ADOPTION OF TECHNOLOGY IN MALAYSIAN EDUCATIONAL SYSTEM

By

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ABSTRACT

This paper provides a brief understanding of the educational technology in the teaching and learning of mathematics to Form Two students (equivalent to the eighth-graders) in Malaysia. In particular, it attempts to understand the relationships between educational technology and mathematics achievement in both the urban and rural schools. The study draws its findings solely from the Trend in Mathematics and Science Study (TIMSS) 2003 which includes 5,314 students from 150 schools. The technology discussed in this paper is confined to the use of calculator and computers in mathematics learning and teaching. The use of computer for academic purpose was scarce among the Form Two students, which is reflective of our current curriculum that lacks the technological approach. However, we found that students who computers, used computers at home, library or friend's home performed relatively better in the TIMSS mathematics test compared to those who did not. The findings also show that students in rural areas were less likely to own home computers but are more likely to use calculator as compared to their urban counterpart their achievement in TIMSS mathematics scores were significantly lower and were more likely from schools that had greater shortage of computer facilities. Although the findings implicated that the use of computers help in achieving higher mathematics scores, it was not conclusive since students' socio-economics status, motivation and other factors related to achievement were not considered in this study. This study also found that teachers' pedagogical style do not encourage mathematical creativity. However, the instructional approach of the teachers did not seem to affect students' performance in mathematics.

Keyword:Educational technology, mathematics achievement, TIMSS, urban, rural

INTRODUCTION

The Malaysian education system is a highlight in the Ninth Malaysia Plan tabled recently. The second thrust of the plan shows the government's relentless effort towards improving education and training in line with the aim to develop and enhance the human capital of Malaysia (Ministry of Finance Malaysia, 2006). A sum of RM33.4 billion representing 21% of the overall 2007 budget is allocated for this cause. From this amount, RM6.2 billion is for secondary education and RM10.1 billion is for training programs. Around 200 new schools including a few specialized ones will be constructed. About RM800 million is allocated for teachers' training while 101 million is for the housing projects for teachers in rural areas. Computer usage in schools is boosted with RM288 million for the purchase of computer equipment in 1,000 schools and all teachers' training colleges. This budget has been lauded for its effort to increase capacity. It also paves a good way towards improving the quality of our educators and enhancing the current state of technological facilities at our schools as well as training centers.

While we seem right on path with these mega measures, how much thought have we put into ensuring effective adoption of educational technology in our education system? The successful implementation of educational technology in our schools does not stop at the acquisition of computer technology. Simply having the technology does not guarantee enhanced learning (Barton, 2000). Professional training of our teachers is important. The way our teachers are trained cannot be the same as before. Our current curriculum should permit teachers the flexibility to integrate educational technology into the teaching of mathematics in their own way (Mergendoller, 1997).

The objective of this paper is to provide an overview of the current practice of educational technology in the learning and teaching of mathematics to the Form Two students in urban and rural Malaysia using data from the Trends in International Mathematics and Science Study (TIMSS) 2003. This study is important to provide understanding of the effect of computing technology on the learning outcome of mathematics. It also covers the issue of technology gap and scholastic difference in the performance of mathematics between the rural and urban schools.

Literature Review

The positive impact of technology on the learning of mathematics has been documented in many studies. Wilson (2006) explained that visual reasoning is central in the study of mathematics. Technology allows students the ability to construct visual and symbolic representations of ideas in solving problems which is difficult with the traditional manual mode. In Malaysia, studies showed that graphs, visual presentation and the use of graphing calculator help student understanding various mathematics topics and concepts (Azman, 2005; Kassim et al., 2002). In our neighboring country, Singapore, the government helped to improve students' understanding of mathematics by encouraging the use of computer technology such as spreadsheet to better understand certain mathematical concepts (Koh, Koh & Wu, 2004).

In contrast, Papanastasiou, Zembylas & Vrasidas (2004) found that students who often used internet to communicate with other students and had teachers who frequently used computers in classrooms tend to have lower achievement scores than others without such condition. However, they revealed that students who own computers at home often had higher academic achievement than students who do not. The same was observed in the study of fourth-graders in Hong Kong and USA.

A few studies (Barton, 2000; Ravitz, Mergendoller & Rush, 2002) found that technology and computer use were indeed beneficial in improving achievement especially for high performing students. On the other hand, Papanastasiou, Zembylas and Vrasidas (2003) noted that it was not the computer use that has positive or negative effect on the achievement of students, but rather the way the computers were used. More studies are needed to understand the impact of pedagogical differences among teachers and prior achievement on the learning outcome and its relation with educational technology.

The gaps in school achievement between rural and urban schools are large and have been persistent. In a study by World Bank in 1995 found that students from rural areas received lower grades not only in mathematics but also in English. Rural students often have many more obstacles to overcome, than urban students in receiving their education such as longer traveling distances, inadequate school resources and constantly changing and inexperienced teaching staff. Although efforts have been made to remedy these problems by building more schools, hostels or teachers' residence, the difficulties remain thus far.

Data And Methods

The sources of data examined in this paper were the TIMSS student, teacher and school questionnaires contained in the TIMSS 2003 database for Malaysia. Data regarding the urban or rural location of the TIMSS schools were obtained from the Ministry of Education Malaysia. TIMSS Malaysia covered only the Form Two students that is equivalent to the eighth graders in North America. It involved 150 schools with a total of 5,314 subjects aged 14.34 years on average and girls made up 57.8% of the sample.

To meet the objective of this paper, questionnaire items related to the educational technology as well as the instructional techniques in mathematics were selected by research literature and experience. These items correspond to the students' existing technological resources related to the learning of mathematics, the pattern of computer use, the teaching techniques by teachers and the current condition of educational facilities in schools. Some of the items were cross examined with the urban and rural variable whenever appropriate. For students' mathematics score, the average of the 5 plausible values given in the TIMSS database is used by the faculty. The mathematics achievement score for the individual school was computed by taking the average of all students in that particular school.

Relationships between two categorical variables were analyzed using Pearson Chi-square. The t-test was performed to test for mean differences between two groups of subjects. When there were more than 2 groups, Analysis of Variance (ANOVA) was used instead. The homogeneity of variance was ascertained using the Levene test prior to the execution of ANOVA. If the equal variance assumption of ANOVA is violated, we use the alternative Welch ANOVA instead. Post hoc multiple comparison tests such as Tukey HSD, Scheffe and Dunnett T3 were performed to single out significant pair wise comparisons. Dunnett T3 was referred when the equal variance assumption did not hold. Otherwise mentioned, all tests were conducted at the significance level of 5%.

All analyses contained herein were carried out by SPSS 12 for Windows.

Results

The learning of mathematics and computing technology

Data from the TIMSS 2003 showed that computing experience was fairly common among our Form Two students with 89% reported they had used a computer before. Almost everyone had a calculator at home (95%). This is expected as calculator is required in the Form Two curriculum. Slightly more than half of them (57%) owned a computer at home. Table 1 shows that most of the

	N	Yes (%)	Mean Math Score		t statistic[a]
			Yes	No	
Ever use a computer	5,207	89.1	513.5	477.9	13.05*
Possess calculator at home	5,299	94.6	511.2	463.1	11.09*
Possess computer at home	5,285	56.8	526.1	486.3	20.89*
Use a computer at home	4,624	58.0	533.7	485.7	23.46*
Use a computer at school	4,623	55.3	515.2	511.7	1.60
Use a computer at library	4,608	11.4	529.9	511.7	5.43*
Use a computer at friend's home	4,612	47.2	524.6	504.0	9.72*
Use a computer at internet café	4,618	49.8	507.7	519.7	-5.65*
Use a computer elsewhere	4,592	36.0	513.6	513.9	-0.16

Yes is coded (1) and No (2). * denotes significance at 5%.
[a] Test of equality of mathematics mean scores.

Table 1: The use of technological resources and mathematics achievement

	Percentage of Yes		Pearson Chisquare[b]
	Rural	Urban	
Ever use a computer	80.1	93.1	191.39*
Possess calculator at home	91.5	96.0	44.81*
Possess computer at home	38.3	65.3	337.13*
Use a computer at home	39.1	65.3	260.41*
Use a computer at school	65.3	51.5	72.08*
Use a computer at library	10.0	11.9	2.92
Use a computer at friend's home	41.3	49.5	24.81*
Use a computer at internet caf	45.3	51.6	14.28*
Use a computer elsewhere	35.0	36.4	0.77

[b] Test of independence between the resource use and the urban/rural variable. With continuity correction.

Table 2: The use of technological resources by rural and urban schools

computer usage took place at home, school, friend's home and internet café. An analysis of the mean difference of mathematics scores disclosed that students who owned computer at home, used computer at home, library or friend's fared relatively better in the TIMSS mathematics test, with the exception of those who frequently visited to internet café, which had an adverse effect on their scores. This finding is similar to those reported in Ravitz, Mergendoller & Rush (2000). It is also worth noting that the accessibility and usage behavior of computer were largely different between urban and rural students as suggested by the significant Pearson Chi-squares in Table 2. Students in the rural area were less likely to own computers at home.

The use of calculator was first allowed in Form Two. Prior to that, students were taught using the traditional manual instruction. Depending on the instructor, the use of calculator might not be consistent across all secondary high schools as suggested by the results in Table 3. Half the sample reported the use of calculator in all or almost every mathematics lesson. Welch ANOVA showed that the mean scores were different for all categories. All pair wise comparisons were significant at 5% as indicated by Dunnett T3. The results led to the interpretation that those with lesser use of calculator performed relatively better in mathematics test. This finding contradicts many studies that reported as the use of calculator improves achievement (Barton, 2000). The result may not reflect the actual relationship between the use of calculator and mathematical achievement since prior to Form Two, students did not use calculator in doing mathematics. This is further substantiated by the finding that teachers taught mathematics without calculator 75% of the time as reported in the later section (Table 6). Hence, the achievement of these Form Two students is irrespective of the use of calculator which is newly introduced to them.

	Percent	Mean Math Score
Every or almost every lesson	49.9	524.3
About half the lesson	21.9	504.2
Some lessons	19.2	489.9
Never	9.0	473.2
Total	*100.0*	
Welch ANOVA[a]		109.63
Sig.		$p < 0.001$

[a] Test of the equality of mathematics mean scores.

Table 3: Mathematics lessons without calculator and mathematics score (n = 5,288)

It can be also noted that in this sample, the use of calculator differed significantly between the rural and urban schools. Results suggest relatively more rural students used calculator in their learning of mathematics. One possible reason of this finding is the teachers who employ calculator in the teaching of quantitative subjects to weaker students (Papanastasiou, 2004) who were mostly from the rural schools. The discrepancy in mathematics achievement of rural and urban schools is discussed later in table 9.

	Percent	Percentage	
		Rural	Urban
Every or almost every lesson	49.9	46.9	51.3
About half the lesson	21.9	21.1	22.2
Some lessons	19.2	23.2	17.4
Never	9.0	8.8	9.1
Total	*100.0*	*100.0*	*100.0*
Pearson Chi-square[b]		25.03	
Sig.		$p < 0.001$	

[b] Test of independence between mathematics lessons without calculators and the urban/rural variable

Table 4: Mathematics lessons without calculator by rural and urban (n = 5,288)

Although computers have become fairly accessible in and out of schools, the use of computers for academic purpose is scarce among our Form Two students. Referring to Table 5, half the sample reported that they never used computer to write reports for school and some samples said the same about using computer for processing and analysis of data. Some 34% of these students never used computer to look up mathematical information. This result perhaps is a reflection of our current secondary curriculum which remain rather traditional in its pedagogical approach that lacks in technological implementation.

The Welch ANOVA and the related multiple comparison tests revealed significant negative relationship between computer use and mathematical achievement. Nonetheless, as argued by Papanastasiou (2004), just like other non-experimental studies that found positive or negative relationship between the said two variables, one cannot simply argue from these results that computer use decreases achievement in mathematics and vice versa (Papanastasiou & Ferdig, 2006; Papanastasiou, Zembylas, & Vrasidas, 2003). Papanastasiou (2004) noted that in the evaluation of the effect of computer use, more understanding about the classroom implementation, learning goals, type of assessment used to measure

	To write reports for school (n = 4,583)		To process and analyze data (n = 4,601)		To look up ideas and information on mathematics (n = 4,596)	
	%	Mean Score	%	Mean Score	%	Mean Score
Everyday	2.2	482.1	3.1	488.2	2.9	497.9
At least once a week	9.4	494.1	13.4	508.5	20.5	500.6
Once or twice a month	17.8	515.5	19.7	515.2	24.0	519.3
A few times a year	20.6	531.7	20.3	527.7	18.6	524.4
Never	50.0	511.5	43.5	510.4	34.0	513.9
Total	*100.0*		*100.0*		*100.0*	
Welch ANOVA*		26.69		14.36		15.99
Sig.		$p < 0.001$		$p < 0.001$		$p < 0.001$

* Test of the equality of mathematics mean scores

Table 5: Frequency of computer use in percentage

improvement and the awareness of complex learning in school are needed. The TIMSS 2003 does not provide enough information for this purpose.

The teaching of mathematics and school resources

Our findings summarized in Table 6 revealed, that majority of our teachers taught mathematics to the Form Two students without using a calculator. Fractions and decimals were only taught in some lessons. Students were occasionally asked to interpret data in tables, charts or graphs and write equation and functions to represent relationships. The fact that these topics were not commonly raised is not a problem however, because our secondary educational curriculum is centralized at the national level. Students sometimes worked in small groups. They were also asked to relate mathematics to their daily life even though the frequency differed depending on the teachers. Very often students were required to explain their answers but rarely do they get to decide their own way of solving tough problem. TIMSS data also shows that many teachers appeared to stay away from problems with no clear method of solution. This implies a lack of opportunities for students to express their creativity in mathematics, which is considered relevant by many mathematics educators in fostering and rewarding mathematical creativity (Haylock, 1987).

Referring to Table 6, it can be noted that none of the instructional items have any significant effect on the

	Percent			
	Every or almost every lesson	About half the lessons	Some lessons	Never
Practice mathematics without calculator	74.5	8.0	12.1	5.4
Work on fractions and decimals	10.7	35.6	53.0	0.7
Work on problems with no obvious solution	8.7	16.8	55.0	19.5
Interpret data in tables, charts, or graphs	2.0	23.5	69.1	5.4
Write equations and functions	6.7	24.8	63.1	5.4
Work together in small groups	16.9	27.0	52.7	3.4
Relate mathematics to daily lives	28.2	33.6	37.6	0.6
Explain their answers	50.7	27.0	22.3	0.0
Decide own procedures to solve problem	8.7	31.5	52.4	7.4

Table 6: Teaching of mathematics to TIMSS class (n = 149)

	Mean Math Score				F[a]
	None	A little	Some	A lot	
Instructional materials	520.6	498.1	486.7	503.2	2.421
Budget for supplies	517.3	500.0	513.4	517.3	1.499
School building and grounds	511.2	521.1	502.2	491.6	1.689
Heating/cooling and lighting system	516.5	502.8	501.1	513.0	0.718
Instructional space	510.0	514.0	501.4	503.0	0.379
Special equipment for the handicapped	511.4	516.8	502.7	472.2	2.717*
Computers for mathematics instruction	513.1	499.1	521.4	500.2	1.237
Computer software for mathematics instruction	513.8	504.2	517.3	498.8	0.897
Calculators for mathematics instruction	539.5	498.6	482.5	513.3	8.526*
Library materials relevant to mathematics instruction	538.0	504.9	500.9	504.3	2.472
Audio-visual resources for mathematics instruction	516.7	511.1	503.4	503.7	0.364

[a] ANOVA to test the equality of mathematics mean scores.

Table 7: Shortage of resources and technology in school with respect to average mathematics score (n = 149)

	Pearson Chi-square[b]
Instructional materials	5.201
Budget for supplies	3.741
School building and grounds	1.839
Heating/cooling and lighting system	1.426
Instructional space	4.341
Special equipment for the handicapped	3.432
Computers for mathematics instruction	8.348*
Computer software for mathematics instruction	10.119*
Calculators for mathematics instruction	2.981
Library materials relevant to mathematics instruction	2.933
Audio-visual resources for mathematics instruction	2.199

[b] Pearson Chi-square test of independence between shortage and the urban / rural variable.

Table 8: Shortage of resources and technology in school by urban and rural (n = 149)

achievement of Form Two students in mathematics. The ANOVA tests for the equality of mathematics mean scores were insignificant for all items. The teaching approach of the instructors essentially does not affect students' performance in mathematics.

Table 7 contains a selected list of school questionnaire items that relate to the shortage of facilities that impair the school's function. Our analysis shows the highest complain of serious shortage of computer facilities in 27% of the schools. About 38% of these schools cited some shortage of library material and audio-video resources for mathematics classes. It is also noted that more than 94% of the 150 schools reported no computers during mathematics lessons. Rural schools recorded higher shortage of computer hardware and software for mathematics instruction as indicated by the significant Pearson Chi-squares (Table 8).

Mathematical achievement wise, schools with no complain of shortage of equipment for the handicapped recorded higher scores than those with high complain as indicated by the significant F statistics and Tukey multiple comparison (Table 7). The same explanation goes for the school with no shortage of calculators for mathematics lessons which resulted in significantly higher achievement scores.

The mathematics achievement of urban and rural schools

The digital divide between the urban and rural schools in Malaysia is of great concern. Young (1998) showed in a study that after controlling student background variables, rural students in Australia did not perform as well as students in urban school. Looker and Thiessen (2003) reported that Canadian students in the rural area from low socio-economic strata were less likely to have computer at home. Although this was partially assisted by the rural school, the lack of computer access at home kept them away from developing positive orientation towards ed information and computer technology. Our analysis shows that the mathematics achievement scores differed significantly between the urban and rural students (Table 9). If the technological gap in mathematics instruction persists between the urban and rural schools in Malaysia, the achievement of the students in the different regions may possibly be unbalance in the long run.

		n	Mean	Std. Deviation
Rural		47	480.79	43.73
Urban		102	520.82	56.71
	Total	*149*	*508.20*	*56.01*
Welch				22.19
Sig.				< 0.001

Table 9: Average mathematics score by urban and rural

Discussion And Conclusion

The study is not without limitations. Following the directive from the ministry, the medium of instruction for mathematics and science subjects was switched to English beginning 2001. Our Form Two students were already learning mathematics in English when they sat for the TIMSS tests in Malay language. Hence, this might have a negative effect on the overall achievement score for both subjects.

Furthermore, the authors would like to caution that the use of calculator was first permitted in Form Two and were not be widely used at the time when this study was carried out. Hence, students are not used up to calculator and this may be translated to lower achievement in mathematics. This technology was not given enough time to show its effect on mathematics achievement score.

Papanastasiou, Zembylas & Vrasidas (2004) explained that if the educators and researchers are not assume by the installation of computer facilities in schools, the achievement level of the students would automatically increase. They believed that teachers should not teach students how to use computers but how educational technology could help them to learn. The results from our study shows that students who use computers performed relatively better than those who did not. However, the mean scores had negative relationships with the frequency of computer use in writing reports for school, processing and analyzing data and looking up ideas and information on mathematics. This contradiction implies that there could be other factors that had not been taken into account so far yet, such as socio-economics status, motivation towards learning mathematics and other factors related to achievement. Further investigation should be carried out to reveal the actual effect of educational technology on achievement.

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