

Correlates of Mathematics Anxiety among Business Studies Students: A Case of an Institution of Higher Learning in Malaysia

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DOI: <https://doi.org/10.37178/ca-c.22.1.173>

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Abstract

This paper attempts to explore mathematics anxiety levels among students in a tertiary education institution. The data set was taken from a survey entitled "Exploring Mathematics Anxiety among Business Students in New Era University College (NEUC)".

The variables of study were measured using the Mathematics Anxiety Rating Scale (MARS) which developed by [1]. One-way ANOVA analysis was conducted to validate the impact of demographic factors drive their mathematics anxiety levels. The findings were based on descriptive and One-way Analysis of Variance. The results from this study show that poor performance in mathematics examinations in the past was associated with higher level of mathematics anxiety among the respondents. However, there was no significant difference in the level of mathematics anxiety across the academic levels and programs. This study would be significant for the educator to enhance their teaching style by offering educators the important information about mathematical anxiety during the learning process of students.

Keywords: Mathematics anxiety, perceived previous knowledge, institute of higher learning students, programme enrol, education level.

INTRODUCTION

New Era University College, Malaysia recognised as a community-funded institution of higher learning. It was founded by the neighbouring community. It is opened to local Malaysians and international students from different backgrounds. With student's community of more than 2,500 students studying in this campus, NEUC offers a truthfully multi-ethnic learning environment which prepares students fit for the sufficient experience to conduct scientific and technological development. Thus, Mathematics as a subject which usually link to the development of science and technology play an important role in the development of student's skills especially in the key of problem solving. Some of studies try to highlight possible reasons for students' difficulties in the beginning of the university life toward Maths learning. Past examination results play an important factor in influencing the mathematics anxiety level of students in all of institute of higher learning. Hence, the main focus of this study is to explore the effects of SPM results on maths anxiety level of NEUC students. It also help in addressing math anxiety link factor has the latent to increase interest and success of students in STEM fields.

Definition of math anxiety

Anxiety disorders are some of the most widespread mental health problems worldwide. In educational settings, anxiety can have detrimental effects on the students. It involves feelings in specific situations, such as examinations, overall learning, and even lifelong academic and vocational development. Along with more overarching anxiety disorders, individuals may suffer from specific forms of test and performance anxiety that are connected to a knowledge domain. Among the most prominent of these disorders is math anxiety.

According to [2], math anxiety manifests itself on an emotional, cognitive, and physiological level and leads to outcomes such as decreases in achievement. On an emotional level, individuals suffer from feelings of tension, apprehension, nervousness, and worry. On a cognitive level, math anxiety compromises working memory while on a physiological level, the symptoms of math anxiety include increased heart rate, clammy hands, upset stomach, and light-headedness.

The American Psychological Association [3] defined anxiety as "an emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure". Hence, anxiety can become unpleasant and stressful which could cause stress, an emotional experience that takes over our mind and body.

[4] defined mathematical anxiety as feelings of tension, apprehension, or even dread that interfere with the ordinary manipulation of numbers and the solving of mathematical problems. Furthermore, [5] defined mathematical anxiety as involving feelings of tension and anxiety that interfere with the manipulating of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations. [6] defines maths anxiety as 'an adverse emotional reaction to mathematics or the prospect of doing mathematics'. [6] research focused on a meta-analysis of 151 studies and has been cited more than 1550 times since its publication.

Relationship between math's experience and math anxiety

According to [7], mathematics anxiety varies significantly across the various disciplines in institutions of higher learning. Those who majored in business were found to have higher self-efficacy in mathematics than those majoring in either liberal arts or communication. On the other hand, communication majors had the highest rate of mathematics anxiety and the lowest for mathematics self-efficacy. Mathematics anxiety is a useful predictor of course choice in a college student's major. Furthermore, mathematics anxiety has also been studied by numerous researchers in the West. Findings by [8] highlighted that mathematics anxiety can start to influence a student's ability in the subject as early as in fourth grade and aggravates through middle and high school as mathematics classes become more advanced. It seems that many students, both in secondary and college level, are affected by some form of mathematics anxiety as well as test anxiety [8].

[9] found interesting results in the study of mathematics anxiety and college major, as 33% of students majoring in the social sciences reported mathematics avoidance. The same conclusion also highlight in the study of [10]. These statistic are worrisome since some degrees in the social sciences, such as psychology and sociology, require students to take statistics courses and perform adequately in these courses in order to fulfil degree requirements.

In a similar vein, 70% of Americans surveyed believed that Mathematics and Science are very important for students and graduates, and 44% believed that many students avoid these subjects because they are too difficult [11]. This is not a complicated statistic to consider when thinking about the controversies surrounding America's shortage for science, technology, engineering and mathematics (STEM) related jobs. One reason why these jobs are flourishing in other countries, such as in China, is because the teachers presumably have a deeper understanding of mathematics and its content which give students better opportunities to grasp the materials given to them [12].

In addition, [13] also found relationships in mathematics anxiety among students in institutions of higher learning who majored in Science and Mathematics. Those who encountered more years of preparatory mathematics courses in high school were more likely to major in mathematics or the sciences at college level. Those who rated themselves lower in mathematics anxiety and higher in mathematics self-efficacy were also more likely to major in the sciences or mathematics in undergraduate programs.

Problem Statement

The emergence of powerful digital economy globally demands new knowledge and skills to drive the economy. Creativity and innovation are vital for nations to remain competitive. Malaysia is placing great emphasis on STEM courses, as emphasized in the Malaysian Education Blueprint (2013 - 2025). STEM looks into integrating Science, Technology, Engineering and Mathematics curricula into an applied model. Although the

nation is on the right track, the mathematics components of STEM seem to be an issue with learners

The performance of Malaysian learners in mathematics is well below that of her Asian counterparts as shown in OECD's Programme for International Student Assessment (PISA) 2015 scores. The top performers for mathematics among the 72 countries that participated were Singapore (564), Hong Kong (548), Macao (544), Taiwan (542) and Japan (532). Malaysia was at 46th place with a score of 446, falling below the OECD's average of 490 (Business Insider, 2016). Therefore, there is a need of a study to ascertain the reasons behind the poor performance of Malaysian students in mathematics.

This topic has been of great interest to many scholars; however, the studies conducted in Malaysia are still far fewer in number than in many other countries with many focusing on secondary and primary pupils. The significance of math anxiety does not stop when one leaves school [14], particularly as the current graduate population is faced with increasing demands for science and technological skills. Among the studies done that looked into secondary school pupils were by [15] to gauge mathematics anxiety and mathematics achievement among pupils in Selangor, Malaysia. This study shows that math anxiety is one of the main factors that affects student achievement.

Other studies include [16], who compared mathematical anxiety levels and its influences on performance between Malaysia and Tanzania secondary schools pupils; and [17] who sought to explore the use of TI-84 Plus graphing calculator in improving teaching and its impact on achievement and mathematics anxiety. Both research papers did not highlight the causes of math anxiety especially the impact of prior knowledge.

Several studies were undertaken at institutions of higher learning, [18] explored the anxiety levels among undergraduates at a private institution of higher learning in Malaysia; [19] conducted a study at Universiti Malaysia Pahang (UMP) to explore mathematics anxiety among engineering students; and [20] investigated the relationships between mathematics anxiety, attitudes toward mathematics and mathematical thinking among public university students. These studies provide sufficient room for further investigation to be done at institutions of higher learning, especially in measuring the impact of prior knowledge and its impact on current mathematics anxiety level.

Research hypothesis

- i. There are significant relationships between levels of previous results and mathematics anxiety among students from institutions of higher learning.
- ii. There are significant differences in students' mathematics anxiety across academic programs (foundation, diploma and degree) and majors.

Research Objectives

- i. To determine the impact of SPM Mathematics and Additional Mathematics scores towards on students's mathematics anxiety at tertiary level education.
- ii. To examine the effect of education level on students's level of mathematics anxiety.

METHODOLOGY

This study utilized the cross-sectional survey method. The target population for this study was all the Chinese students in the School of Business at NEUC. The rationale for

choosing this sampling frame was the requirement in completing Business Mathematics and Business Statistics in every level of the program offered by the college. The sample size of 100 students was determined on sample size table presented by [21]. The selection of respondents from population size of 250 was made based on random sampling method. The instrument known as Mathematics Anxiety Rating Scale (MARS) used 1-5 Likert scale in this research was adapted from [1]. This instrument is also widely used by a lots of researchers for similar study [3, 17, 22, 23]. The instrument was validated by the subject expert and the Head of Department of the School of Business and was further tested for reliability which gave a result of .86 on the Cronbach's Alpha. Most of the students obtained moderate results in the mathematics anxiety test. This indicates that students in the Business Studies courses in NEUC may experience a moderately level of anxiety and they may become nervous when dealing with mathematical problems.

RESULTS

Profiles of the Respondents

New Era University College (NEUC) was established in 1998. It is the outcome of many years of concerted efforts by the Chinese community. On 30 December 2016 New Era was upgraded to University College status by the Ministry of Higher Education. This upgrading allows New Era University College to offer its own degrees and post-graduate degrees. New Era continues to be a non-profit making institution. At the same time, it provides a large number of scholarships and fee waivers to deserving students. To encourage a multi-ethnic and multi-cultural environment, New Era extends scholarships to the non-Chinese communities in Malaysia as well.

A number of 100 students from NEUC participated in this study. Of these, 55 of the students were females and the rest males. All were from the Faculty of Business and IT. Business Studies students making up 70% of the respondents while the Accounting and Finance students made up the remaining 30%. Majority of the participants were between the ages of 19 and 20 years old. In addition, most of the participants are currently in Diploma programmes (74%), followed by Foundation (13%) and, lastly, Bachelor degree programmes (12%). Majority of the respondents obtained atleast a credit in SPM for Mathematics (77%) and Additional Mathematics (61%). There were four respondents who failed SPM Mathematics and 13 students who failed Additional Mathematics. Furthermore, 70% of the respondents would be attending workshops related to Business Mathematics offered in NEUC.

Table 1

Demographic Characteristics

Category	Frequency
Gender	
Male	45
Female	55

Academic Level	
Pre U/ Foundation	13
Diploma	74
Bachelor	13
Programme Enrolled	
Business Studies	70
Accounting and Finance	30
SPM Result for Mathematics	
Credit (Grade C) or better (?)	77
No Credit	19
Fail	4
SPM Result for Additional Mathematics	
Credit (Grades C) or better	61
No Credit	26
Fail	13

Level of Mathematics Anxiety

A survey questionnaire comprising 15 questions was used to gather information regarding NEUC students' mathematics anxiety, in particular in the School of Business. The Likert five-point scale was adopted to measure the anxiety level of the 100 respondents. The scales ranged from 1 (strongly disagree) to 5 (strongly agree). Table 2 below explains the 15 items that measured mathematics anxiety

Table 2

Level of Mathematics Anxiety

Statements	Mean	Standard Deviation	Level Low (1.00-2.339) Moderate (2.34-3.669) High (3.67-5.00)
1. I am tensed when I prepare for a mathematics test.	3.09	1.01	Moderate
2. I feel nervous when I have to use mathematics outside of college.	2.65	.95	Moderate
3. I am worried that I will not be able to use mathematics in my future career when needed.	2.67	.98	Moderate
4. I am worried that I will not be able to get a good grade in my mathematics course.	3.30	.10	Moderate
5. I am worried that I will not be able to do well on mathematics tests.	3.27	.11	Moderate
6. I feel stressed when listening to mathematics instructors in class.	2.67	1.03	Moderate

7. I am nervous when asking questions in class.	2.58	1.06	Moderate
8. I am stressed when working on mathematics homework.	2.84	1.03	Moderate
9. I am worried that I do not know enough mathematics to do well in future mathematics courses.	3.35	.95	Moderate
10. I am worried that I will not be able to complete every assignment in a mathematics course.	3.02	1.04	Moderate
11. I am worried I will not be able to understand mathematics.	3.01	1.15	Moderate
12. I am worried that I will not be able to get an "A" in my mathematics course.	3.43	1.17	Moderate
13. I worry that I will not be able to learn well in my mathematics course.	3.05	.94	Moderate
14. I get nervous when taking a mathematics test.	3.12	1.13	Moderate
15. I am afraid to give an incorrect answer during my mathematics class.	2.97	.99	Moderate
Overall	3.00	.71	Moderate

Comparison of maths anxiety across academic levels

Table 3 below explains the differences in mathematics anxiety based on academic level. ANOVA test is the appropriate statistical tool since it allows comparison to be made across more than 2 groups. In NEUC, the academic level is divided into 3 levels, namely, Foundation, Diploma and Bachelor. Table shows no significant differences in maths anxiety across academic levels.

Table 3

Comparison based on education level

Education level	n	Mean	Standard Deviation	F	Sig
Foundation	13	2.641	.813	2.361	.100
Diploma	74	3.028	.713		
Bachelors	12	3.106	.577		

Comparison of maths anxiety between programs

The programmes under this study were offered by two departments, namely Business Studies, and Accounting and Finance from the Faculty of Business and Information Technology. Table 4 shows that there were no significant differences in mathematics anxiety between the two programmes since $p > 0.05$. It means that the research null hypothesis cannot be rejected.

Table 4

Comparison based on program enrolled

Program Enrolled	n	Mean	Standard Deviation	F	Sig	t	Sig
Business Studies	70	3.091	.674	.299	.586	1.951	.054
Accounting and Finance	30	2.793	.754				
Total	100						

Impact of SPM Mathematics towards Student’s Mathematics Anxiety

The focus of this study was to examine if SPM results in Mathematics have a significant influence on the maths anxiety level among university college students. The scoring in SPM Mathematics is divided into 3 categories; namely Credits, Non-credits and Fail. The mathematics anxiety was calculated based on mean score. The findings showed there were significant differences in mathematics anxiety score among the three categories in the SPM-level Mathematics scores (Table 5). Tukey HSD was used to identify the differences between groups. From the analysis, it was found that students with Credit in SPM Mathematics had lower mathematics anxiety (M=2.880, SD =.694) than the Non-credit students (M=3.321, .613) and also the students who received a Fail grade (M=3.833, .401). It is clear that students who failed Mathematics in SPM had the highest anxiety level.

Table 5

ANOVA analysis on mathematics anxiety based on categories of SPM-level Mathematics score

Categories of Maths Score	n	Mean	Standard Deviation	F	Sig
Credit	77	2.880	.694	6.460	.002
Non-Credit	19	3.321	.613		
Fail	4	3.833	.401		

Impact of SPM-level Additional Mathematics towards Students’ Mathematics Anxiety

Past studies show that that SPM-level Additional Mathematics could assist institutions of higher learning students to perform well in quantitative subjects. Therefore, this study was aimed at finding out whether past experience in attempting SPM Additional Mathematics could help to reduce mathematics anxiety. Similar to SPM Mathematics, the scoring in SPM-level Additional Mathematics is also divided into three categories, namely Credits, Non-credits and fail. The findings showed there were significant differences in mathematics anxiety score among the three categories of Additional Mathematics scores. Tukey HSD was used to identify the differences between groups. From the analysis, it was found that students with Credit in SPM-level Additional Mathematic had lower mathematics anxiety (M=2.818, SD=.689) than the Non-Credit students (M=3.174, .653) and also the Fail-grade students (M=3.520, .591). Thus, the findings strengthen the assumption that a strong grasp of Additional Mathematics provides a higher level of confidence to students and consequently reduces the anxiety towards Mathematics.

Table 6

ANOVA analysis on mathematics anxiety based on SPM-level Additional Mathematics score categories

Maths Score	n	Mean	Standard Deviation	F	Sig
Credit	61	2.818	.689	7.080	.001
Non-Credit	26	3.174	.653		
Fail	13	3.520	.591		

DISCUSSION

The results of this research gave us a better understanding of the factors influencing NEUC students' mathematics anxiety. The research revealed that the overall level of the students' mathematics anxiety was moderate. The ANOVA analysis provided clear evidence that those with Non-Credit and those who failed the SPM-level Mathematics and Additional Mathematics tests have a higher level mathematics anxiety at tertiary level. This finding is consistent with the study by [6] which found that students with low achievement in mathematics would develop negative emotions and attitudes toward mathematics, thus causing them to avoid mathematics in the future. He also mentioned the trauma caused which required intensive intervention since the anxiety would accumulate each time the students performed poorly in this subject.

In addition, [24, 25] study showed that a poor result on previous mathematics examinations could develop working memory interference which may lead to more worries among the students. Students gradually lose confidence in attempting numerical tasks. The two factors (programme enrolled and student's education level) do not seem to differ significantly in mathematics anxiety. Interestingly, the findings from ANOVA test strengthen the claim made by the Deficit Theory which explains that poor performance in the past in mathematics leads to mathematics anxiety in the present. Levels of achievement also matter - not only past experience in SPM-level Mathematics and Additional Mathematics but also the achievement of Credit in the subjects reduce the anxiety level compared to students who failed to obtain Credit.

CONCLUSION AND RECOMMENDATIONS

The results of this study show students' anxiety about mathematics is influenced by their perceived past experiences in mathematics courses especially at high school level. The study also reveals that students who received Credit in SPM generally felt more at ease and confident about scoring better grades in mathematics-related courses while undergoing tertiary-level programmes.

Mathematics is relevant to the business studies curriculum. It would be more productive in learning if students felt at ease when doing mathematics-related courses. Therefore, more investigation into the methods of reducing mathematics anxiety has to be conducted.

Being a pilot project, this study was limited to the fields of Business and Accounting. It would be more substantial if, in future research, the study was extended to students in other fields and demographics. Future exploration in this area also can be done by looking into other aspects such as personality type, learning environment, support system and peer performance.

Furthermore, the level of English proficiency can be one of the factors that influence the level of mathematics anxiety. The student's fear on this subject probably is because of their different background in English. Language plays an important role for student when they need to interpret the mathematics problem, turn it into a solution and finally draw the conclusion from the solution [1, 8, 26-29].

Lecturers teaching college-level mathematics face an challenge today: how to get across the concepts and skills without filling the classroom with anxiety and dread. Traditionally, students have been taught to memorize mathematical concepts without actually working through problems and comprehending the reasons behind mathematics skills. This method makes learning mathematics less interesting and unattractive from the students' perspectives. In many cases, this leads to a negative perception of mathematics-related courses. Thus, teaching methods for mathematics needs to be re-examined and there should be more emphasis on specific methods, which may mean fewer lectures and more student-directed classes and discussions.

The significance of mathematics anxiety among students should prompt lecturers to pay more attention when designing lesson plans for mathematics-related courses. As in many other fields, mathematics lessons should address a variety of learning styles, where the environment encourages each individual's strengths and successes. Hence, low-anxiety teaching-learning methods for mathematics is another research area which could be extended out of this study.

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