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Mathematics Achievement among Malaysian Students: What Can They Learn from Singapore?

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Abstract

Malaysia was ranked 16th and 10th in mathematics based on the Trends in Mathematics and Science Study (TIMSS) in 1999 and 2003, respectively while its neighbor, Singapore, used to be a part of Malaysia until 1965, was ranked first in both years. Hence, it is the aim of this study to investigate what makes Singaporean students better in mathematics performance compared to Malaysian students using TIMSS data. Factors examined in this analysis include characteristics of students, teachers and schools, educational aids and resources as well as students' attitudes towards mathematics learning. It is hoped that the findings from this study will provide useful inputs to improve mathematics learning among Malaysian students.

Keywords: Achievement, Secondary analysis, Comparative studies, TIMSS

1. Introduction

Numerous research have been undertaken to investigate trends in mathematics achievement and the factors influencing mathematics learning and performance (Ma and Klinger, 2000; Papanastasiou, 2000; Al Khateeb, 2001; Tsao, 2004; Mullis, Martin, Gonzalez and Chrostowski, 2004; House and Telese, 2008). For example, Ma and Klinger (2000) studied the factors of mathematics achievement which include students' gender, age, ethnicity, their family socioeconomic status and school characteristics. In Papanastasiou (2000), the effects of school, students' attitudes and beliefs in mathematics learning on students' performance were investigated. Mathematics beliefs and self-concept were also studied by House and Telese (2008) and Wang (2007) while Al Khateeb (2001) examined gender differences in mathematics achievement among high school students.

Both House and Telese (2008) and Tsao (2004) used data from the Trends in Mathematics and Science Study (TIMSS) in their comparative analyses of mathematics achievement of students in the United States and Japan, and the United States and Taiwan, respectively. TIMSS data also showed that the eighth grade students from Singapore were ranked first in mathematics among participating countries while its neighbor, Malaysia was ranked 16th and 10th in 1999 and 2003 respectively on the same study (Mullis, Martin, Beaton, Gonzalez et al, 2000; Mullis et al, 2004). One begins to wonder as to why Singapore has done exceptionally well compared to Malaysia when the country was once part of Sultanate of Johor, Malaysia between 16th and early 19th centuries until it became an independent republic in 1965. Is it something about its students, teachers and/or school system that lead to Singapore's superiority over Malaysia in as far as mathematics performance is concerned? Thus it is the interest of this paper to examine the similarities and differences in education system, students, teachers, schools and other characteristics between the two countries in the hope to help Malaysia improve its performance in Mathematics globally.

2. Similarities and Differences between the Two Countries

Like other Asian countries, education systems in both countries are highly centralized and are managed or under the jurisdiction of Ministry of Education in each respective country. The admission age to the first year of primary

schooling is six and primary education takes six years for normal students in both the countries (Table 1). Students in both countries are required to sit for the national examination before they could proceed to secondary education. In Malaysia, this examination is called Ujian Pencapaian Sekolah Rendah (UPSR) or Primary School Assessment Examination and in Singapore, it is called the Primary School Leaving Examination (PSLE).

With an area of around 330 times bigger and a population of 6 times more than Singapore (Table 2), it is expected that the implementation of educational policies and plans, in Malaysia is not as easy as Singapore. Furthermore, Singapore enjoys lower infant mortality rate, longer life expectancy and higher human development index. With per capita income of almost seven times that of Malaysia, Singapore is the most developed nation in ASEAN.

Exceptionally bright students in Malaysia may have spent one year shorter in primary education because they could move from year 3 to year 5, skipping year 4 if they did well in the First Level Assessment examination or known as *Penilaian Tahap Satu* (PTS). However, this exam was removed in 2001. The promotion from grade 6 to 7 is automatic for students in Malaysia. Students who perform well in this examination have the opportunity of being offered a place in government funded boarding schools but due to limited places, priority has always been given to students from lower income families and those from the rural areas. In Malaysia, secondary education is divided into lower and upper secondary with a period of 3 and 2 years respectively. Upon completion of the lower secondary, students sit for a common examination called the Lower Secondary Assessment (PMR). Based on this examination, students may choose a combination of available subjects in the first year of upper secondary according to their interest. In the last year of upper secondary, students sit for Sijil Pelajaran Malaysia (SPM), Malaysian Certificate of Education, which is equivalent to the British Ordinary or O Levels.

On the other hand, Singapore students are placed in different secondary education tracks depending on their performance in PSLE. Students are divided into two categories: express and normal. Express is a four-year course leading up to a Singapore-Cambridge General certificate of Education Ordinary-level (O-level) examination. Normal is a four-year course leading up to a Normal-level examination with the possibility of a fifth year leading to an O-level.

Unlike Singapore, where English is the medium of instruction, Malaysia uses the national language (Bahasa Malaysia) as the main medium of instruction in all government schools except for international schools. Only in 2002, English language was made the medium of instruction for mathematics and science subjects in secondary schools for students starting grade 1 and grade 7 that year. Hence, the eighth grade students in Malaysia in this study still learning Mathematics in Bahasa Malaysia and therefore, the language of test used in this study is Bahasa Malaysia for Malaysia and English for Singapore.

3. Methodology

This paper uses TIMSS 2003 data with the hope that it would reveal important characteristics that could be used to improve mathematics learning and achievement among students in Malaysia. TIMSS is an educational research project conducted by the International Association for the Evaluation of Educational Achievement (IEA). The variables used this analysis include characteristics of students, resources for learning, how they spend their time out of school, their self-confidence in learning mathematics and the value they place on mathematics, teacher and school characteristics in both countries. However, the study will not investigate on effect of the curriculum or content areas and instructional practices on mathematics achievement.

To include the variables mentioned above, we need to use all three questionnaires (students, teachers and schools) and responses used in TIMSS 2003. These questionnaires aim to obtain background information from students, teachers and schools. Since the number of variables involved in this study is tremendous, we just show those variables that have association with Mathematics achievement among Malaysian students.

The data consists of 150 schools and teachers as well as 5314 eighth grade students from Malaysia and 164 schools and teachers together with 6018 eighth grade students from Singapore. The average age of the sampled students of both the countries at the time of testing was 14.33 years. Mathematics achievement in this study is represented by the average of five plausible values. Almost 94 per cent of Singaporean students obtain a score above the international average whereas only 70 per cent of Malaysian students are in this category.

This study will employ the t-test or ANOVA to relate each of these variables with mathematics achievement in these countries. The chi-square tests are used to investigate the differences in distribution of each variable between the two countries.

4. Mathematics Achievement

The distribution of mathematics scores shown in Table 3 clearly indicates how well students in Singapore have done in TIMSS 2003. Over 50 percent of them achieved more than the average score of 603 compared to Malaysian students (only 10 %). Expectedly the proportion of students in Singapore with achievements lower than the International average is very small (6%) compared to students in Malaysia (31%) even though the Malaysian average score is much higher

(508).

Comparison of mathematics achievement between the two countries is presented in Table 4 indicating that Singapore's average scores is significantly higher than Malaysia's not only in terms of the overall performance but also in each of the five mathematics content areas. However, students in both countries exhibit the best and worst performance in the same content areas, Fraction and Geometry, respectively.

5. Students Characteristics

5.1 Background of Students

Only two variables are considered in this section, gender of the students and parents highest level of education. Both countries register significant gender differences with girls scoring higher than boys and achievement significantly increases with education level of the parents (Table 5). Although Singapore registers a higher proportion of boys (51%) compared to Malaysia (42%) (Table 6), their mean scores are higher than Malaysian girls. It also has higher proportion of parents with at least university education.

5.2 Educational Aids and Resources

Further analyses of the average mathematics achievement with respect to educational aids and resources, both countries register that achievement significantly increases with ownership of books and study desk, computer ownership and usage (Table 7).

From Table 8, there is no doubt that students in Singapore are well ahead of their counterparts in Malaysia especially with regard to computer ownership and usage. More than 94 percent of Singapore students own a computer and 78 percent of them use computer both at home and school compared to only 56 percent and 25 percent, respectively, of the Malaysian students.

5.3 Students Attitudes

The responses for the characteristics in this category are based on students' perception and may be influenced by the culture of modesty or high expectation in the society and therefore are less reliable. With that in mind, it was found that achievement significantly increases with students' aspiration, perception of being safe in school, self-confidence in learning mathematics and time spent on mathematics homework (Table 9).

Students in Malaysia reported a higher proportion of them inspire to finish university, feel being safe in school, value mathematics and confidence in learning mathematics (Table 10). Although the distributions of time spent on mathematics homework are different between the two countries, it is very difficult to draw conclusion about the differences of the distributions of the two countries.

6. Teachers Characteristics

Examining mathematics achievement across teacher's characteristics in Table 11 reveals interesting results. In Malaysia, students with female teachers achieve significantly higher scores than those with male teachers. Teacher's participation in the development of mathematics content as well as mathematics curriculum have significant positive impact on students' performance and that average achievement significantly increases with increasing index of teacher's reports on teaching mathematics classes with few or no limitation on instruction due to student factors. In contrast none of the teacher - related factors matter in as far as mathematics achievement is concerned among students in Singapore. Further analysis of the distribution of teacher's characteristics between the two countries using Chi-square tests in Table 12 shows no significant difference in the distribution of gender of teachers, teachers' participation in development of Math content and curriculum between the two countries. The proportion of high index of having classes with few or no limitation on instruction due to student factor is higher among Malaysian students.

7. School Characteristics

School related characteristics are found to have significant influence on students' mathematics scores in both countries as shown in Table 13 and that the distribution of students coming from economically disadvantaged homes, index of principal's perception of school climate and index of good school and class attendance differ significantly between Malaysia and Singapore (Table 13). Among Singaporean students mathematics achievement significantly increase with increasing level of socio-economic status, index of principal's perception of school climate and index of good school and class attendance. Similar results are found among students in Malaysia except for the GSCA index where students with low GSCA index register a higher average achievement in mathematics than those with medium GSCA index. Table 14 shows that higher proportion of Malaysian students coming from economically disadvantage homes. However, Singapore has higher proportion of index of good school and class attendance as compared to Malaysia.

8. Conclusion and Implications

This study reveals several significant and important findings with respect to mathematics achievement among eighth grade students in Singapore and Malaysia. There are significant differences in the overall average achievement as well

as in all the five mathematics content areas between the two countries with Singaporean students exhibiting superiority over Malaysian students. Although Malaysia has the advantage of having more inspired students to finish university, feel safe in school and value mathematics more, these advantages do not compensate the socioeconomic advantage of Singapore students. Furthermore, student aspiration, feeling safe in school and student valuing mathematics are based on students' perception and may not be reliable.

The data also shows that except for gender of teacher, participation of teacher in the development of mathematics content and curriculum, the distribution of the other variables in consideration differ significantly between the two countries and with the exception of these three teacher related factors, all the other factors contribute significantly to the differences in mathematics achievement among students in Singapore. However, unlike Singapore differences in achievement among Malaysian students are found to be significant across student, teacher and school characteristics. It is clear from this study that mathematics teachers matter in Malaysia while they do not in Singapore and since there are no significant differences between the two countries in as far as teacher related characteristics are concerned, the substantial difference in mathematics achievement could then be due to other factors. Firstly, it is important to note that Singapore sample of students in TIMSS 2003 are more homogeneous in terms of location of schools that are all urban based compared to Malaysian sample. The homogeneity could also be due to the fact that there is some form of screening of students in Grade 6 going to Grade 7 being practiced in Singapore while promotion to secondary schooling in Malaysia is automatic.

Another big difference between students in the two countries is with regard to study aid, especially ownership of books and computers as well as computer usage. There is variation in digital divide between urban and rural schools and between developed and less developed states in Malaysia while this does not exist in Singapore. And lastly, because of its size, the implementation of academic strategies and activities can be carried out easily in Singapore as compared to Malaysia.

One aspect that is not covered in this study that could have significant impact on mathematics achievement is instructional strategies although the indexes of time students spend on mathematics homework and levels of computer usage do reflect some aspect of it. Singapore is of course far well ahead of Malaysia in this respect.

We should also note that this study does not include the differences of curriculum or contents of mathematics taught which may affect mathematics achievement in both countries. Furthermore, this study is using unvaried analysis and just investigates the role of one characteristic without taking into the account the effect of the other characteristics. However, this shortfall does not deny the fact that the findings in this study give an important contribution to understanding mathematics performance in Malaysia.

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Table 1. Information about the Grades Tested in TIMSS 2003 for Malaysia and Singapore

Information	**Malaysia**	**Singapore**
Policy on Age of Entry to Primary School	Children must be 6 years old by January 1 of the academic year	Children must be 6 years old
Practice on Age of Entry to Primary School	6 or older	6
Policy on Promotion/Retention	Automatic	Automatic in grades 1 – 5, students in grade 6 must satisfy basic requirements on national exam to be promoted to grade 7
Country's name for grade tested	Form 2	Secondary 2
Years of schooling	8	8
Average age at the time of testing	14.3	14.3

Source: TIMSS 2003 International Mathematics Report (2004) by Ina V. S. Mullis, Michael O. Martin, Eugenio J. Gonzalez and Steven J. Chrostowski

Table 2. Selected Characteristics of the Two Countries

Characteristics	**Malaysia**	**Singapore**
Population Size (in million)	24.3	4.2
Area of Country (1000 square kilometers)	330	1
Life Expectancy at Birth (Years)	73	78
Infant Mortality Rate (per 1000 Live Births)	8	3
Gross National Income per Capita (in US Dollars)	3540	20690
GNI per Capita (Purchasing Power Parity)	8500	23730
Net Enrollment Ratio in Primary Education (% of Relevant Group)	95	-
Net Enrollment Ratio in Secondary Education (% of Relevant Group)	69	-
Primary Pupil-Teacher Ratio	19.6	25.4
Human Development Index	0.790	0.884

Source: TIMSS 2003 International Mathematics Report (2004) by Ina V. S. Mullis, Michael O. Martin, Eugenio J. Gonzalez and Steven J. Chrostowski

Table 3. Distribution of Overall Mathematics Scores

Score	Malaysia	Singapore	Total
International Average (467) and below	30.9	6.4	17.9
Above International Average to Malaysian Average (508)	51.8	28.4	39.3
Above Malaysian Average to Singapore Average (602)	7.7	11.2	9.6
Above Singapore Average	9.7	54.0	33.2

Table 4. Differences in Mathematics Score Among the Two countries

	Country		
Score	**Malaysia**	**Singapore**	**p-value of t-test**
N	5314	6018	
Overall Mathematics Score	508.60	602.20	< 0.001
Algebra	495.25	586.49	< 0.001
Data	505.18	576.75	< 0.001
Fraction	524.54	614.59	< 0.001
Geometry	494.47	576.43	< 0.001
Measurement	504.13	607.43	< 0.001

Table 5. Differences in Mean Scores for Each of the Background Variables in the Two Countries

		Malaysia		Singapore	
Background of Students	**Categories**	**Mean Score**	**p-value**	**Mean Score**	**p-value**
Gender	Girl	512.1385	<0.001	608.2070	<0.001
	Boy	503.7568		596.4771	
Parents Highest Education Level	Finish university or equivalent or higher	545.7464	<0.001	644.5178	<0.001
	Finish at least secondary level but not university	521.5286		617.2856	
	Finish lower secondary schooling	496.0411		597.8530	
	No more than primary	482.9198		569.5420	

Table 6. Distribution of Background of Students of the Two Countries

Characteristics of Students	**Category**	**Malaysia**	**Singapore**	**Total**	**p-value of χ^2 test**
Gender	Girl	57.8	48.8	53.0	<0.001
	Boy	42.2	51.2	47.0	
Parents Highest Education Level	Finish university or equivalent or higher	10.9	15.5	13.3	<0.001
	Finish at least secondary level but not university	47.1	25.0	35.6	
	Finish lower secondary schooling	24.5	48.1	36.7	
	No more than primary	17.5	11.4	14.3	

Table 7. Differences in Mean Scores for Each of the Educational Aids and Resources Variables in the Two Countries

Educational Aids and Resources	Categories	Malaysia		Singapore	
		Mean Score	p-value	Mean Score	p-value
Number of books in your home	None or very few (0-10 Books)	474.6524	<0.001	553.0663	<0.001
	One Shelf (11-25 Books)	497.4163		578.8126	
	One Bookcase (26-100 Books)	525.5488		613.7643	
	Two Bookcases (101-200 Books)	540.8780		623.0313	
	Three or more Bookcases (>200 Books)	556.1203		636.9755	
Home possess study desk	Yes	511.5622	<0.001	606.1434	<0.001
	No	489.5567		566.4155	
Home possess computer	Yes	526.0765	<0.001	606.1653	<0.001
	No	486.2853		540.4483	
Availability Of Computer	Use computer both at home and school	539.1198	<0.001	611.0053	<0.001
	Use computer at home but not at school	528.5997		587.9800	
	Use computer at school but not at home	490.2774		538.4948	
	Use computer only at places other than home or do not use computer at all	477.7659		537.4113	

Table 8. Distribution of Educational Aids and Resources of the Two Countries

Educational Aids and Resources	Category	Malaysia	Singapore	Total	p-value of χ^2 test
Number of books in your home	None or very few (0-10 books)	17.1	12.5	14.7	<0.001
	One shelf (11-25 books)	40.1	24.6	31.9	
	One bookcase (26-100 books)	28.2	33.4	31.0	
	Two bookcases (101-200 books)	8.9	15.8	12.5	
	Three or more bookcases (>200 books)	5.7	13.8	10.0	
Home possess study desk	Yes	87.6	90.4	89.1	<0.001
	No	12.4	9.6	10.9	
Home possess computer	Yes	56.8	94.1	76.7	<0.001
	No	43.2	5.9	23.3	
Availability of computer	Use computer both at home and school	25.1	78.1	53.5	<0.001
	Use computer at home but not at school	26.5	14.8	20.3	
	Use computer at school but not at home	24.2	5.5	14.1	
	Use computer only at places other than home or do not use at all	24.3	1.6	12.2	

Table 9. Differences in Mean Scores for Each of the Students' Attitudes Variables in the Two Countries

Attitude		**Malaysia**		**Singapore**	
	Categories	**Mean Score**	**p-value**	**Mean Score**	**p-value**
Students education aspirations relative to parents education level	Finish university and either parent went to university or equivalent	550.1332	<0.001	648.4953	<0.001
	Finish university but neither parent went to university or equivalent	516.4770		623.7637	
	Not finish university regardless of parent education	485.4389		565.1771	
	Do not know regardless of parent education	508.4914		599.7761	
Index of student perception of being safe in school (SPBSS)	High	517.0834	<0.001	614.6541	<0.001
	Medium	501.1759		598.2520	
	Low	492.8745		573.9248	
Index of self-confidence in learning mathematics (SCM)	High	546.0560	<0.001	635.2171	<0.001
	Medium	490.3007		591.5126	
	Low	471.7448		568.5869	
Index of students valuing mathematics (SVM)	High	515.1316	<0.001	612.8612	<0.001
	Medium	486.8400		588.3184	
	Low	455.1655		554.6826	
Index of time on mathematics homework (TMH)	High	515.8836	<0.001	618.0197	<0.001
	Medium	509.7004		601.0755	
	Low	484.5889		562.0714	

Table 10. Distribution of Students' Attitudes of the Two Countries

Attitude	**Category**	**Malaysia**	**Singapore**	**Total**	**p-value of χ^2 test**
Students education aspirations relative to parents education level	Finish university and either parent went to university or equivalent	9.7	13.3	11.6	<0.001
	Finish university but neither parent went to university or equivalent	54.8	43.1	48.7	
	Not finish university regardless of parent education	24.9	28.4	26.7	
	Do not know regardless of parent education	10.5	15.2	13.0	
Index of student perception of being safe in school (SPBSS)	High	51.7	44.2	47.7	<0.001
	Medium	40.8	43.2	42.0	
	Low	7.6	12.6	10.2	
Index of self-confidence in learning mathematics (SCM)	High	38.5	39.0	38.8	<0.001
	Medium	45.3	33.9	39.2	
	Low	16.2	27.1	22.0	
Index of students valuing mathematics (SVM)	High	77.9	63.8	70.4	<0.001
	Medium	21.4	31.4	26.7	
	Low	0.7	4.8	2.9	
Index of time on mathematics homework (TMH)	High	33.0	37.9	35.6	<0.001
	Medium	55.8	51.0	53.3	
	Low	11.2	11.1	11.2	

Table 11. Differences in Mean Score between Teacher's Characteristics between the Two Countries

		Malaysia		Singapore	
Variables	**Categories**	**Mean Score**	**p-value**	**Mean Score**	**p-value**
Sex of teachers	Female	516.8760	0.001	601.9629	0.731
	Male	484.6620		599.0367	
Teacher's participation in development of Math content	Yes	515.902	0.013	601.0832	0.987
	No	491.910		600.9369	
Teacher's participation in development of Math Curriculum	Yes	517.005	0.009	599.9705	0.735
	No	491.941		602.7272	
Index of teacher's reports on teaching Mathematics classes with few or no limitation on instruction due to student factors (MCFL)	High	529.6016	<0.001	611.6863	0.121
	Medium	485.5834		595.6496	
	Low	466.9453		594.0351	

Table 12. Distribution of Characteristics of Teachers of the Two Countries

Characteristics of Teachers	**Category**	**Malaysia**	**Singapore**	**Total**	**p-value of χ^2 test**
Sex of teachers	Female	72.5	66.6	68.4	0.197
	Male	27.5	33.4	31.6	
Teacher's participation in development of Math content	Yes	67.1	75.3	72.7	0.063
	No	32.9	24.7	27.3	
Teacher's participation in development of Math Curriculum	Yes	64.9	60.1	61.6	0.325
	No	35.1	39.9	38.4	
Index of teacher's reports on teaching Mathematics classes with few or no limitation on instruction due to student factors (MCFL)	High	54.4	34.0	40.4	<0.001
	Medium	37.1	41.1	40.0	
	Low	8.1	24.8	19.6	

Table 13. Differences in Mean Scores between School's Characteristics among the Two Countries

Variables	**Categories**	Malaysia **Mean Score**	**p-value**	Singapore **Mean Score**	**p-value**
Students coming from economically disadvantaged homes	0 to 10	549.3830	0.006	614.5903	<0.001
	11 to 25	526.8228		595.1565	
	26 to 50	513.1465		566.0584	
	>50	497.6376		572.5419	
Index of principal's perception of school climate	High	537.6151	0.007	645.4136	<0.001
	Medium	503.1126		588.4722	
	Low	490.8208		556.7344	
Index of good school and class attendance (GSCA)	High	531.0384	0.044	616.5186	0.002
	Medium	501.4766		593.9968	
	Low	509.0602		565.9910	

Table 14. Distribution of Characteristics of Schools of the Two Countries

Characteristics of Schools	**Category**	**Malaysia**	**Singapore**	**Total**	**p-value of χ^2 test**
Students coming from economically disadvantaged homes	0 to 10	8.0	53.8	31.5	<0.001
	11 to 25	12.7	27.8	20.5	
	26 to 50	16.0	12.0	14.0	
	>50	63.3	6.3	34.1	
Index of principal's perception of school climate	High	17.6	26.9	22.4	0.044
	Medium	70.9	67.5	69.2	
	Low	11.5	5.6	8.4	
Index of good school and class attendance (GSCA)	High	18.7	40.0	29.7	<0.001
	Medium	68.7	55.0	61.6	
	Low	12.7	5.0	8.7	