Predicting Pre-University International Students' Math Performance by Learning Strategies and Math Anxiety in Malaysia

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Abstract: There is a rising interest in exploring factors that influence international students' math performance in the Monash University Foundation Year (MUFY) as the total number of international students enrolled in the pre-university program is increasing and also their results in math will determine the degree programs to be taken in the university. The primary aim of this study is to determine whether self-regulated learning strategies and math anxiety are significant predictors of math performance for international students in the MUFY program. The use of self-regulated learning strategies was measured by the Learning and Study Strategies Inventory (LASSI), math anxiety was measured by a revised version of the Math Anxiety scale, and math performance was measured by the final score of Fundamental Mathematics A. The study group was comprised of 76 international students in the pre-university program at a Malaysian private college. The analysis suggests that international students' math performance is positively correlated with attitude, motivation and test strategies, but negatively correlated with math anxiety. And also attitude and test strategies are two significant predictors of math performance for international students. The results of this study have significant contribution to the program at the college.

Key words: pre-university; learning strategies; math anxiety; math performance; international students; correlation;

1. Introduction

According to the data provided by Ministry of Higher Education (2010), there were 86,923 international students in both Malaysian public and private higher education sectors in 2010. Of this total, 72.1% was with the private institutions of higher education and 27.9% in the public higher education sector. Among the international students in the private institutions of higher education, 65.3% came from Asian countries and 27.1% came from African countries. Adding to that, Malaysia has captured 1.2% of market share of all international students in its higher education sector, according to UNESCO Institute of Statistics (2011). Furthermore, the country was rated as one of top 5 higher education destinations for Asian students (Asian Correspondent, 2011). The growing popularity as a destination of higher education has placed Malaysia as a new player in the global education market particularly for the markets in Asian and African regions.

Studies on international students for both public and private higher education sectors in Malaysia have focused mostly on student choice criteria in selecting Malaysia as their destination of higher education (British Council, 2008; National Higher Education Research Institute, 2009; Rohana Jani et al., 2010; Rohaizat Baharun et al., 2011). For example, one of the choice criteria was affordable education cost, which is only a fraction of the cost if studying in major education-exporting countries. According to Asian Correspondent (2011), pursuing an Arts or Business bachelor's degree in Malaysia for international students would cost a total of US $7,000 per year in a private institution compared to $35,000 in the US (private) or $25,000 in the UK (public). Certainly, the choice criteria are important for the Malaysian government and institutions of higher education in their efforts to promote Malaysia as a higher education hub in the region, but international students' academic performance should not be omitted.

Studies on international students' academic performance in major education-exporting countries have shown mixed results as compared to home students. A large-scale study in Australia involved 22 universities found that international students performed as well as Australian counterparts based on their pass rates

(Olsen et al., 2006). Several other studies reported that home students performed better than international students. International students dominated the group that obtained third class and unclassified degrees in the School of Surveying at Kingston University (Smith & Eccles, 1993). International students in a first-year business studies program obtained lower marks in some forms of assessment than home students at a UK university (De Vita, 2002). Morrison et al. (2005) analyzed data collected by the Higher Education Statistics Agency (HESA) and found that, overall, UK undergraduate students did significantly better than overseas counterparts. He and Banham (2009) analyzed collected data over a six-year time period for students in the Okanagan School of Business, Canada, and they found that home students' academic performance was generally better than international students' performance, but the gap was significantly narrowing as international students' performance was improving over time. Foster (2011) found that international students earned persistently lower marks than other students at business faculties of two Australian Technology Network.

On the other hand, several studies suggested that international students did better than home students. Overseas-fee-paying students outperformed the general student body at Curtin University of Technology, Australia (Pauley, 1988). Another Australian study at Murdoch University found that overseas students performed as well as, or better than home students (Williams, 1989). Dobson et al. (1998) analyzed data collected by the Student Progress Units in Australia found that, on average, overseas undergraduates outperformed non-overseas counterparts.

Most attempts to predict international students' academic performance by English-language proficiency (Light et al., 1987; Poyrazli et al., 2001; Li et al., 2010). One important factor not measured by English-language proficiency is the use of self-regulated learning strategies, which is described as the process by which learners personally activate and sustain cognitions, affects, and behaviors that are systematically oriented towards achieving learning goals (Schunk & Zimmerman, 2008). Empirical evidence has established the importance of learning strategies in predicting academic performance for general student populations. Yip and Chung (2005) documented the differences on the use of learning strategies between matriculation and university students. They found that selecting main idea, attitude, study aids, motivation, time management, self-testing, and test strategies were the significant indicators for their mean grade point average (GPA) of matriculation students, and for university students, concentration and motivation were the significant indicators of their mean GPA. Reaser et al. (2007) reported that motivation was the significant predictor of the GPA for undergraduate students without learning disability. Crede and Kuncel (2008) reported study motivation, study skills and study attitudes exhibit positive relationships with their GPA among college students, and academic specific anxiety was found to be a negative predictor of academic performance. Kamariah Abu Bakar et al. (2010) found that achievement motivation and attitude towards studying were significant predictors of the cumulative GPA of undergraduates. However, the use of learning strategies has not fully been explored by research on international students. One important study on international students by Stoynoff (1997) found that motivation, self-testing and test strategies were positively correlated with their GPA among freshman international students.

The past literature offered little understanding on the relationship between self-regulated learning strategies and math performance at the pre-university level. Belcheir (2002) reported that motivation was a significant predictor of undergraduates' performance in immediate algebra. MacNamara and Penner (2005) reported that math results among the first year college students major in mathematics was positively correlated with time management, motivation, concentration and study aids, but negatively correlated with anxiety. Wadsworth et al. (2007) found that motivation, concentration, information processing and self-testing were significant in predicting the final grade of the online math course for college students.

Besides the use of self-regulated learning strategies, math anxiety is another important factor yet to be explored in detail by research on international students. According to Richardson and Suinn (1972), math anxiety is defined as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations". Math anxiety has

a long term impact on individuals. Students with high math anxiety experienced smaller working memory spans, and the reduction in memory capacity resulted in longer reaction time and increased errors while performing computational functions (Ashcraft & Kirk, 2001). Moreover, math anxiety can lead to negative outcomes such as avoidance of college math courses and majors or avoidance of careers that involve frequent math use (Hembree, 1990; Ashcraft, 2002). Empirical studies have shown that students' performance in math is decreased as their math anxiety increased (Engelhard, 2001; Lee, 2009; Legg & Locker, 2009).

Although previous research has examined in a wide range of student factors that influence overall academic performance in undergraduate programs, only a handful of studies have investigated specifically on math performance. There is no research to date focuses on math performance of pre-university international students. Pre-university is regarded as a crucial junction where students are in the transition from the traditional teacher-centered learning environment at secondary schools to the student-centered learning environment at university. Furthermore, pre-university achievement results, particularly in math, determine degree programs to be enrolled at university and careers they are heading for in the future.

International students in Malaysia have contributed significantly to the private institutions of higher education in terms of revenue. And for some institutions their main revenues are come from international students. The MUFY program is not exceptional as the total number of international students enrolled has increased in the recent years. As recorded in the student database in September 2011, there were 729 students in the pre-university program at a Malaysian private college, of that 25% were international students who mainly came from Asian and African countries. If we can initiate a research study to obtain some student factors that influence pre-university international students' math performance, the result will definitely be helpful for math instructors and the pre-university program on their ultimate goal to prepare international students for excellent achievements and university success. Subsequently, this will help to promote the pre-university program at the college as a provider that emphasizes on educational success.

The present study focuses on self-regulated learning strategies and math anxiety, and directly assesses their effects on math performance for international students in the MUFY program. This study is guided by the following objectives:

1. to examine the correlations between international students' math performance and their self-regulated learning strategies and math anxiety.

2. to determine whether math anxiety and self-regulated learning strategies are significantly predictors of math performance for international students in the pre-university program.

1.1 Monash University Foundation Year

MUFY is a two-semester program, which provides a successful pathway from secondary schools to Monash University. Students have the option of completing the program in more than two semesters. The program offers various subjects and each subject is divided into two units: part A and part B. Three of the subjects offered are mathematical subjects, namely Fundamental Mathematics, Mathematics and Advanced Mathematics. Fundamental Mathematics is the most manageable mathematical subject, which is equivalent to Year 11 Mathematics. Students must pass Fundamental Mathematics A before they are allowed to do Fundamental Mathematics B. The selection of mathematical subjects in the program determines the degree programs students will be taking at Monash University. For example, students who plan to take business degree programs at that university are required to do Fundamental Mathematics, while students who plan to do engineering degree programs are required to take Mathematics.

2. Methodology

2.1 Sample

76 international students (39 males, 37 females) who registered for Fundamental Mathematics A in July 2010 (25 students), August 2010 (11 students), July 2011 (21 students) and August 2011 (19 students) voluntarily participated in the research study at a Malaysian private college. All students in July and August 2010 semesters were taught by the same instructor, whereas students in each of July and August 2011 semesters were taught by two different instructors. Among the total 76 students, 76.3% were in their 1st semester, 17.1% were in their 2nd semester and 6.6% were in their 3rd semester when the survey was taken place. 4 international students did not have the final score of the mathematical subject due to the students not sitting for their final exam.

The international students ranged in age from 16 to 24 years with M = 18.16 and SD = .91. They came from 26 countries and their numbers are as shown below: Indonesia (10), Sri Lanka (8), Bangladesh (7), Pakistan (5), China (4), Saudi Arabia (4), Uganda (4), Bahrain (3), Kazakhstan (3), Kenya (3), Maldives (3), South Korea (3), Vietnam (3), Iran (2), Nigeria (2), Sudan (2), Bosnia (1), Guinea (1), India (1), Jordan (1), Mauritius (1), Singapore (1), Taiwan (1), Tajikistan (1), Thailand (1) and Zimbabwe (1). International students were summarized according to geographical regions, which can be seen in Table 1.

International students' educational background are as shown below: General Certificate of Education (GCE) O-Level (26.3%), International General Certificate of Secondary Education (IGCSE) O-Level (11.8%), Ujian Akhir Nasional (UAN) or National Final Exam (9.2%), Secondary School Certificate (SSC) (3.9%), Uganda Advanced Certificate of Education Exam (UACE) (3.9%), General Certificate of Secondary Education (GCSE) O-Level (2.6%), Hui Kao or National Senior High School Graduation Examination (2.6%), others (30.5%) and no response (9.2%).

Table 1. Composite of International Students according to Geographical Regions

Region	Frequency	Percentage
South Asia	24	31.6
Asia Pacific	23	30.3
Africa	14	18.4
Middle East	10	13.2
Central Asia	4	5.3
Others	1	1.2
Total	76	100.0

2.2 Questionnaire

The questionnaire consisted of three parts:
The first part contained demographic questions and educational information: gender, age, nationality, secondary school examination, and number of semesters in the pre-university program.

The second part contained the 2nd Edition of the LASSI (Weinstein, Palmer & Shulte, 2002), which was used to measure students' self-regulated learning strategies. The instrument consists of 80 items in which students respond to questions using 5-point ratings that range from *not at all typical of me* to *very much typical of me*. The inventory is both diagnostic and prescriptive, measuring students' use of learning and study strategies in the areas of skill, will, and self-regulation. Specifically, the inventory contains 10 subscales:

1. Anxiety – feelings of worry towards school and tests despite being well prepared.
2. Attitude – interest in and attitude towards school; desire to work on academic tasks.

3. Concentration – ability to pay attention to, concentrate on, and think about the learning materials; will not be easily distracted.
4. Information Processing – the use of verbal and imaginational elaboration; strategies of organizing and interrelating information; skills of comprehending, reasoning, and use of logic.
5. Motivation – desire and willingness to work hard; level of motivation and incentive for school; self-discipline.
6. Self-Testing – regular review of course materials; checks of the comprehension level attained; preparation for the lesson.
7. Selecting Main Ideas – ability to figure out the critical points and key ideas in the course materials and focus on these during studying.
8. Study Aids – good use of various aids and techniques to support learning; use of key words, examples, headings, and diagrams to help learning.
9. Time Management – create and use schedules to manage their responsibilities effectively.
10. Test Strategies – knowledge of different types of tests and the necessary preparation for them.

The internal consistency reliability coefficients (Cronbach's alpha) for subscales as reported in the manual of the LASSI are: Anxiety (α = .87), Attitude (α = .77), Concentration (α = .86), Information Processing (α = .84), Motivation (α = .84), Self-Testing (α = .84), Selecting Main Ideas (α = .89), Study Aids (α = .73), Time Management (α = .85), and Test Strategies (α = .80).

The third part contained a revised version of the Math Anxiety scale, one of nine scales constituting the Fennema-Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1976). The revised version was done by Betz (1978). Item responses were obtained on a 5-point Likert scale, ranging from 1 (strongly agree), 2 (agree), 3 (undecided), 4 (disagree) to 5 (strongly disagree). The first five items were worded negatively and the last five items were worded positively. Scoring of positively worded items was reversed so that higher scores would indicate more math anxiety. A reliability coefficient of .92 was obtained using the split-half method.

2.3 Math Assessment

The syllabus of Fundamental Mathematics A consists of six topics: 1. Number Systems; 2. Fractions, Decimals and Percentage; 3. Algebra; 4. Ratio and Proportion; 5. Sequence and Series; 6. Business Mathematics. The final score of the subject is calculated based on two components: coursework mark (40%), which is based on five topic tests and all have the same weightage, and final exam (60%), which covers all the topics. The final score of the subject is used to assess international students' math performance. The grade distribution is as follows: High Distinction (HD) (80% or above), Distinction (D) (70% to 79%), Credit (C) (60% to 69%), Pass (P) (50% to 59%) and Fail (F) (49% or below).

2.4 Data Collection Procedure

The survey was conducted during math classes one week before their semesters end. Students were briefed on the purpose of the survey and then were given an informed consent form and the questionnaire. Students completed the consent form and the questionnaire in classrooms. The final score of the subject was then obtained from student data record at the end of each semester.

2.5 Data Analysis

The collected data were then entered into the SPSS version 19. The Pearson correlation analysis was employed to investigate the relationships among math performance, self-regulated learning strategies and

math anxiety. It followed by the multiple regression analysis with the least square method to determine significant predictors of international students' math performance. The independent variables in the regression analysis are self-regulated learning strategies and math anxiety, whereas the dependent variable is the final math score. Variance inflation factor (VIF) was used to investigate multi-collinearity problem that may exist between independent variables in the multiple regression model.

3. Results

Descriptive statistics in Table 2 show that the data are normally distributed, with acceptable skewness and kurtosis values. All the LASSI subscales and math anxiety show acceptable levels of reliability, apart from information processing, study aids and time management (Table 2). The grade distribution of the mathematical subject according to geographical regions can be seen in Table 3, with the overall pass rate of 73.6%.

Table 2. Descriptive Statistics including Min.-Max., Mean, Standard Deviation, Skewness, Kurtosis and Cronbach's Alpha

Variable	Min.–Max.	M	SD	Skew.	Kurt.	Cronbach α
ANX	11–38	23.09	5.90	.36	-.06	.76
ATT	14–39	28.29	6.14	-.48	-.36	.77
CON	14–39	25.46	5.06	.07	-.24	.72
INP	19–40	27.97	4.82	.35	-.73	.69
MOT	16–40	28.68	5.04	-.01	-.33	.75
SFT	8–38	24.32	5.22	.09	.75	.70
SMI	13–40	27.74	5.42	.10	-.15	.80
STA	13–40	25.26	5.08	.26	.27	.66
TMT	15–39	25.00	4.10	.21	1.24	.67
TST	14–40	26.46	5.48	.31	.32	.78
MAT*	12–50	27.78	7.89	.27	.06	.87
FMS	3–99	62.75	23.94	-.65	-.38	–

Note: ANX = Anxiety; ATT = Attitude; CON = Concentration; INP = Information Processing; MOT = Motivation; SFT = Self-Testing; SMI = Selecting Main Ideas; STA = Study Aids; TMT = Time Management; TST = Test Strategies, MAT = Math Anxiety, FMS = Final Math Score; * A reliability coefficient of .81 was obtained using the split-half method for math anxiety.

Table 3. Grade Distribution of the Mathematical Subject according to Geographical Regions

Grade	Overall	Region					
		South Asia	Asia Pacific	Africa	Middle East	Central Asia	Others
HD	23	8	13	1	1	0	0
D	13	5	3	3	1	1	0
C	8	1	4	2	1	0	0
P	9	5	0	3	1	0	0
F	19	5	2	4	4	3	1
Total	72	24	22	13	8	4	1

The Pearson correlation results in Table 4 show that the final score of the mathematical subject is positively correlated with attitude (r = .58, p < .01), motivation (r = .24, p < .05) and test strategies (r = .38, p < .01), but negatively correlated with math anxiety (r = -.32, p < .01). Math anxiety is negatively correlated with anxiety (r = -.53, p < .01), attitude (r = -.35, p < .01), concentration (r = -.54, p < .01), motivation (r = -.30, p < .01), selecting main ideas (r = -.38, p < .01), time management (r = -.27, p < .05), and test strategies (r = -.49, p < .01). Test strategies is positively correlated with anxiety (r = .57, p < .01), attitude (r = .40, p < .01), concentration (r = .52. p < .01), motivation (r = .53, p < .01), selecting main ideas (r = .69, p < .01) and time management (r = .36, p < .01). Time management is positively correlated with concentration (r = .55, p < .01), information processing (r = .44, p < .01), motivation (r = .60, p < .01), self-testing (r = .48, p < .01), selecting main ideas (r = .44, p < .01) and study aids (r = .39, p < .01). Study aids is positively correlated with information processing (r = .46, p < .01), motivation (r = .40, p < .01) and self-testing (r = .54, p < .01). Selecting main ideas is positively correlated with anxiety (r = .48, p < .01), attitude (r = .36, p < .01), concentration (r = .54, p < .01), information processing (r = .27, p < .05) and motivation (r = .54, p < .01). Self-testing is positively correlated with concentration (r = .33, p < .01), information processing (r = .48, p < .01) and motivation (r = .40, p < .01). Motivation is positively correlated with anxiety (r = .25, p < .05), attitude (r = .35, p < .01), concentration (r = .49, p < .01) and information processing (r = .48, p < .01). Information processing is positively correlated with concentration (r = .29, p < .05). Concentration is positively correlated with anxiety (r = .46, p < .01) and attitude (r = .33, p < .01). Finally, attitude is positively correlated with anxiety (r = .29, p < .05).

Table 4. Correlations between Learning Strategies, Math Anxiety, and Final Math Score

	2	3	4	5	6	7	8	9	10	11	12
1. ANX	.29*	.46**	-.06	.25*	-.19	.48**	-.16	.12	.57**	-.53**	.19
2. ATT	1	.33**	-.02	.35**	.00	.36**	-.12	.16	.40**	-.35**	.58**
3. CON		1	.29*	.49**	.33**	.54**	.19	.55**	.52**	-.54**	.06
4. INP			1	.48**	.48**	.27*	.46**	.44**	.10	-.13	-.06
5. MOT				1	.40**	.54**	.40**	.60**	.53**	-.30**	.24*
6. SFT					1	-.05	.54**	.48**	-.10	-.07	-.15
7. SMI						1	-.04	.44**	.69**	-.38**	.15
8. STA							1	.39**	.01	-.20	-.07
9. TMT								1	.36**	-.27*	-.04
10. TST									1	-.49**	.38**
11. MAT										1	-.32**
12. FMS											1

* Correlation is significant at the .05 level; ** Correlation is significant at the .01 level.

The result of the regression analysis in Table 5 shows that attitude and test strategies are significant predictors of the final math score for international students (R^2 = .483, adjusted R^2 = .389, F(11, 60) = 5.102, p < .01). As the R^2 suggests, 48.3% of variance in math performance of international students are explained by the predictors in the model. F statistics further indicates that the model is significant. The multiple-collinearity may exist in the model as the Pearson correlation results in Table 4 shown that some predictors are strongly correlated. The result of VIF's confirmed that no multiple-collinearity problem exists in the model with all VIF's being less than 5.

Table 5. Unstandardized and Standardized Coefficients for Regression Model Predicting Final Math Score and VIF Values

Variable	B	SE	Beta	t	p	VIF
ANX	-.47	.54	-.12	-.87	.388	2.12
ATT	1.88	.43	.49	4.40	.000**	1.42
CON	-.90	.70	-.19	-1.28	.204	2.52
INP	.07	.60	.01	.12	.907	1.74
MOT	1.00	.74	.21	1.35	.181	2.87
SFT	-.53	.65	-.12	-.81	.422	2.34
SMI	-1.14	.67	-.26	-1.70	.094	2.80
STA	-.17	.60	-.04	-.28	.780	2.00
TMT	-.67	.79	-.12	-.85	.400	2.17
TST	1.44	.67	.34	2.15	.035*	2.86
MAT	-.71	.41	-.23	-1.74	.088	1.99

Note: B = Unstandardized coefficient, Beta = Standardized coefficient;
* Significant at the 0.05 level; ** Significant at the 0.01 level

4. Discussion

There are three concerns in the classes of Fundamental Mathematics A before this research study is carried out. First of all, it is about the assessment format of the subject, which is very exam-orientated in which students are assessed by topic tests in classrooms and the final exam at the end of semester. Thereby to achieve a better grade in the subject, students have to have good and effective strategies while learning math. For some international students, they find the assessment format is difficult to cope. Secondly, the increase in the number of international students from different countries in the program in the recent years makes classes very diversified in the aspects of cultural and educational backgrounds. The widely diversified backgrounds certainly poise a tremendous challenge to math instructors to engage students in their learning as their ways of learning math are different from home students. Finally, the phenomenon that was observed by myself during a topic test of the subject. Few minutes before the test started, an international student's head was facing down and both his hands were shaking, even though the test only involving the use of addition, subtraction, multiplication and division operations. This is a physical symptom of math anxiety. Although other international students do not exhibit any symptoms of math anxiety, it does not mean they do not have anxiety towards math.

Thereby, a research study is conducted to better understand the influence of learning strategies and math anxiety on math performance for international students in the pre-university program. Subsequently, measures to be taken by instructors and the department of the pre-university program to ensure that international students have a smooth and successful transition from secondary schools to university.

It is a common practice to examine the relationships between one dependent variable and independent variables before one can formulate a model to predict the dependent variable based on the independent variables. The correlation result suggests that international students' performance in math is significantly and positively correlated with attitude. This result is consistent with previous literature on academic performance of general student populations (Yip & Chung, 2005; Crede & Kuncel, 2008; Kamariah Abu Bakar et al., 2010). However, attitude was not found to be significantly correlated with math performance in MacNamara and Penner's (2005) study and also with academic performance of international students in Stoynoff's (1997) study. Motivation is also significantly and positively correlated with pre-university math performance, which is

in accordance with a number of studies on academic performance of general student populations (Yip & Chung, 2005; Reaser et al., 2007; Crede & Kuncel, 2008), a study on international students' academic performance (Stoynoff, 1997) and several studies on math performance of general student populations (Belcheir, 2002; MacNamara & Penner, 2005; Wadsworth et al., 2007). Pre-university math performance is significantly and positively correlated with test strategies. The positive effect of test strategies was also found in studies on general student populations' academic performance (Yip & Chung, 2005; Crede & Kuncel, 2008) and Stoynoff's (1997) study on international students' academic performance. However, the use of test strategies did not appear to be significantly correlated with math performance in MacNamara and Penner's (2005) study. Finally, math anxiety is significantly and negatively correlated with math performance in the pre-university program, which is in accordance with numerous studies on general student populations (Hembree, 1990; Ashcraft, 2002; Legg & Locker, 2009) and cross-cultural studies (Engelhard, 2001; Lee, 2009).

The comparison between this study and the past studies on the correlations between learning strategies and math performance discussed above can be summarized as the findings of the previous studies on math performance of general student populations and international students and the past studies on math performance of general student populations are partially consistent with this study's findings. One possible explanation is the participants in this research study are pre-university students who are still dependent on instructors in learning and their cultural and educational backgrounds are widely diversified as compared to those previous studies the participants are undergraduates who are more homogeneous in the aspects of cultural and educational backgrounds, apart from Yip and Chung's (2005) study on matriculation students and Stoynoff's (1997) study on international students. On the other hand, anxiety towards math is a world phenomenon regardless of students' cultural and educational backgrounds and levels of mathematical subjects taken.

The significant inter-connected relationships between learning strategies and math anxiety are observed in this research study, with the relationship between selecting main ideas and test strategies to be the strongest one. The strong relationships between learning strategies and math anxiety (or multi-collinearity) create a challenge to this study in the attempt to formulate a regression model to predict math performance. A further analysis on the effect of multi-collinearity indicates that its effect is not significant and can be ignored. The result of the correlations between learning strategies and math anxiety suggests a study to be carried out in the future to ascertain the inter-connected relationships.

The regression analysis suggests that attitude and test strategies are significant and positive predictors of international students' math performance in the program. Both attitude and test strategies were found to be two of significant predictors of matriculation students' academic performance in Yip and Chung's (2005) study. However, both attitude and test strategies were not found to be significant predictors in several past studies on math performance of general student populations (Belcheir, 2002; Wadsworth et al., 2007). Only the test strategies subscale was found to be a positive and significant predictor of international students' academic performance in Stoynoff's (1997) study. The result of this analysis provides an important message to instructors of this mathematical subject and the pre-university program as a whole. If international students exhibit negative attitude towards academic tasks given in classrooms or they do not possess good test taking strategies, math instructors should take immediate action to advise these students accordingly. The department of the pre-university program should get support from the International Office for counseling assistance to overcome the problem related to attitude towards academic tasks. On the other hand, test strategies can be taught to those who are weak at. Perhaps, a supportive training should be provided to those who are lacking in test taking strategies in math. The training is very important to international students as the mathematical subject is exam-orientated.

Although the results of this study contribute significantly to the teaching and learning of the subject, we should bear in mind that the results cannot be applied on the other two mathematical subjects whose levels are higher than this subject. Another limitation of this study is the sample size, which is relatively small. And also, the number of international students is not distributed evenly across geographical regions and

educational backgrounds. The shortcomings limit a chance to carry out a further study to compare math performance of international students from different geographical regions and between different educational backgrounds. Perhaps, in the future, when the total number of international students is increased, it will provide a better chance to compare their math performance between different cultural and educational backgrounds.

Math performance of international students in the pre-university program is complex and not completely understood. The learning strategies and math anxiety in this regression model only explain 48.3% of the variation of pre-university math performance. This implies that 51.7% of the variation of math performance is explained by other factors, which are not included in this research study. A further study on international students may include other factors such as English-language proficiency, communication between compatriots, social communication with the locals and communication between math instructors and students.

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