Full Title:

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

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Abstract

Malaysia is 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 part of Malaysia until 1965, is 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. However, this study is limited to investigating factors that are collected by TIMSS in student, teacher and school background questionnaire. 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*

Introduction

The eighth grade students from Singapore were ranked first in mathematics among participating countries in the Trends in Mathematics and Science Study (TIMSS). On the other hand, its neighbor, Malaysia was ranked 16th and 10th in 1999 and 2003 respectively on the same study (Mullis 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 century 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 factors that contribute to the differences in mathematics achievement between the two countries.

Education in both countries is managed or under the jurisdiction of Ministry of Education in each respective country. However, with an area of around 470 times bigger and a population of 6 times more than Singapore, it is expected that the implementation of education policies and plan in Malaysia is not as easy as Singapore.

Admission age to the first year of primary schooling is seven and primary education takes six years for normal students in both countries. 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. Students in both countries were also 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. 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 Singapore, it is called the Primary School Leaving Examination (PSLE) and the primary purpose of this examination is to eventually allocate places in secondary schools to students based on their performance.

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 instruction for mathematics and science subjects in secondary schools.

As mentioned earlier, 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. 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.

Methodology

This paper aims to investigate and compare the mathematics achievement in the two countries using TIMSS 2003 data with the hope that it would reveal important determining factors that could be used to improve mathematics learning and achievement among students in Malaysia. The variables used in 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 and responses used in TIMSS 2003. These questionnaires aim to obtain background information from students, teachers and schools.

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 at the time of testing was 14.33 years for both countries. 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 chi-square tests to investigate the differences in distribution of each variable between the two countries. The t-test and ANOVA will be used to relate each of these variables with mathematics achievement in these countries.

Discussion

Table 1 presents some basic information about the grades tested in TIMSS 2003 for both countries. The policy on age of entry to primary school and the automatic promotion of grades at the primary years are similar but the promotion to secondary education or grade 7 is quite different between the two countries. While going to grade 7 is automatic for grade 6 students in Malaysia, students in Singapore must satisfy basic requirements on national examination before they are allowed to proceed to grade 7. This means that the grade 8 students in Singapore sample could be more homogeneous since all of them have had some kind of screening.

[Take in Table 1 about here]

As can be observed in Table 2, Malaysia's population in 2003 was six times larger than that of Singapore but the latter enjoys lower infant mortality rate, longer life expectancy and expectedly higher human development index (HDI). With per capita income of almost seven times that of Malaysia, Singapore is the most developed nation in ASEAN. It is interesting to note though that the ratio of primary pupil to teacher is larger in Singapore compared to Malaysia.

[Take in Table 2 about here]

The distribution of mathematics scores shown in Table 3 clearly indicates how well students in Singapore students have done in TIMSS 2003 with more than 50 percent of them achieved more than the average score of 603 compared with only 10 percent among Malaysian students. 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).

[Take in Table 3 about here]

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.

[Take in Table 4 about here]

Table 5 shows the distribution of students' characteristics which could have significant influence on mathematics achievement. Singapore registers a higher proportion of boys (51%) compared to Malaysia (42%) and higher proportion of parents with at least a university education (16% and 11%, respectively). Surprisingly, almost 60 percent of Singaporean students' parents completed lower secondary schooling and below compared to 42 percent of Malaysian students' parents. It is also somewhat surprising that the proportion of students who aspire to finish university regardless of their parents' education is significantly higher in Malaysia (65%) than in Singapore (56%).

[Take in Table 5 about here]

It should be noted that Malaysia and Singapore do not have a common language of the test. The language of the test in Malaysia is Bahasa Malaysia (Malay) while English was used to conduct TIMSS 2003 in Singapore. It should also be noted that Malaysia's population consists of three main ethnic groups namely, Malays which comprise more than 50 percent, Chinese about 30 percent and Indians about 10 percent and thus is expected that majority of the students always or almost always speak the language of the test at home (65%). However, it is somewhat surprising that Singapore registers a much lower proportion of students who always or almost always speak the language of test at home (43%) because English is the medium of instruction throughout the schooling system.

In terms of educational resources and aids, 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 with only 56 percent and 25 percent, respectively, of the Malaysian students. However, in terms of the students' perception and attitudes, students in Malaysia report a higher proportion of high index of being safe in school while there is no difference in the proportion of high index of self-confidence in learning mathematics. And although the proportion of high index of students valuing mathematics is higher among Malaysian students, the reverse is true of the proportion of high index of student spending time on mathematics homework.

Further analyses of the average mathematics achievement with respect to the variables mentioned above are shown in Table 6. Both countries register significant gender differences with girls scoring higher than boys, and that achievement significantly increases with educational level of the parents, students' aspiration relative to parents' education, ownership of books and study desk, computer ownership and usage as well as index of students' perception and attitudes towards mathematics learning. However, contrasting results in average

achievement are observed across the language spoken at home. Among Malaysian students mathematics scores significantly increases with decreasing frequency of speaking the language of test at home while among students in Singapore the reverse is true.

[Take in Table 6 and Table 7 about here]

Examining mathematics achievement across teacher's characteristics 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 shows no significant difference except for the index of teacher's reports (Table 8).

[Take in Table 8 about here]

School related characteristics are found to have significant influence on students' mathematics scores in both countries as shown in Table 9 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 10). 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.

[Take in Table 9 and Table 10 about here]

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. Examination of mathematics achievement across student, teacher and school related variables within each country shows both similar and contrasting results. For example female students in both countries achieve significantly higher scores than their respective male counterparts and that achievement significantly increase with increasing level parents' educational level, students' aspirations relative to parents' education and index of students' attitude and self-concept in learning

mathematics. 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 which 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.

Secondly, English is the medium of instruction for all subjects in Singapore schools where as in Malaysian government schools, only in 2001 that English was introduced as the medium of instruction for the teaching of mathematics and science subjects. This explains why contrasting results were obtained between the two countries with respect to the language of test spoken at home. Malaysian students, majority are Malays who speak the language of test which is the national language or Bahasa Malaysia at home, have difficulty learning mathematics in English.

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 is non existence in Singapore.

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

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Table 1: Some information about education policies of 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 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 TIMSS 2003 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 mathematics scores of the two countries

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: Characteristics of Malaysian and Singaporean students

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	
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	
Often speak language of test at home	Always	50.4	23.3	36.0	<0.001
	Almost Always	14.8	19.3	17.2	
	Sometimes	27.9	49.2	39.2	
	Never	6.9	8.3	7.6	
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	

Table 5 (Continued)

Characteristics of Students	Category	Malaysia	Singapore	Total	p-value of χ^2 test
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	
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 6: Differences in means between student's characteristics

Variables	Categories	Malaysia		Singapore	
		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	
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	
Often speak language of test at home	Always	490.4438	<0.001	621.6135	<0.001
	Almost Always	509.5871		616.1709	
	Sometimes	530.5822		591.8995	
	Never	550.6853		576.6155	
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	

Table 6 (Continued)

		Malaysia		Singapore	
Variables	**Categories**	**Mean Score**	**p-value**	**Mean Score**	**p-value**
	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	
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 7: Differences in means between teacher's characteristics among the two countries

Variables	Categories	Malaysia		Singapore	
		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 8: Characteristics of teachers

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 9: Differences in means between school's characteristics among the two countries

Variables	Categories	Malaysia		Singapore	
		Mean Score	**p-value**	**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 10: Characteristics of Schools

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	