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A COMPARATIVE STUDY ON THE EFFECT OF STUDENTS RELATED FACTORS (SELF-CONFIDENCE, ATTITUDE AND FAMILY BACKGROUND) ON SCIENCE ACHIEVEMENT OF MALAYSIAN & SINGAPOREAN STUDENTS

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Abstract. This study is a cross-national comparative study to assess the effects of student related factor (students' self-confidence in learning science, attitude toward science, family background and being safe in school) on science achievement of students of Malaysia and Singapore. A total of 5314 eighth-grade students (3071 girls and 2243 boys) from Malaysia and 6018 students (2938 girls and 3080 boys) from Singapore who participated in Trends in International Mathematics and Science Study (TIMSS) 2003 were studied. The Principal Component Analysis (PCA) was performed to examine the underlying constructs among the Students' Questionnaire items. Subsequently, Multiple Regression technique was employed to explain the variance of science achievement. The results of (PCA) showed 23 items from the questionnaire distributed among six factors for both sets of the data. The results of (PCA) showed 23 items from the questionnaire distributed among six factors for both sets of the data. The regression results revealed that 26% of the variance of science achievement of Malaysian students were accounted for by the selected factors. In addition, 33% of the variance of science achievement of Singaporean contributed by the selected factors.

Keywords: Achievement; attitude; factors; family background; self-confidence; science; TIMSS

1.0 INTRODUCTION

The Trends in International Mathematics and Science Study (TIMSS) which was previously known as Third International Mathematics and Science Study is the largest and most ambitious international comparative assessment of student achievement initiated by the International Association for Evaluation of Educational Achievement (IEA) (Beaton, Martin, *et al.,* 1996). TIMSS assesses students' achievement in mathematics and science at fourth and eighth-grade and

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collects a rich array of background information to address school resources, school climate and the quality of curriculum and instruction, conducted every four years on a regular cycle (Mullis, *et al.*, 2005).

Malaysia and Singapore are two participating countries in the TIMSS studies. Malaysia joined the TIMSS since 1999 only at eighth-grade, while Singapore did in 1995 at fourth and eighth-grade. Malaysia is 470 times larger than Singapore in terms of country area. Its population is 6 times more than Singapore, where 32 percent of them are living in rural areas. In contrast, the whole population of Singapore is urbanite. In contrast, population density of Singapore is 81 times of Malaysia (Martin, Mullis, & Foy, 2008).

In spite of these differences, there are several similarities between educational systems of these two countries. For instance, the educational systems in both countries are centralized. Educational structures and school admission age in both countries almost are the same (Gary, *et al.*, 2008; Hamidah, 2008). The instructional time for science at lower secondary school in Malaysia is 3 hours and 20 minutes and it ranges from 3 to 3 hours and 30 minutes in Singapore (Gary, *et al.*,., 2008; Hamidah, 2008; Quek, *et al.*, 2008). Student in both countries requires sitting for national exam at the end of primary school (Azina Ismail & Awang, 2009).

Malaysia and Singapore are multiethnic and multilingual countries. In both countries there are four languages namely: bahasa Malaysia, Chinese (Mandarin), Tamil, and English. In Malaysia at primary school the medium of instruction is different and it could be bahasa Malaysia, Chinese, or Tamil. However, at secondary school bahasa Malaysia remains the medium of instruction. Though, since 2003, English has been the language of instruction for mathematics and science. Eventually, it changed to bahasa Malaysia in July 2009. Similarly, there are all the mentioned languages in Singapore but English is the language of instruction (Gary, *et al.*, 2008; Hamidah, 2008; Quek, *et al.*, 2008).

Findings show that Singapore often was the top performing country in science and mathematics over the past four successive studies of TIMSS (1995 to 2007). For example, it stood at the first place in science among 38, 45 and 48 participating countries around the world in 1995, 2003 and 2007. In contrast, Malaysia stood at 22th, 20th and 21th in these studies at that order (Beaton, Martin, *et al.*, 1996; Beaton, Mullis, *et al.*, 1996; Martin, *et al.*, 1997; Martin, *et al.*, 2008; Martin, Mullis, Gonzalez, & Chrostowski, 2004; Martin, *et al.*, 2000; Mullis, *et al.*, 1997; Mullis, Martin, & Foy, 2008; Mullis, Martin, Gonzalez, & Chrostowski, 2004; Mullis, *et al.*, 2000).

Table 1 indicates the superiority of Singaporean students over Malaysian in science as overall subject and in the all science content areas as well in TIMSS 1999 and 2003. The difference between science achievement of Malaysian and Singaporean students, overall in both studies on average is 72 points.

The influential variables on students' academic achievement vary among different groups (e.g., male and female, urban and rural) as well as across countries. Despite of several similarities in educational system, language and culture characteristics between these two countries, there is a vast difference in students' achievement based on TIMSS studies. The present study was designed to explore the effects of a number of students-related factors on their science achievement across these two countries.

Table 1 Science achievement of Malaysia and Singapore eighth-grade students

Content Areas	TIMSS	Singapore	Malaysia	Differences
Science as overall subject	1999	568	492	76
	2003	578	510	68
Life Science	1999	541	479	62
	2003	569	504	65
Chemistry	1999	545	485	60
	2003	582	514	68
Physics	1999	570	494	76
	2003	579	519	60
Earth Science	1999	521	491	30
	2003	549	502	47
Environmental Science	1999	577	502	75
	2003	568	513	55

Source :(Martin *et al*, 2000; Martin *et al*, 2004)

2.0 OBJECTIVES OF THE STUDY

Research evidences show a wide variety of factors are correlated with students' achievement. Generally, these factors can be classified into two broad categories. Firstly, factors those are relevant to students (e.g., student characteristics). Secondly, factors pertaining to classroom and school (e.g., teacher characteristics, school climate). This study focused on assessment of the effects of a number of students' related factors on science achievement of Malaysian and Singaporean. Particularly, the following objectives addressed here are:

(1) To assess the effects of students' self-concept in learning science, students' attitude toward science, science valuing, parents' level of education, home educational resources, being safe in school, students'

aspiration, speaking the language of the test at home, books ownership at home on science achievement.

(2) To compare the effects of the above mentioned factors on students' science achievement between Malaysia and Singapore and to find out similarities and differences in this regard.

3.0 THEORETICAL FRAMEWORK

Shavelosn *et al.* (1987) developed one of the important models (Figure 1) of school effects research that explicitly describes educational system. They acknowledged that monitoring a system requires some indicators which they should be derived from a sound conceptual model of how that system actually works. Shavelson *et al.* (1991) defined the term of indicator as a "statistic". Johnstone (1981) made a distinction between indicator and variable; however, in this study these two expressions and the term of factor as well have been used interchangeably. The model contains (a) inputs i.e., the human and financial resources available to the educational system, (b) processes, i.e., what is taught and how is taught, and (c) outputs, i.e., the consequences of schooling for students from different backgrounds (Shavelosn, McDonnell, Oakes, Carey, & Picus, 1987; Shavelson, McDonnell, & Oakes, 1991). This model identified important features of educational system that can be served as key indicators of the system.

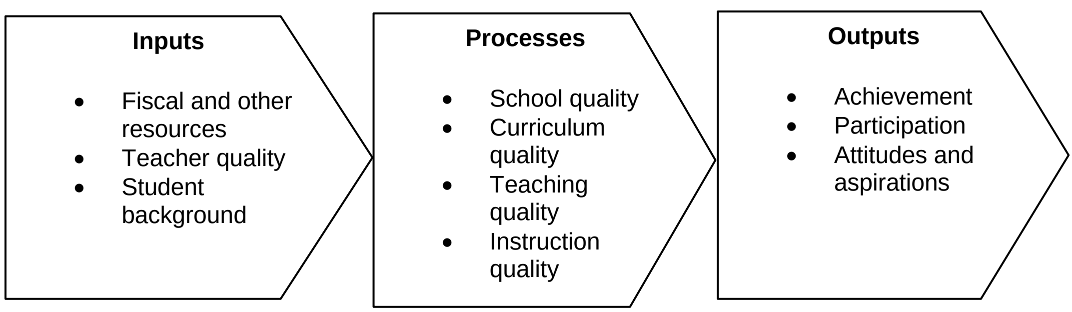

Figure 1 Basic model of educational system

Figure 1 indicates that there are many different variables at inputs and processes stages of the system which affect the educational outputs. Considering all or even most of these variables in a study may not be possible. Thus, the present study focused only on a number of students-related factors as mentioned in the objectives section.

4.0 LITERATURE REVIEW

The literature shows that students' science achievement may be influenced by students' attitude toward science, students' self-concept in learning science, parents' level of education, home educational resources, students' aspiration to go to university (Azina Ismail & Awang, 2007; Beaton, Martin, *et al.*, 1996; Kiamanesh, 2004; Martin, *et al.*, 2008; Martin, *et al.*, 2004; Martin, *et al.*, 2000; Mettas, Karmiotis, & Christoforou, 2005; Mohammadpour, Moradi, & Najib Abdul Ghafar, 2009; Mokshein, 2002). The TIMSS findings internationally, indicate that more than 80% of eighth-grade students in some participating countries reported that they liked science. This index is 99% among Singaporean (Beaton, Martin, *et al.*, 1996). Research shows that a great percentage of Malaysian students displayed a high level of positive attitude toward science (Martin, *et al.*, 2000).

TIMSS findings confirmed that the trend of expressing positive attitude toward science among eighth-grade students of Malaysia and Singapore and some other countries (e.g., Slovenia, the Czech Republic, England, Iran, Thailand, Hong Kong SAR, the United States, and Chinese Taipei) has declined from TIMSS 1999 to 2003 (Martin, *et al.*, 2008). Internationally, findings indicated that there is a positive association between eighth-grade students' self-concept in learning science and science achievement. However, relation between these two variables at the country level is more complex (Beaton, Martin, *et al.*, 1996). In particular, relatively a low percentage of students (21 percent or less) in several countries (e.g., Singapore, Japan, Hong Kong, Chinese Taipei, and Korea) which usually have been the top performing countries, estimated their self-concept in science at the high level of the scale (Martin, *et al.*, 2004; Martin, *et al.*, 2000).

Researchers compared science achievement among Japanese and Singaporean eighth-grade students based on TIMSS 1999 and pointed out that a higher percentage of Singaporean than Japanese indicated that they like science (91.9% compared to 56.1%). Japanese students spent less than one hour per day outside of school for studying or doing homework in science, while Singaporean spent between one to two hours. Only about 13% of Singaporean students stated that they spend their time outside of school for extra lessons, whereas nearly 50% of Japanese students reported that they do (Aun, Riley, Atputhasamy, & Subramaniam, 2006). Mokshein (2002) based on TIMSS 1999 found that self-concept in learning science, awareness of social implications of science, gender and home educational resources are significantly related to Malaysian students' science achievement but students' attitude toward science and parents' level of education were not. Kiamanesh (2004) found that science self-concept, view of science in the world, home background, attribution or belief and external motivation had significant influence on Iranian students' science achievement at eighth-grade and the two factors of students' attitude toward science and home-school interface did not have a significant contribution. Researchers indicate that students' self-beliefs and attitude are significantly related to science achievement (Martin, 2005). Mohammadpour *et al* (2009) using multilevel modeling found that students' self-concept in learning mathematics as a student level variable explained 11% of the variance of mathematics of Singaporean eight-grade students, which is the most effective factor among other student level factors.

Research findings indicate that there is a strong positive relationship between students' science achievement and availability of educational resource at home (a dictionary, a study desk for their own use, and a computer) in TIMSS participating countries (Beaton, Martin, *et al.*, 1996; Martin, *et al.*, 2008; Martin, *et al.*, 2004; Martin, *et al.*, 2000). There is a positive relationship between parents' level of education and students' science achievement at eighth-grade (Beaton, Martin, *et al.*, 1996; Davis-Kean, 2005; Feinstein, Duckworth, & Sabates, 2004; Martin, *et al.*, 2000; Nordtveit, 2005). Research findings show that in most countries, students who come from home where there are more books, achieved a higher score in science (Beaton, Martin, *et al.*, 1996; Martin, *et al.*, 2008; Martin, *et al.*, 2004). TIMSS findings internationally indicate that students who always and almost always speak the language of the test at home had a higher average in mathematics than those who speak it less frequently (Mullis, *et al.*, 2004). Researcher based on TIMSS 2003 in South Africa concluded that students who always and almost always speak the language of the test at home attained a higher score in mathematics test than those who never speak the language of the test at home (Howie, 2005). However, other researchers using TIMSS 2003 data sets pointed out that Malaysian students who always or almost always speak the language of the test at home performed a lower score in mathematics than those who sometimes or never speak it (Azina Ismail & Awang, 2007). A review of the literature reveals that a growing body of empirical research indicates that a positive school climate conceived by student is associated with academic achievement (Cohen, McCabe, Michelli, & Pickeral, 2009).

5.0 PARTICIPANTS

The data for the present study were obtained from 5314 eighth-grade students (3071 girls and 2243 boys) from Malaysia and 6018 students (2938 girls and 3080 boys) from Singapore with a mean of 14.3 years old for both countries who participated in TIMSS 2003. The TIMSS study centre in TIMSS 2003 (1995, 1999 as well) used a two stage stratified cluster sampling design. At the first stage, schools sampled with probability proportional to size (PPS). Subsequently, within each sampled school, all eight-grade classes were listed and then one intact class was selected using a systematic random method. However, Singapore was an exception among other participants, where at the third stage students were sampled randomly among eighth-grade classes. It is worth to mention that, finally the unit of sample was student and not class for all countries (Martin, Gregory & Stemler, 2000; Martin, Mullis & Chrostowski, 2004; Olson *et al.*, 2008).

6.0 VARIABLES

Dependent variable, TIMSS used science test to assess students' achievement. This test yielded four types of scores for individual of students (1) raw scores (2) standardized scores (3) national Rasch scores and (4) a set plausible values or multiple imputation scores. TIMSS used a large number of items (189 items) to coverage the content of science. Indeed, it was not possible to implement all the items for individual students. Thus, the items assembled into 14 different booklets and each student only answered to one booklet which included a small portion of the items. Consequently, Item Response Theory (IRT[3]) scaling was used to describe students' achievement in the test (Olson, Martin, & Mullis, 2008). A plausible value in fact, is an estimate of how a student might have performed if s/he has been administered to entire of the items. TIMSS estimated five plausible values for individual students based on their response to a portion of the items. The raw scores computed based on the students' score on individual items. Since, students answered different items; the item difficulty is not comparable among the students. As a result, using the raw scores is not reliable for comparison purpose. However, the raw scores standardized to a score with mean 50 and standard deviation 10 within each country because comparison among student based on standardized scores still is not much reliable. The national Rasch scores were standardized to have a mean score of 150 and a standard deviation 10 within each country. Because each country has the same mean score and dispersion, these scores are not useful for cross-country comparison. The plausible values for any given scale are the best available measures of student achievement on that scale in

[3] Item Response Theory is a theory in testing situations suppose that examinee performance on a test can be predicted by defining examinee's characteristics referred to as trait or ability estimating scores for examinees on these traits and using the scores to predict or explain item and test performance (Hambelton & Swaminathan,1985)

TIMSS database, and it should be used as the outcome variable in any study of student achievement (Foy & Olson, 2009). Hence, in the present study a set of five plausible values averaged for individual students and served as dependent variable. It is worth mentioning that the five plausible values ranged from the highest 509.47 to 509.83 for Malaysian and 574.24 to 573.62 for Singaporean and the differences among these two sets of scores were .63. The differences among the plausible values can be interpreted as an index of reliability. The less differences the more reliable the plausible values are and it was satisfied in this study (Wu, 2005).

Independent variables, TIMSS also used Students' Questionnaire to collect comprehensive information about students' characteristics, their family background and their experiences in learning science as well as mathematics. In this study six composition factors (described at data analysis section, step3) which are students' self-concept in learning science, attitude toward science, science valuing, home educational resources, parents' level of education and being safe in school resulted of PCA and also three single variables of number of books at students' home, speaking the language of the test and students' aspiration to go to university were used as independent variable to explain the variation of science achievement. All these composition factors and single variables as well with their properties including factors name, items, scales, factors loadings and the reliability indices for composition factors presented in (Appendix A).

7.0 DATA ANALYSIS

In this study in total, four steps were followed for the data analysis:

Step 1. First, to select a number of items from the Students' Questionnaire, correlation matrices were made among the questionnaire items for the two countries separately.

Step 2. Explanatory Data Analysis (EDA) was carried out to examine the basic assumptions underlying principal components analysis and multiple regression analysis and assessing missing data pattern among the data sets. Sufficient sample size, normality, linearity, absence of outliers among cases, absence of multicolinearity and singularity among variables are the important assumptions of PCA and multiple regression (Coakes, 2005; Fild, 2009; Ho, 2006; Meyers *et al.*, 2007; Tabachnik & Fidell, 2007). Basically, factor analysis is one of the large-sample sized statistical technique (Meyers *et al.*, 2007). Comrey & Lee (1992) provided as a guide sample sizes of 50 as very poor, 100 as poor, 200 as fair, 300 as good, 500 as very good, and 1000 as excellent. Tabachnik & Fidell (2007) give a general rule of thumb in this regard; it is comforting to have at least 300 cases for factor analysis. The assumption of sufficient sample size is a matter of research design and there is no statistical test to check it. The sample sizes of this study were far larger than the mentioned criteria. A probability plot (Q-Q plot) was used to check the dependent (predicted) variable for the assumption of normality distribution (Appendix C). The graphs were approximately linear, indicating that there were no serious departure from a normal distributions and the assumption of normality of the dependent variables in both data sets were tenable. The Mahalanobis test was used to check absence of outliers among cases. In both data sets ($p<.001$) and it was concluded that there were no multivariate outliers in the plausible values in both data sets which averaged and used as dependent variable.

8.0 MISSING DATA

Tabachnik & Fidell (2007) regarding to the size of missing data, pointed out that if only a few data (i.e., *5%* or less) are missing in a random from a large data set, the problem is less serious and almost any procedure for handling missing values either deletion methods (list wise or case wise) or imputation methods (mean substitution, regression estimation, expectation maximization and multiple imputation) for detail see (Allison, 2002; Cool, 2000; Dow & Eff, 2009; Enders, 2010; Longford, 2008; Peng, Harwell, Liou, & Ehman, 2007; Peugh & Enders, 2004; Tabachnik & Fidell, 2007) yields similar results. Hence in this study Expectation Maximization (EM) was used to handle missing data. However, the sizes of missing in the data sets were far less than the size suggested by Tabachnik & Fidell (2007).

9.0 WEIGHTING VARIABLE

As described in section of participants, TIMSS used a multistage cluster sampling design rather than simple random sampling. Unlike simple random sampling, in multistage cluster sampling designs the probability of selection of unites are unequal. In such cases sampling weight issue must be taken into account to avoid bias in parameters estimates (Dargatz & Hill, 1996; Rabe-Hesketh & Skrondal, 2006; Rutkowski, Gonzalez, Joncas & von Davier, 2010; Thomas & Heck, 2001; Willms & Smith, 2005). To avoid the problem of bias in parameters estimates, TIMSS computes several weighting variables that they should be considered by the analysts (Foy & Olson, 2009, PP.104-106; Martin, 2005, PP.2-45 to 2-49; Rutkowski, Gonzalez, Joncas & von Davier, 2010). One of these weighting variables is student house weight which it is recommended for cross-country studies (Foy & Olson, 2009; Gonzalez, Joncas & von Davier, 2010). Thus, the data were weighted using students' house weight before proceeding with the analysis.

Step 3. The dimensionality of 23 items from the Students' Questionnaire was analyzed using Principal Components Analysis (PCA). Two criteria of eigenvalue and the Scree Plot tool were used to determine the number of factors. Based upon eigenvalues equal to one or above and Scree Plot, six factors rotated, using Varimax rotation procedure (Appendix A). The results showed that the Bartlett's test of sphericity was significant and the Kaiser-Mayer-Oklin (KMO) measure of sampling yielded (.61 and .64) for Malaysia and Singapore data sets respectively. The Bartlett's test of sphricity in measure of Chi-squire yielded 2990.85 and 4145.68 for Malaysia and Singapore correspondingly. The values of Chi-squares were statistically significant ($p<.001$) for both countries, thus, the null hypotheses that assumed the correlation matrices are an identity matrix were rejected. Authors have mentioned that the KMOs statistics value greater than .6 is acceptable (Field, 2009; Hutcheson & Sofroniou, 1999; Kaiser, 1974; Koakes, 2005). So, it was concluded that the factor analysis was an appropriate procedure to analyze the data.

Appendix A is shows the factor lodging for both groups of students. It ranges from .909 to .495 for Malaysian and .896 to .484 for Singaporean students. Tabachnik & Fidell (2007) highlighted that "as a rule of thumb, only variables with loadings of .32 and above are interpreted", p.649. Thus, all the factor loadings in the present study have met the criteria. It also shows the reliability coefficients for the all the items that clustered under the corresponding factors and they are ranging from .786 to .455 for Malaysia and .822 to .426 Singapore.

Step 4. After construction the factors, two correlation matrices between the independents and the dependent variables were made to assess the relationships between predictors and predicted variable for the two sets of data separately (Appendix B).

Table 1 in Appendix B indicates that correlation between the independents and dependent variable of Malaysian data. It ranges from the high .342 for number of books at the students' home to .120 being safe in school. Whereas, the correlation among predictors except for self-concept, science valuing, and some cases of students' aspiration to go to university is low. The low correlation among independents indicates that multicollinearity is not a problem for this set of data.

Similar to that of Malaysia, Table 2 in Appendix B indicates that correlation between the independents and dependent variable for Singaporean students is relatively high. It ranges from .399 for number of books at the students' home to .139 for being safe in school. While, the correlation among independents except for self-concept, science valuing is not high. Similar to Malaysian data, it showed that multicollinearity is not a problem for this set of data as well.

Step 5. Finally, in order to assess the effects of selected factors on the variance of science achievement, all the factors introduced into the multiple regression model simultaneously.

10.0 RESULTS AND DISCUSSION

Table 2 indicates that slightly above one fourth of the variance of science achievement of Malaysian students explained for by the predictors, R^2 =.26, f (10, 4983) = 177.670, p<.001. The standardized beta values for the predictors are displayed in Table 3.

Table 2 Multiple regression, predicting science achievement of Malaysian students

Model	R	R Squared	Adjusted R Squared	Std. Error	
	.513	.263	.261	54.10430	
	Sum of Square	**df**	**Mean Square**	**F**	**Sig**
Regression	5200898.678	10	520089.868	177.670	.000
Residual	14586611.573	4983	2927.275		
Total	19787510.251	4993			

Table 3 Regression coefficients of predictor factors for Malaysia data

Model	Standardized Coefficients	t	sig
Books in home	.196	14.498	.000
Language of test	.166	13.449	.000
Science valuing	-.142	-8.222	.000
Parents' level of education	.131	9.843	.000
Being safe in school	.111	9.087	.000
Self-confidence in science	-.086	-5.799	.000
Home educational resources	-.083	-6.200	.000
Attitude toward science	-.077	-4.162	.000
Student's educational aspirations	.066	4.916	.000

Table 3 represents the regression standardized coefficients of predictor factors and their corresponding levels of significance. It was shown that the effects of all the predictors were statistically significant ($p<0.001$). The number of books at students' home had the highest effect in explanation of variance of science achievement. Specifically, increasing one unit in books ownership corresponds with .196 increases in science achievement. The language spoken at home was the second factor. It suggested that one unit increase in speaking the language of the test at home (increasing the codes from 1 to 2 for example (as presented in Appendix A) was associated with .166 in science achievement. Science valuing, self-concept in learning science, attitude toward science and home educational resources were negatively associated with science achievement. Specifically, decreasing one unit in measure of science valuing, self-concept in learning science and attitude toward science were associated with amounts of -.142, -.086 and -.077 decrease in science achievement in that order. In addition, lack of each item of home educational resources were correlated with -.083 decrease in science achievement. In contrast, increasing parents' level of education, being safe in school and students' educational aspirations were positively correlated with increase in science achievement by.131, .111 and .066 in that order.

Table 4 reveals that closely one third of the variance of science achievement of Singaporean students' accounted for by the predictors, R^2 =.33, f (10, 5784)= 283.908, p<.001.

Table 4 Multiple regression, predicting science achievement of Singaporean students

Model	R	R Squared	Adjusted R Squared	Std. Error	
	.574	.329	.328	71.115	
	Sum of Square	**df**	**Mean Square**	**F**	**Sig**
Regression	14358284.011	10	1435828.401	283.908	.000
Residual	29251805.951	5784	5057.366		
Total	43610089.962	5794			

Table 5 displays the regression standardized coefficients of predictors for Singapore data. The effects of the first eight predictors on the variance of science achievement were statistically significant $p<0.001$., while that of students' attitude toward science was not. Similar to Malaysians' regression model, the number of books at students' home had the highest effect on science achievement. Meaning that, increasing in books ownership at home was associated with increase in science achievement by .230. Also, increasing in parents' level of education, students' aspiration and being safe in school were associated to increase in science achievement by .140, .129 and .111 in that order. In contrast, decreasing in science valuing, self-concept in learning science, home educational resources and speaking the language of the test at home were negatively associated with decrease in science achievement by (-.168, -.068, -.128 and -.080) respectively.

Table 5 Regression coefficients of predictor factors for Singapore data

Model	Standardized Coefficients	t	sig
Books in home	.230	19.250	.000
Science valuing	-.168	-11.130	.000
Parents' level of education	.140	12.100	.000
Student's educational aspirations	.129	10.739	.000
Home educational resources	-.128	-11.591	.000
Being safe in school	.111	10.248	.000
Language of test	-.080	-6.751	.000
Self-confidence in science	-.068	-4.690	.000
Attitude toward science	-.025	-1.399	.162

11.0 CONCLUSION

Notwithstanding a number of differences between Malaysia and Singapore in terms of population size, area of the country, density of population, per capita income, there are close similarities regarding population structure (e.g., ethnic groups, languages) and educational system such as structure, schooling admission age, instructional time allocated to science at secondary school.

The information of Table 1 shows that there is a big difference in science achievement of Malaysia and Singapore eighth-grade students over TIMSS 1999 and 2003. To provide answers for proposed research objectives a number of student-related factors were explored.

The findings showed that the selected factors overall explained a higher percentage of the variance of science achievement of Singaporean than Malaysian (Tables 2 and 4). It indicates that the predictor variables were more affective for Singapore data. Ownership of books at home can be an indicator of home environment and academic support and reflecting the parents' level of education, their occupation and the value they placed for education is the strongest factor to explain the variance of science achievement of students in both countries. That is, the more books at home the higher science achievement. However, its coefficient was higher for Singaporean than that of Malaysian. This finding is consistent with the international findings of TIMSS by (Beaton, Martin *et al.*, 1996; Martin *et al.*, 2008; Martin *et al.*, 2004).

A remarkable difference was found in the effect of speaking the language of the test at home between Malaysian and Singaporean students. As exhibited in Appendix B (Tables 1 and 2), correlation between speaking the language of the test at home and science achievement is positive in Malaysian data set, while it is negative for Singaporean. The same direction found in regression models (Tables 3 and 5). Since, this single variable, coded as a categorical scale (Appendix A), the result shows increasing in the codes (1 to 2, 2 to 3 and 3 to 4) which are representing four categories of frequently speaking the language of the test is associated with increase in science achievement for Malaysian. While, it is reversed for Singaporean. Specifically, students who always speak Malay at home achieved worse in science than those who almost always, sometimes and never speak it. On the contrary, students who never speak Malay at home performed better in science achievement. Whereas, Singaporean who always speak the language of the test (English) performed better than those who almost always, sometimes and never speak it. In addition, the coefficient of this factor for Malaysian is greater than two times of Singaporean. That is, the differences between Malaysian students who always, almost always, sometimes and never speaking the language of the test are far more than that of Singaporean. It is different from the TIMSS findings internationally Mullis *et al.*, 2004) and also research finding by Howie (2005) and on the other hand it confirm findings by Azina Ismail & Awang, 2007)

The attitudinal factors including science valuing, self-concept in learning science and attitude toward science are negatively associated with science achievement of both students groups. The effects of these factors are relatively similar in both regression models. Though, attitude toward science was not statistically significant for Singaporean. In addition, home educational resources are also negatively correlated with science achievement in both models. However, the effect of this factor is stronger for Singaporean than Malaysian. The three factors of parents' level of education, students' aspiration to go to university and being safe in school are positively associated with science achievement for both students groups. Among these three factors, students' aspiration to go to university is more effective for Singaporean than Malaysian, but the other two are similar.

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APPENDIX A Factors and indicator variables, factor loadings and their reliability coefficients

Factors	**Items**	**Malaysia**			**Singapore**			**Scale**
		Missing	Factor Loading	Reliability	Missing	Factor Loading	Reliability	
Attitude toward science	I enjoy learning science	1.6%	.858	.742	1.3	.877	.822	TIMSS coding maintained based on a 4 point Likert scale: 1= Agree a lot; 2= Agree a little; 3= Disagree a little; 4= Disagree a lot
	I would like a job involve using science	.2	.800		.2	.814		
	I would like to take more science in school	.2	.790		.2	.895		
Students' self-confidence in learning science	I usually do well in science	.2	.741	.660	.1	.844	.822	TIMSS coding maintained based on a 4-point Likert scale: 1= Agree a lot; 2= Agree a little; 3= Disagree a little; 4= Disagree a lot (Science is not one of my strengths and Science is more difficult for me reverse coded)
	I learn things quickly in science	.2	.730		.2	.812		
	Science is not one of my strengths	.2	.675		.2	.816		
	Science is more difficult for me	.3	.677		.2	.763		
Students Valuing Science	learning science will help me in my daily life	.1	.733	.754	.1	.791	.781	TIMSS coding maintained based on a 4-point Likert scale: 1= Agree a lot; 2= Agree a little; 3= Disagree a little; 4= Disagree a lot
	I need science to learn other school subjects	.1	.674		.2	.775		
	I need to do well in science to get into the	.2	.814		.2	.803		

	university							
	I need to do well in science to get the job I want	.1	.810		.2	.761		
Students' Perception of Being Safe in School	I was hit or hurt by other student(s)	.4	.699	.455	.2	.725	.489	TIMSS coding maintained based on a two point scale: 1= Yes, 2= No
	Something of mine was stolen	.2	697		.2	.689		
	I was left out of activities by other students	.5	.593		.2	.595		
Parental education	What is the highest level of education of your mother (or stepmother or female guardian)?	.2	.909	.786	.4	.896	.748	TIMSS coding maintained based on students' responses to: 1 = Some primary education, Lower secondary education or did not go to schoo;2= Lower secondary; 3 = Upper secondary; 4 = Postsecondary; 5 = Diploma; 6 = First degree, 7 = Beyond first degree; 8 = I don't know (I don't know recoded to zero)
	What is the highest level of education of your father (or stepfather or male guardian)?	.2	.909		.3	.896		
Home	having a calculator	.3	.647	.458	.6	.690	.426	TIMSS coding

educational resources	having a computer	.5	.583		.1	.484		remained based on a two point scale: 1= Yes; 2= No
	having a study desk	.3	.540		.1	.521		
	having a dictionary	.2	.507		.2	.710		
Books in the home	About how many books are there in your home	TIMSS coding maintained *based on answers to a single-item:* 1= None or very few (0-10 books); 2= Enough to fill one shelf (11-25 books); 3= Enough to fill one bookcase (26-100 books); 4= Enough to fill two bookcases (101-200 books); 5= Enough to fill three or more bookcases (more than 200 books) Missing in both data sets was equal= .1						
Language of test	How often do you speak language of test at home	TIMSS coding maintained *based on answers to a single-item: 1=* Always; 2= Almost always; 3= Sometimes; 4= Never Missing in Malaysian data set was = .1 but in Singaporean was zero.						
Student's educational aspirations	How far in school do you expect to go	TIMSS coding maintained based on students' answers to a single-item: 1 = Upper secondary education; 2= Postsecondary, but not tertiary; 3= Diploma, but not in education; 4= First degree; 5= Beyond first degree; 6= I don't know((I don't know recoded to zero) Missing in both data sets was equal = .1						

APPENDIX B

Table 1 Correlation matrix among independents and depending variables for Malaysian data

Factors	1	2	3	4	5	6	7	8	9	10
1-Science achievement										
2-Attitude to science	-.286**									
3- Self-confidence	-.253**	.556**								
4- Science valuing	-.306**	.691**	.421**							
5- Being safe in school	.120**	-.030*	-.011	-.035*	-.070**					
6-Parents' education	.276**	-.122**	-.116**	-.146**	.170**	.030*				
7- Educational aids at home	-.229**	.080**	.069**	.119**	-.273**	-.030*	-.261**			
8- Books in home	.342**	-.160**	-.144**	-.197**	.156**	-.009	.328**	-.292**		
9- Language of test	.139**	.059**	.007	.108**	.049**	-.019	-.011	-.054**	.037**	
10- Student's educational aspirations	.220**	-.300**	-.235**	-.308**	.047**	.030*	.217**	-.140**	.228**	-.112**

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2- tailed)

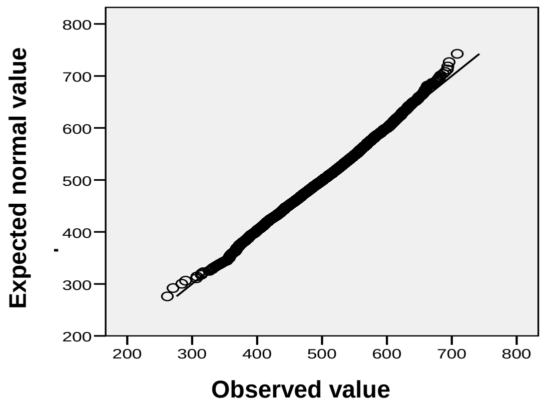
Table 2 Correlation matrix among independents and depending variables for Singaporean data

Factors	1	2	3	4	5	6	7	8	9	10
1-Science achievement										
2-Attitude to science	-.285**									
3- Self-confidence	-.244**	.661**								
4- Science valuing	-.351**	.679**	.424**							
5- Being safe in school	.139**	.006	.006	-.014	-.054**					
6-Parents' education	.313**	-.120**	-.112**	-.165**	-.083**	.029*				
7- Educational aids at home	-.240**	.045**	.045**	.076**	-.089**	-.074**	-.102**			
8- Books in home	.399**	-.162**	-.128**	-.203**	-.073**	.013	.273**	-.163**		
9- Language of test	-.286**	.139**	.169**	.181**	.030*	-.021	-.240**	.124**	-.336**	
10- Student's educational aspirations	.337**	-.257**	-.198**	-.311**	-.139**	.041**	.277**	-.106**	.255**	-.228**

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed)

APPENDIX C

Normal Q-Q Plot of Mean of Science Achievement of Malaysian



Normal Q-Q Plot of Mean of Science Achievement of Singaporean