety as a predictor of academic performance in the subjects of science and mathematics (Mallow, 2010; Karimi & Venkatesan, 2009). Similarly, X. Luo, Wang, and Z. Luo (2009) indicated that mathematics anxiety negatively correlated with mathematics performance.

Rameli et al. (2014) felt that anxiety towards mathematics could lead to avoidance in doing mathematics. Students tried to avoid solving mathematics related problems or choosing mathematics related courses. As the result, they were unable to perform well in mathematics. Several poor physical conditions such as drowsiness, headache and dizziness appeared once teachers mentioned certain topics in mathematics. Therefore, this study was carried out to assist mathematics educators and curriculum planners in reducing students' mathematics anxiety. At the same time, this study helps students in reducing their mathematics anxiety levels as well as improving their mathematics performance. Hence, appropriate guidance for the students can be implemented before they enroll in universities.

1.2 Research Aims

Pre-university programme aims at cultivating young generation for a right path in their future careers. Therefore, educators must learn how to eliminate negative emotional experienced by these students especially in solving

mathematical problems. This study focuses on the influence of mathematics anxiety towards students' mathematics achievement. Thus, this study addresses the following objectives:

1) To identify the relationship between students' mathematics anxiety and mathematics achievement.

2) To determine the linear relationship of mathematics anxiety comprising of anxiety before test, after test, quizzes, difficult mathematical task, basic operations and daily life's application on students' mathematics achievement.

3) To investigate the difference between male and female students' mathematics anxiety and their mathematics achievement.

2. Literature Review

2.1 Mathematics Anxiety and Numerical Anxiety

Research on mathematics anxiety has begun in the 50s. Mathematics anxiety can be explained as the fear of doing mathematics and students' minds go blank of fearing this subject. Levels of anxiety grow stronger with the constraint of time in answering mathematics quizzes, tests and examinations (Hembree, 1990). Devine et al. (2012) defined mathematics anxiety as a state of discomfort associated with performing mathematical tasks and this problem was caused by low level of understanding the skills in mathematics. As the result, mathematics phobia emerged due to their poor mastery of basic mathematical concepts.

Effandi and Norazah (2008) noted that majority of Malaysian students had moderate level of mathematics anxiety and believed that mathematics anxiety was rooted during elementary and secondary years. Factors such as truancy, poor self-image, poor coping skills, teacher attitude and learning through drill without understanding could lead to mathematics anxiety. Besides, passive mathematics learning among secondary school students might cause mathematics anxiety in later years. Luo et al. (2009) described in their study that mathematic anxiety as a cognitively passive mood which was produced while solving mathematical problems. Their finding showed that there was no difference between all the grades for mathematics anxiety.

Numerical anxiety is defined as an anxiety present during mathematics learning processes. Nolting (2002) explained that numerical anxiety was an emotional response of a person when solving mathematical problems. Numerical anxiety was related to everyday situation that require working with numbers and perform arithmetic calculations. For instance, students face numerical anxiety in calculating the amount of tips for a service. Their minds were thinking about mathematics or seeking mathematical instructions. Numerical Anxiety occurred when manipulating of numbers in an ordinary situation and it has been recognized as one of the two major dimensions of mathematics anxiety (Johnston-Wilder & Lee, 2010).

2.2 Mathematics Anxiety and Gender

Devine et al. (2013) measured 433 male and female seventh- to tenth-graders' mathematics performance and their levels of mathematics anxiety. Data collected showed that there was no gender difference in mathematics anxiety and their mathematics performance. However, female students' anxiety level was higher compared to the male students. Both gender showed a positive correlation between mathematics anxiety and test anxiety but mathematics anxiety was negatively correlated with mathematics performance. An analysis revealed that mathematics anxiety was significant predictor for female students.

Likewise, Cheema and Galluzzo's (2013) reported that female students demonstrated higher anxiety dealing with mathematics or science subjects. Venkatesan and Karimi (2010) claimed that there was a need to address gender differences in the levels of mathematics anxiety and overall academic performance. They had selected 424 students from 12 high schools in South India. Their results supported that there was no gender difference in mathematics anxiety and academic performance. However, female students' mathematics anxiety was higher compared to male students. Similarly, Luo et al. (2009) found that female students had higher mathematics anxiety level especially in the cognitive aspect but also scored higher in mathematics. Analysis showed that there was no statistical significant between all the grades for mathematics anxiety but displayed certain tendency: seventh-graders had the lowest anxiety level and ninth-graders experienced the highest. It indicated that students' mathematics anxiety levels increased according to their grades.

2.3 Mathematics Anxiety and Mathematics Achievement

Many students experienced mathematics anxiety in their school lives. Venkatesh and Karimi (2010) perceived that mathematics anxiety was a good predictor of mathematics performance and overall academic performance. Conversely, several studies have identified that negative influences of mathematics anxiety in students' mathematics performance. Hembree (1990) felt that students who did not master mathematical operations might

not be able to do well in mathematics. Karimi and Venkatesh (2009) indicated that mathematics anxiety influenced mathematics and academic performance. There were significant relationships between mathematics anxiety, mathematics performance and academic hardiness. Students with hardy attitudes would be more motivated in mathematics learning.

Students' learning attitude is an important indicator than the cognitive status of interested in a subject (Mallow et al., 2010). Luo et al. (2009) surveyed 311 middle school students who attached to a university in China ranged from seventh grade to twelfth grade. Their finding showed that Seventh graders had lowest anxiety level compared to ninth graders and mathematics anxiety influenced students' mathematics performance. Shaikh's (2013) study indicated there were several reasons why students experienced difficulties in learning mathematics. Some students perceived mathematics as a difficult subject. Besides, he also identified six levels of mathematics performance and four types of mathematics anxiety. Jain and Dowson (2009) study revealed that widely diversified backgrounds of international students poised some challenges to mathematics instructors who engaged students in learning. Their study examined the correlations between international student's mathematics performance via self-regulated learning strategies and mathematics anxiety. The results showed that students' performance in mathematics was negatively correlated with mathematics anxiety.

3. Methodology

The sample comprised of pre-university students at one of the universities in Malaysia. A total of 140 pre-university students were involved in this study. Purposive sampling was used in choosing 74 male and 66 female students. Mathematics anxiety was being categorized as test anxiety and numerical anxiety. Test Anxiety consisted of items pertaining to the feeling of anxiety before the test, after the test, answering quizzes and solving difficult mathematical task. On the other hand, numerical anxiety comprised of items related to the 4 basic operations such as summation, subtraction, multiplication and division and application of daily life's mathematical problems.

The present study used quantitative method to examine the relationships between mathematics anxiety and mathematics achievement. The relationship between these two variables could be the framework of this study. Figure 1 shows mathematics test anxiety and numerical anxiety contribute to the mathematics anxiety. How gender responds to mathematics anxiety and the impact of mathematics anxiety on students' mathematics achievement.

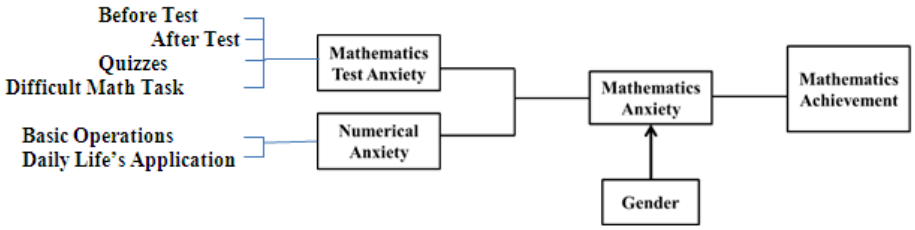

Figure 1. Theoretical framework

Data were collected by administering Short Version of Mathematics Anxiety Rating Scale (MARS-S). It was developed by Richardson and Suinn (1972) and this test consisted of 30 situations items which causes mathematics anxiety; whereas, the instrument used in this study was adopted from previous studies (Dunkle, 2010; Wilder, 2013). The survey questionnaires were divided into mathematics test anxiety (14 items) and numerical anxiety (15 items). There were a few studies (Shaikh, 2013; Tang, 2012; Devine et al., 2012; Venkatesh, & Karimi, 2010; Karimi & Venkatesh, 2009) used this Math Anxiety Rating Scale (MARS) to test students' mathematics anxiety levels. Therefore, this instrument was considered reliable in measuring students' mathematics anxiety levels. According to Wilder (2013), the reliability and validity of scores in MARS-S were consistent with the original version of MARS and was examined these psychometric data through test-retest reliability of its coefficients. The factor analysis of the MARS-S result (Wilder, 2013) showed that mathematics test anxiety and numerical anxiety was important indicator of mathematics anxiety among college students. In this study, the respondents used five points Likert scale with 1=Not at all, 2=A little, 3=A fair amount, 4=Much and 5=Very much. Data were analysed by using mean, standard deviations, Pearson correlation coefficient and Mann-Whitney U test. Mann-Whitney U test was used to determine the difference between male and female

students' mathematics anxiety levels based on their mathematics achievement.

4. Results

Hypothesis 1

There is a significant relationship between mathematics anxiety and mathematics achievement.

Pearson r was computed to determine the relationship between students' mathematics anxiety scores and mathematics achievement.

Table 1. Correlations

		Math Anxiety	Math Achievement
Math Anxiety	Pearson Correlation	1	.429**
	Sig. (1-tailed)		.000
	N	140	140
Math Achievement	Pearson Correlation	.429**	1
	Sig. (1-tailed)	.000	
	N	140	140

**. Correlation is significant at the 0.01 level (1-tailed).

Table 1 shows the output between mathematics anxiety and mathematics achievement were statistically significant with coefficient of correlation0.429and $p < 0.01$. Hence, the null hypothesis was rejected. Mathematics anxiety and mathematics achievement were positively correlated. Higher mathematics anxiety scores were associated with higher level of mathematics achievement.

Hypothesis 2

A significant portion of the variation in students' mathematics achievement is explained by the linear model of mathematical test anxieties comprising of anxiety before test, after test, quizzes, difficult mathematical task, basic operations and daily life's application.

Table 2. Multiple regressions

	Sum of Squares	df	Mean Square	F	Sig.
Regression	80.894	6	20.224	402.085	.000[b]
Residual	6.790	135	.050		
Total	87.684	139			

a. Dependent variable: Mathematics Achievement.

b. Predictors: (constant), Before Test, After Test, Quiz, Difficult Math Task,Basic Operations.

Daily Life's Application

Since the p-value was less than 0.05 (Table 2), reject the null hypothesis and conclude that a significant portion of the variation in the students mathematics achievement was explained by the linear model.

Table 3. Multiple regressions

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.004	.092		.042	.967
BeforeTest	.721	.035	.747	20.529	.000
AfterTest	.111	.021	.139	5.310	.000
Quizzes	.096	.029	.114	3.315	.001
Difficult MathTask	.090	.024	.111	3.782	.000
Basic Operations	.373	.016	.438	22.842	.000
Daily Life's Application	.601	.018	.641	33.434	.000

a. Dependent Variable: Mathematics Achievement.

Table 3 indicates that all the independent variables were significant as p-value less than 0.05. There was a linear relationship between mathematics achievement and the anxiety before test, after test, quizzes, difficult mathematical task, basic operations and daily life's application. The regression model as follows:

Mathematics Achievement = 0.004 + 0.721 *(Before Test)* + 0.111 *(After Test)* + 0.096 *(Quizzes)* + 0.090 *(difficultMathematical Task)*+ 0.373 (*Basic Operations*) + 0.601 (*Daily Life's Application*)

Hypothesis 3

There is a significant difference between male and female students' mathematics anxiety and mathematics achievement.

Table 4. Mann-Whitney U test

	Gender	N	Mean Rank	Sum of Ranks
Math Anxiety	male	74	69.86	5169.50
	female	66	71.22	4700.50
	Total	140		
Math Achievement	male	74	68.99	5105.50
	female	66	72.19	4764.50
	Total	140		

Table 5. Test statistics[a]

	Math Anxiety	Math Achievement
Mann-Whitney U	2394.500	2330.500
Wilcoxon W	5169.500	5105.500
Z	-.198	-.581
Asymp. Sig. (2-tailed)	.843	.561

a. Grouping Variable: Gender.

Table 4 shows the mean scores of mathematics anxiety of male and female students. Female students scored higher in mathematics anxiety scores (71.22) compared to male students. Similarly, female students' mean scores were higher for mathematics achievement compared to male students (Table 4).Table 5shows p-value is

greater than 0.05, therefore, do not reject the null hypothesis. The result indicated that there was no significant difference between male and female students in mathematics anxiety and their mathematics achievement. In other words, the samples were not statistically significant and any differences observed could due to chance.

5. Conclusion

Mathematics anxiety is expected to have an impact on students' mathematics performance. This finding reveals that there is a positive relationship between students' mathematics test and numerical anxiety on students' mathematics achievement. The multiple regressions analysis showed that there was a linear relationship of mathematics anxiety comprising of anxiety before test, after test, answering quiz and solving difficult mathematical task, four basic operations and daily life's application on students' mathematics achievement. However, there was no significant difference between the male and female students on the scores of mathematics anxiety and mathematics achievement.

This study indicates that mathematics test anxiety and numerical anxiety are positively associated with mathematics achievement. This result is concurred with the study of Yousafi et al. (2010) that positive relationship between mathematics test anxiety and mathematics performance. This study provides evidence that test anxiety and numerical anxiety influenced students' mathematics achievement. It was found that anxiety before test contributed highest in students' mathematics achievement compared to anxiety after test, answering quizzes and solving difficult mathematical task in mathematics test anxiety. Similarly, anxiety in daily life's application was the highest compared to anxiety in the four basic operations in numerical anxiety. Previous studies also justified that aspiration of students was believed to have a significant influence on their academic achievement and test anxiety was one of the most significant predictors for mathematics anxiety (Kazmi, 2014; Kesici & Ergodan, 2009).

References

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science*, *11*(5), 181-185. http://dx.doi.org/10.1111/1467-8721.00196

Cheema, J. R., & Galluzzo, G. (2013). Analyzing the gender gap in Math achievement: Evidence from a large-scale US sample. *Research in Education*, *90*(1), 98-112. http://dx.doi.org/10.7227/RIE.90.1.7

Devine, A., Fawcett, K., Szucs, D., & Dowker, A. (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. *Behavioural and Brain Functions*, *8*(33), 2-9. http://dx.doi.org/10.1186/1744-9081-8-33

Devine, A., Soltész, F., Nobes, A., Goswami, U., & Szűcs, D. (2013). Gender differences in developmental dyscalculia depend on diagnostic criteria. *Learning and Instruction*, *27*, 31-39. http://dx.doi.org/10.1016/j.learninstruc.2013.02.004

Dunkle, S. M. (2010). *Remediation of Math Anxiety in Preservice Elementary School Teachers*. ProQuest LLC. 789 East Eisenhower Parkway, PO Box 1346, Ann Arbor, MI 48106.

Effandi, Z., & Norazah, M. N. (2008). The effects of mathematics anxiety on matriculation students as related to motivation and achievement *Eurasia Journal of Mathematics, Science & Technology Education*, *4*(1), 27-30.

Furner, J. M., & Berman, B. T. (2003). Review of Research: Math Anxiety: overcoming a major obstacle to the improvement of student math performance. *Childhood education*, *79*(3), 170-174. http://dx.doi.org/10.1080/00094056.2003.10522220

Hembree, R. (1990). The nature, effects, relief of mathematics anxiety. *Journal for Research in Mathematics Education*, *1*, 33-46. http://dx.doi.org/10.2307/749455

Jain, S., & Dowson, M. (2009). Mathematics anxiety as a function of multidimensional self-regulation and self-efficacy. *Contemporary Educational Psychology*, *34*(3), 240-249. http://dx.doi.org/10.1016/j.cedpsych.2009.05.004

Johnston-Wilder, S., & Lee, C. (2010). Mathematical resilience. *Mathematics Teaching*, *218*, 38-41.

Karimi, A., & Venkatesan, S. (2009). Mathematics anxiety, mathematics performance and academic hardiness in high school students. *International Journal of Educational Sciences*, *1*(1), 33-37.

Kazmi, M. (2014). Effect of motivational type on goal-setting behaviour.*Undergraduate Research Journal for the Human Sciences*, *13*(1).

Kesici, S., & Erdogan, A. (2009). Predicting college students' mathematics anxiety by motivational beliefs and

self-regulated learning strategies. *College Student Journal*, *43*(2), 631-642.

Loong, T. E. (2012). *Predicting pre-university international students' math performance by learning strategies and math anxiety in Malaysia*.

Luo, X., Wang, F., & Luo, Z. (2009). Investigation and analysis of mathematics anxiety in middle school students. *Journal of Mathematics Education*, *2*(2), 12-19.

Mallow, J. V. (2010). *Gender, science anxiety, and science attitudes: A multinational perspective*. Meeting of the United Nations Division for the Advancement of Women, United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris, France.

Mallow, J., Kastrup, H., Bryant, F. B., Hislop, N., Shefner, R., & Udo, M. (2010). Science anxiety, science attitudes, and gender: Interviews from a binational study. *Journal of Science Education and Technology*, *19*(4), 356-369. http://dx.doi.org/10.1007/s10956-010-9205-z

Nolting, P. D. (2002). *Winning at math: Your guide to learning mathematics through successful study skills*. Academic Success Press Inc.

OECD. (2014). *PISA 2012 Results in Focus: What 15-year-olds know and what they can do with what they know*. Paris: OECD Publications. Retrieved from http://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf

Rameli, M. R. M., Kosnin, A., Said, H., Tajuddin, N., Karim, N. A., & Van, N. T. (2014). Correlational analyses between mathematics anxiety and mathematics achievement among vocational college students. *Jurnal Teknologi*, *69*(6).

Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2013). Math anxiety, working memory, and math achievement in early elementary school. *Journal of Cognition and Development*, *14*(2), 187-202. http://dx.doi.org/10.1080/15248372.2012.664593

Richardson, F. C., & Suinn, R. M. (1972). The mathematics anxiety rating scale: psychometric data. *Journal of counseling Psychology*, *19*(6), 551. http://dx.doi.org/10.1037/h0033456

Shaikh, S. N. (2013). Mathematics anxiety factors and their influence on performance in mathematics in selected international schools in Bangkok. *Journal of Education & Vocational Research*, *4*(3).

Sheffield, D., & Hunt, T. (2006). How does anxiety influence maths performance and what can we do about it? *MSOR (Maths, Stats & OR Network) Connections*, *6*(4), 19-23. http://dx.doi.org/10.11120/msor.2006.06040019

Venkatesh, K. G., & Karimi, A. (2010). Mathematics anxiety, mathematics performance and overall academic performance in high school students. *Journal of the Indian Academy of Applied Psychology*, *36*(1), 147-150.

Wilder, S. (2013). *Dimensions of Math Anxiety as Measured by the MARS-Brief: Factor Analysis*.

Yousefi, F., Abutalib, M., Mansoor, M. B., & Juhari, R. B. (2010). Relationship between test anxiety and academic achievement among Iranian adolescents. *Asian Social Science*, *6*(5). 100. http://dx.doi.org/10.5539/ass.v6n5p100