Mathematics and Science Achievement in Malaysia

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Abstract

Research focusing on factors affecting mathematics and science achievement in Malaysia has been mostly exploratory in nature, largely due to the lack of data. With this point in mind, this study attempts to identify some important influences on grade eight mathematics and science achievement using data from the Third International Mathematics and Sciences Study Repeat Project (TIMMS-R) conducted in 1999. We use home language to proxy Malay and non-Malays students. The analyses showed that non-Malay natives performed significantly better in mathematics achievement than Malay natives. Male students performed significantly better in mathematics and science achievement than females students. Student's educational expectations, perceived usefulness and reasons for doing well in the subject were significant predictors of mathematics and science achievement. Parent's education and family structure were significant predictors of mathematics achievement. Mother and peer's perceived usefulness of the subject were significant predictors of science achievement. There is some evidence that engagement in extra classes outside formal schooling is associated with science achievement when controls for school characteristics were added. All school characteristics are significantly related to mathematics and science achievement. The impact is positive for the type of school community and the number of full time teachers and negative for the severity of absenteeism.

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<u>Preliminary Findings from TIMMS 1999 on Mathematics and Sciences Achievement in Malaysia</u>

INTRODUCTION

Malaysia became an ethnically stratified society as a result of the British colonial government's policy of unrestricted immigration and the practice of separate educational systems for different ethnic groups. The major ethnic groups are Malays (60%), followed by Chinese (27%) and Indians (9%) (Lim 2003). This colonial legacy had serious implications for ethnic inequality and the development of a national system of education in the post-independence period. The Chinese and Indians populations in Malaysia have traditionally controlled most of the wealth in the country, and the indigenous Malays have generally held political power. After years of tension and some racial rioting, the country's New Economic Policy (NEP) was introduced in 1971. This policy allowed the newly independent Malaysian government to institute radical measures to narrow gaps in education, employment, ownership, and income between the Malay majority and non-Malays, (particularly the economically dominant Chinese). As a result of these measures, in the last three decades Malaysia has experienced a dramatic growth of educational attainment with a rapid erosion of ethnic differentials in such attainment.

Although Malaysia is one of the few countries that have improved educational opportunities for the formerly disadvantaged Malays (Pong 1993), disparities in mathematics and science achievement between Malays and non-Malays students have concerned educators, researchers and policymakers at all levels for the past few decades (Mohamad-Ali 1995; Khalid 1997; Lim and Saleh 2002; Mokshein 2002; Lim 2003). In the cited work, Lim (2003) had pointed out that the results of the Primary national examinations (UPSR) have shown that pupils from the Chinese medium schools perform consistently better in mathematics than those in the other types of schools. This raises concern especially to mathematics educators and the Ministry of Education and the Ministry of Education has since attempted to upgrade the mathematics achievement of the Malay medium schools (Lim 2003).

Malaysia is an interesting setting for the purpose of the present study. Malaysia is a small country with a population of about 21 million, is made up of people from different races, who speak different languages, and practice several different religious beliefs. The Malaysian education system is based on the British model due to its past tie to the colonial master and there are three types of primary schools available at the national type schools. These are: Malay medium national schools (SK); Chinese medium national type schools (SRJKC); and Tamil medium national type schools (SRJKT). In Malaysia, all national type schools follow a common mathematics and sciences curriculum even though the medium of instruction is different (Lim and Saleh 2002). Being a multi-ethnic and multi-cultural country, Malaysia has unique characteristics which may make the determinants of mathematics and science achievement distinct from its neighbors in the region.

REVIEW OF LITERATURE

There are basically two parts to this section. The first part reviews literature on factors that influence mathematics and science achievement in other countries. The second part of this section reviews literature on factors that influence mathematics and science achievement in Malaysia.

Research in other countries

In other countries, researchers have weighed the effects of family socioeconomic status (Lockheed et al 1989; Muller 1995; Goyette and Xie 1999; Adaju and Vargas 2002; Farkas and Wallin 2002) and parental influence (Kao and Tienda 1995; Ho and Willms 1996; Goyette and Xie 1999) on student's mathematics and science achievement. Others have examined the roles of students' attitudes towards mathematics and sciences (Lockheed et al 1989; Goyette and Xie 1999). Still others have examined the role of peers (Natriello and McDill 1986; Ainsworth and Downey 1998; Farkas, Lleras and Maczuga 2002), ethnicity (Goyette and Xie 1999), and gender (Hallinan and Sorensen 1987; Muller 1998; Zhang 1999; Sandefur and Campbell 2002).

Family background has a considerable influence on achievement in science and mathematics education. Much of the literature on the predictors of educational achievement highlights the importance of parental involvement (Ho and Willms 1996; McNeal 1999) and parental education (Sewell and Shah 1968; Hauser, Tsai and Sewell 1983; Muller 1995). Research indicates that certain types of parent involvement, such as parental discussions with the children about school-related topics, such as the importance of getting an education benefit students because these students show higher rates of homework completion and academic achievement in the middle and high school years (Teachman 1987; Ho and Willms 1996). According to McNeal (1999), parent involvement can be conceptualized as social capital. Using NELS data, McNeal (1999) attempted to examine how various dimensions of parent involvement affect cognitive outcomes (e.g. science achievement) and behavioral outcomes (e.g., truancy and dropping out). His study found that social capital (parent involvement) is associated with increased student achievement (McNeal 1999). The evidence also indicates that there is a relationship between parental aspirations and mathematics achievement and parental expectations are important factors in shaping educational expectations (Goyette and Xie 1999).

These findings speak to the importance of family socioeconomic status about types of interactions at home that support student learning. Research also shows that parent's education was a strong predictor of mathematics achievement. As has been found in the study on eighth-grade students by Muller (1995), parent's, especially mother's education and resource (e.g. time) availability is strongly related to parent's ability to help their children with school work.

Several studies from United States (McLanahan and Sandefur 1994; Pong 1997 and 1998) and Europe (McNab and Murray 1985; Murray and Sandqvist 1990; Jonsson and Gahler 1997) found that children who grew up in single-parent families experienced lower educational achievement and attainment. According to McLanahan and Sandefur (1994), the educational disadvantage faced by children in single parent families is not a family effect but simply an economic effect. However, the findings on the effects of stepparent families on educational achievement are mixed. On one hand, studies have shown that children in stepfamilies perform below those in intact families (Amato and Keith 1991; Wojtkiewicz 1993; Boggess 1998; Bilbarz and Raftery 1999; Painter and Levine 2000; Ginther and Pollak 2003). On the other hand, McLanahan and Sandefur (1994) found that the educational outcomes for stepchildren are essentially the same as outcomes for children in single parent families.

In United States and Canada, the literature has looked at the gender dimension of mathematics and science achievement and policies, focusing on girls' educational opportunities and achievement. The fact that boys generally do better in mathematics and science than girls has been widely recognized and a number of different explanations have been posited for the differences that have been observed (Parsons, Adler and Kaczala 1982; Parsons, Kaczala and Meece 1982; Catsambis 1994; Zhang 1999; Sandefur and Campbell 2002). Research on gender differences in mathematics and science achievement suggests that the difference appears primarily in tasks involving topics such as spatial relations and geometric reasoning (Zhang 1999). A number of sociocultural facrtors have also been suggested as possible influences on gender differences in mathematics and science achievement. These factors include attitudes toward the subject (Catsambis 1994), differential expectations of parents and teachers (Parsons, Adler and Kaczala 1982; Parsons, Kaczala and Meece 1982), differential treatment of boys and girls in classrooms, different advice given to boys and girls by high school teachers and counselors, and limited opportunity for participation in mathematics (Catsambis 1994).

Other literatures in United States have looked at the influence of school peers in mathematics and science achievement (Natriello and McDill 1986; Ainsworth and Downey 1998; Farkas, Lleras and Maczuga 2002). However, only one research (i.e. Natriello and McDill 1986) supports peer influence as a powerful indicator of academic success. Peers can be a source of motivation by influencing an individual's educational expectations and a source of information regarding the benefits of school success (Natriello and McDill 1986). Analyzing data from a sample of 12,146 students from 20 public high schools, Natriello and McDill (1986) found that in addition to teachers' and parents' standards, and peers' standards can have a positive and significant effect on the time students spend on homework.

There is a small international literature on "shadow education" (Stevenson and Baker 1992; Stevenson, Schiller and Schneider 1994; Baker et al 2001). Stevenson and Baker (1992) and Baker et al. (2001), for example, found that shadow education closely follows the curricula of the main public school system, engages in homework support, test preparation, and cramming schools, and is usually offered by individual tutors. Scholars typically trace demand for tutoring to whether countries have post secondary entrance exams, major status differences among their post secondary institutions, and direct occupational rewards for entry into those institutions (Stevenson and Baker 1992; Baker et al 2001).

Research in U.S. (Rosenthal et al. 1983; Fernandez and Nielsen 1986; Portes and Schauffler 1994; Schmid 2001) and Hong Kong have (Cheung et al. 2003) emphasized differences in medium and instruction and language ability as a primary determinant of the gaps in educational performance. For example, Fernandez and Nielsen (1986) find that Mexican-origin students in the United States who do not speak fluent English are at a serious disadvantage in school. Studies by Rosenthal et al. (1983) indicate that low socioeconomic status and poor language ability are important factors for the underachievement of immigrant youth in the United States, although the effects of socioeconomic status are generally larger than language ability. The findings by Professor Derek Cheung Sin Pui and his research team (2003) resonates that of Fernandez and Nielson (1986). They attempted to compare the academic and psychosocial developments of junior-secondary student, who were assigned by the government into schools using English or Chinese as medium of instruction (EMI or CMI). They also investigated the contributing factors to any differentials in developments between students in EMI or CMI schools. Their results suggested that there are significant differences between students in EMI and CMI schools in terms of their academic achievements and psychosocial developments. Specifically, EMI students were handicapped in science achievement compared to their CMI peers. This gap in science achievement is due to their low levels of English proficiency. The study has also revealed that among the five levels of learning environment contributing to the sampled students' development, factors at institutional level appears to have the greatest effects on students learning outcomes.

Finally, research has been undertaken both in United States (Caldas 1993; Luyten 1994; Lamdin 1995; Ramiez 1990) and Europe Norway (Bonesronning, 1996), the Netherlands, and Sweden (Luyten, 1994) on the relationship between school characteristics and academic achievement at secondary level. A negative relationship between school size and affective achievement is well documented in the American and Australian research literature (Howley, 1994; Keeves 1987; Fetler, 1989; McKenzie 1995). In terms of the type of school community, Zhang (1999) found that students from suburban schools had higher science achievement than those from urban schools. However, rural and suburban schools show the same level of science achievement as their counterparts from urban schools (Zhang 1999). In addition, Zhang's (1999) study did not detect any statistically significant relationship between mathematics achievement and type of school community.

Research in Malaysia

In Malaysia, research focusing on factors affecting mathematics achievement has been mostly exploratory in nature, largely due to the lack of data (i.e. Mohamad-Ali 1995; Khalid 1997; Lim and Saleh 2002; Lim 2003). In his study to identify the relationship between attitudes toward mathematics achievement among Malaysian school children, Mohamad-Ali (1995) found significant differences in mathematics achievement among sixteen-year old students depending on their effort, environment, socioeconomic status, school and all measures of attitude expect attitude toward success. However, readers should be aware of the limitations in generalizing these findings to all Malaysian students because the data of his study were collected from only one east-coast state in Malaysia. The subjects he described here might be clearly different from many (perhaps most) other parts of Malaysia (especially the west coast states) because the east coast states are quite different than the west coast states in terms of economic development and population. Two years later, Khalid improved on Mohamad-Ali's study in two ways: 1) his data study that covers the east-coast and the west-coast states of Malaysia 2) his study concentrates mainly on the factors that influence the Malaysian student's mathematics achievement (Khalid 1997). In his study to, Khalid (1997) found that confidence, socioeconomic status, gender beliefs, motivation, enjoyment, peers, location of school, school environment, ethnicity beliefs and previous achievement in mathematics were significant predictors of mathematics achievement among Malaysian schools.

Likewise, this is also reflected by the data analysis of primary school students by Lim and Saleh (2002) and Lim (2003). In 2000, a group of researchers led by Chap Sam Lim in Malaysia began a project to explore and identify the possible factors of the differences in mathematics learning in Malaysian primary and secondary school. In this project, Lim and his colleagues conducted their study on two elementary school which differed from each other in terms of locality, student family SES, student ethnic composition and institutional religious affiliation. The group's preliminary report (Lim and Saleh 2002; Lim 2003) shows that although the two primary schools which are expected to adhere to a common national mathematics curriculum, the different views of mathematics learning held by the students in these two schools demonstrate the extent to which family background (i.e. parents' occupation and education) plays an important part in the valuing process. In their attempt to compare mathematics learning among different ethnic groups, Lim and Saleh (2002) and Lim (2003) found that most Chinese medium schools favor more drill and practice, as well as more homework and tuition. An important implication from these studies is that student's family SES and home environment affect their views about the utility of mathematics and their enjoyment of it as a school subject.

In Malaysia, studies on mathematics learning and achievement have dominated the research. While their methods vary, these studies tend to conclude that non-Malays tend to perform better in mathematics because of the different ways students and parents valued mathematics learning. However, most of these studies were exploratory in nature, employing mostly classroom observations and in depth interviews. Therefore, their findings were far from conclusive and this dictates caution in generalizing these findings to the larger Malaysian society. In addition, the literature has not paid sufficient attention to science learning and achievement among Malaysian students. To the best of our knowledge, only one research (i.e. Mokshein 2002) has done to identify the factors that influence science achievement. Unlike other studies which employed mostly ethnographic studies and in depth interviews, Third International Math and Science Study (TIMSS) 1999 for Malaysia were employed in the studies of Mokshein (2002). Mokshein (2002)'s study found, among other things, that self-concept in science, awareness of the social implications of science, gender, and home educational resources were significantly related to achievement. However, factors such as parental and peer influences, perceived usefulness of science and shadow education, were not examined fully in Mokshein's study. Using the same data, this study attempts to fill the gap, by investigating the impact of students' background characteristics (age, gender, parental education, family socioeconomic status), significant others' influences (SOI), student's attitudes and educational expectations and shadow schooling on mathematics and science achievement.

STUDY OBJECTIVES AND HYPOTHESES

This study uses the broad conceptual framework (set out in Figure 1) developed by Hemmings (1996) and Professor Derek Cheung Sin Pui and his colleagues (2003) at the Chinese

University of Hong Kong. However, since their models were developed with the purpose of predicting final year secondary school achievement and analyzing students' academic and psychosocial development (using growth curve models), some aspects of this study and the variables selected will deviate from their models. This proposed study uses the TIMMS 1999 to extend previous research to better understand the contribution of students' background, significant others' influences (SOI), student's attitudes and educational expectations, shadow schooling and school characteristics on mathematics and science achievement of the eight graders in Malaysia. The main objective is to examine inter-ethnic differences in mathematics and science achievement of the eight graders in Malaysia. Based on the results of earlier research, the present study proposes to test the following hypotheses.

1. With respect to the effect of ethnicity, we follow Lim and Saleh (2002) and Lim (2003)'s line of reasoning to hypothesize that non-Malay natives and immigrants will have significantly higher scores in mathematics and science than Malay natives, controlling for other relevant factors.
2. Following Zhang (1999)'s findings on gender differences in mathematics and science achievement, we hypothesize that males will have significantly higher scores in mathematics and science than females, controlling for other relevant factors.
3. With respect to the effect of parent's education, we follow Sewell and Shah (1968) and Muller (1995)'s reasoning to hypothesize that parental education is positively related to mathematics and science achievement, controlling for other relevant factors.

4. With respect to the effect of family composition and structure, we follow McLanahan and Sandefur (1994)'s line of reasoning to hypothesize that students from single-parent and stepparent families have significantly lower scores in mathematics and science than those from two-parent families, controlling for other relevant factors.
5. With respect to the effect of parental and peer influences, we follow Ho and Willms (1996) and Natriello and McDill (1986)'s line of reasoning to hypothesize that such influences are positively related to mathematics and science achievement, controlling for other relevant factors.
6. Following Baker et al. (2001)'s findings on the role of shadow education on mathematics achievement, we hypothesize that controlling for other relevant factors, shadow schooling is positively related to mathematics and science achievement.
7. With respect to the effect of type of school community, we follow Zhang (1999)'s line of reasoning to hypothesize that schools located in an urban area have significantly higher mathematics and science achievement, compared to schools located in geographically isolated, village / rural area, sub-urban, or urban areas.
8. Controlling for other relevant factors, students from schools with a higher number of full time teachers will have significantly higher achievement in mathematics and science achievement.
9. Controlling for other relevant factors, students from schools with a higher severity of absenteeism will have significantly higher achievement in mathematics and science achievement.

DATA AND METHODS

Our empirical work was based on the cohort of grade eight Malaysian students who participated in the Third International Mathematics and Sciences Study Repeat (TIMMS-R 1999) conducted in 1998-9. TIMMS was conducted by the Dutch-based International Association for the Evaluation of Educational Achievement (IAE) and the International Assessment of Educational Progress (IAEP) (Mullis et al. 2000). TIMSS 1999 was organized by the IAE and managed by the International Study Center at Boston College, under the auspice of Michael O. Martin and Ina V.S. Mullis. This assessment resulted from the American education community's need for reliable and timely data on the mathematics and sciences achievement of American students compared to that of students in other countries (Mullis et al. 2000). Malaysia participated in the TIMMS 1999 study in 1998-2000 with 37 other countries. The main purpose of TIMSS 1999 was to assess students' mathematics and sciences achievement and factors connected to students’ achievement in 38 countries. In each country, nationally representative samples of approximately 3,500 students were assessed in about 150 schools. The target population for the 1999 assessment was 13 and 14 years old students, which in Malaysia meant students of the grade 8 (Form 2).

TIMSS 1999 used a two-stage sampling procedure to ensure a nationally representative sample of students. In the first stage, schools were randomly selected, and in the second stage, classrooms were randomly selected within schools. In each participating country, approximately 150 schools were randomly selected for the assessment. In each school, one or two mathematics classrooms of eighth-grade students were randomly selected for a total of about 3,500 eighth-grade students in each country.

The TIMMS 1999 data are particularly well-suited for our analysis because of a wide range of variables pertaining to students' mathematics and sciences achievement, the survey's large overall sample size and representativity. TIMMS 1999 is one of the few surveys which collected extensive information from students, parents, teachers, and school principals. Basic indicators reflecting student's attitudes towards mathematics and science, student's expectations for finishing school, and parental and peer influences were also recorded. According to the TIMSS 1999 international report, Malaysia was placed 16th in mathematics and 22nd place in science in the scoreboard for 38 countries (Mullis et al. 2000). The average mathematics and science score for Malaysian eight graders was 519 and 492 respectively, slightly above the international average of 487 and 488 respectively.

VARIABLES AND MEASURES

The exact methods and procedures that will be utilized in this study are still being examined, developed and refined. The selection of the variables, the construction of the model, and the choice of statistical methods will be closely linked to the ultimate practical value of the research. The model (or models) used in this study will be consistent with models from previous research so that current knowledge can be built upon and enhanced.

There are two outcome variables, namely the first plausible values in mathematics and science. The units of analysis in this study are individuals. Five categories of variables were used as predictors of mathematics and science achievement in this study: 1) students' background (ethnicity, gender, family socioeconomic status and family composition and structure), 2) significant others' influences (SOI), 3) student's attitudes and educational expectations, 4) shadow schooling and 5) school characteristics. The variables used in the analysis are summarized in Table 1. The results of the HLM analyses are presented in Table 2 and Table 3.

The first category describes the basic characteristics of students. These variables include ethnicity, gender, family socioeconomic status and family structure. *Ethnicity* is proxied by home language and is indicated by three dummy variables: non-Malay natives, Malay natives, and immigrants, with Malay natives serving as the reference category. *Sex* is indicated by dummy variables for males and females, with females serving as the reference category. *Family socioeconomic status (SES)* is approximated here by respondent's parent's education. Because the father's and mother's levels of educational attainment were highly correlated, we analyzed the effects of education based on which parent had the higher level of education. In addition, parent's education was recoded as years of schooling, as follows: some primary school or did not go to school = 3, finished primary school = 6, some secondary school = 8, finished secondary school = 12, some university = 13, and finished university = 15. In addition to the measures of family SES, we accounted for family composition and structure. *Family composition and structure* is indicated by dummy variables for two-parent families, single-parent families, stepparent families and a residual category (containing all types of family structures not mentioned above), with two-parent families serving as the reference category.

The second category of variables are measures of significant others' influences and these variables include *parental influence* and *peer pressure*. *Parental influence* and *peer pressure* were each approximated by two Likert variables that asked students how strongly they disagreed or agree with their mother's or friend's idea that it is important to do well in mathematics and science and their reasons for doing well in these two subjects. Students were asked to state their agreement with the following statements:

- My mother thinks it is important for me to do well in mathematics / science at school.
- I need to do well in mathematics / science to please my parent(s).
- Most of my friends think it is important for me to do well in mathematics / science at school.

For each statement, students responded on a four-point scale from 1= strongly agree to 4 = strongly disagree.

The third category of variables are measures of *student's attitude and educational expectations*. *Student's attitude* was approximated by four Likert variables that asked students how and why they themselves considered it important to do well in mathematics and science. Students were asked to state their agreement with the following statements:

- I need to do well in mathematics / science to get the job I want.
- I need to do well in mathematics / science to get into the <secondary school> or university I prefer.
- I need to do well in mathematics /science to please myself.
- I would like a job that involved using mathematics.

For each statement, students responded on a four-point scale from 1= strongly agree to 4 = strongly disagree. *Student's educational expectations* were measured by a single item that asked about the level of education the student expected to complete. The survey asked students, "How far do you expect to go in school?" Answers to the question were provided on a five-point scale from 1= some secondary school to 5 = finished university.

The fourth category of variables is measures of *shadow schooling*. This is a continuous variable measuring the number of hours the student reported spending on extra classes in mathematics and sciences before or after school in a week.

The final category of variables is measures of *school characteristics*. These variables include they type of school community (schools located in geographically isolated, village / rural area, sub-urban, or urban area), the number of full time teachers, and the severity of absenteeism.

DATA ANALYSIS PROCEDURES

With these variables, three models will be estimated for each dependent variable. Since the principal concern of this analysis is to examine the inter-ethnic differences in mathematics and science achievement of the eight graders in Malaysia, the analysis will begin by including ethnicity, gender, family socioeconomic status and family structure in the first (baseline) model. The second model adds measures of significant others' influences to consider the impact of parental influence and peer pressure on mathematics and science achievement. The third model adds student's attitudes and educational expectations. The final model adds school's characteristics. Each successive model builds on the previous model.

Individual within a particular group may be more likely to be affected by the structural conditions of that group and therefore they may be more similar to one another than individuals in other groups (Bryk and Raudenbash 1992; Kreft and De Leeuw 1998). Schools can also provide an appropriate context for examining educational achievement because they structure people's potential acquaintance and increase the likelihood of creating and maintaining peer groups. From a contextual point of view, this means introducing a multilevel approach in which individuals (the first level of analysis) are grouped in different contexts (the second level), and variables from the two levels can be jointly analyzed in a unified framework (Bryk and Raudenbash 1992; Kreft and De Leeuw 1998) can be used to establish effects and relationships.

Therefore, preliminary analysis of this study used multilevel modeling to estimate the relationship between the independent variables and the outcome variables.

PRELIMINARY RESULTS

Determinants of Mathematics Achievement

In Table 2 the results for model 1 show that controlling for gender, family socioeconomic status and family structure, the mathematics achievement of non-Malays natives was significantly higher than that of Malays natives. Immigrants performed as well as Malay natives. However, any comparison between immigrants and Malay natives needs to be interpreted with caution because of the small sample size. Controlling for ethnicity, family socioeconomic status and family structure, male students performed significantly better in mathematics than females students. Controlling for ethnicity, gender, and family structure, parent's education is positively associated with mathematics achievement. Controlling for ethnicity, gender, and parent's education, students from stepfamilies have significantly lower mathematics achievement than those from two-parent families. The addition of parental and peer influences, student's attitudes and educational expectations and shadow schooling in model 2 does not affect the statistical significance of ethnicity, gender, parent's education and family structure and only slightly changes their magnitudes. Additional controls for school characteristics in model 3 does not affect the statistical significance of ethnicity, gender, parent's education, family structure, parental and peer influences, student's attitudes and educational expectations and shadow schooling and only slightly changes their magnitudes. Models 2 and 3 show that peer's perceived importance of the subject is positively and significantly related to mathematics achievement. There is, however, no evidence that mother's perceived importance of the subject is significantly related to mathematics achievement. Student's attitudes and educational expectations is positively and significantly related to mathematics achievement. There is no evidence that shadow schooling is significantly related to mathematics achievement. Students from schools located in urban areas scored on average 18 points higher than those from schools located in geographically isolated and village / rural areas. The number of full time teachers is associated with higher mathematics achievement. Schools with a higher severity of absenteeism are associated with lower mathematics achievement.

Determinants of Science Achievement

In Table 3 the results for model 1 show that there are no ethnic differences in science achievement. Controlling for ethnicity, family socioeconomic status and family structure, male students performed significantly better in science achievement than females students. Controlling for ethnicity, gender, and family structure, parent's education is positively associated with mathematics achievement. There is no evidence that family structure is significantly related to science achievement. The addition of parental and peer influences, student's attitudes and educational expectations and shadow schooling in model 2 does not affect the statistical significance of ethnicity, gender, parent's education and family structure and only slightly changes their magnitudes. The effect of parent's education becomes marginally significant. Additional controls for school characteristics in model 3 does not affect the statistical significance of ethnicity, gender, parent's education, family structure, parental and peer influences, student's attitudes and educational expectations and shadow schooling and only slightly changes their magnitudes. Models 2 and 3 show that mother and peer's perceived importance of the subject are positively and significantly related to mathematics achievement. Most of the student's attitudes and educational expectations variables are positively and significantly related to science achievement. Shadow schooling is significantly related to science achievement once controls were added for school characteristics but the coefficients are not in the expected directions. As is the case with mathematics achievement, students from schools located in urban areas scored on average 14 points higher than those from schools located in geographically isolated and village / rural areas. Similarly, the number of full time teachers is associated with higher mathematics achievement and a higher severity of absenteeism is associated with lower mathematics achievement.

CONCLUSION

The analyses showed that non-Malay natives performed significantly better in mathematics but not science achievements than Malay natives, even when controls for students' background, significant others' influences (SOI), student's attitudes and educational expectations and shadow schooling on mathematics and science achievement were added. This finding resonates with earlier studies (e.g. Lim and Saleh 2002; Lim 2003) on the mathematics achievement of two primary schools in Malaysia. Our hypothesis about women's educational disadvantage was confirmed. Male students performed significantly better in mathematics and science achievement than females students. Our hypothesis regarding the role of parent's education proved correct only for mathematics achievement. Analysis of data revealed that parent's education was positively related to mathematics achievement but not science achievement. Students from stepparent families performed significantly worse in mathematics achievement than students from two-parent families. However, students from single parent families performed as well as students from two-parent families in but no significant gender differences were found for science achievement. There is, however, no evidence that living in single parent families or students living in non-parent households is significantly related to mathematics achievement. Our hypothesis regarding the role of parental and peer influences proved correct only for science achievement. Mother and peer's perceived usefulness of the subject is positively related to science achievement. There is, however, no evidence that mother's perceive usefulness of the subject is significantly related to mathematics achievement. Our hypothesis regarding the role of student's attitudes and educational expectations were confirmed for both mathematics and science achievement. In addition, our expectation with regard to students' perceived usefulness of the subject was also confirmed for mathematics and science achievement. In line with our hypothesis, students' educational expectation is a significant predictor of mathematics and science achievement. Our hypothesis regarding the role of shadow education proved correct only science achievement. There is some evidence that engagement in extra classes outside formal schooling is associated with science achievement when controls for school characteristics were added. Overall, our data show that student's attitudes and educational expectations as well as mother, peers' and student's own perceived usefulness of the subject and learning appear to impact on science achievement more than the language of instruction. Collectively, these results are consistent with previous results in the literature. All school characteristics are significantly related to mathematics and science achievement after controlling for students' background, significant others' influences (SOI), student's attitudes and educational expectations, and shadow schooling. The impact is positive for the type of school community and the number of full time teachers and negative for the severity of absenteeism.

DISCUSSION AND IMPLICATIONS

The design of effective and efficient education policies requires a more comprehensive knowledge of the determinants of educational achievement. While the analysis of the TIMSS 1999 do not allow for firm conclusions, this study is a step towards understanding the mathematic and sciences achievement among Malaysian students. Since education is an instrument for national development, national unity and personal development, the discrepancies in mathematics and science achievement may contribute to socioeconomic disparity among ethnic groups. Measuring and explaining the mathematic and sciences achievement of cultural minorities is more essential than ever as this unique understanding would assist Malaysian policy makers toward a more rational choice in implementing educational policies.

The results of this study suggest that there is a pressing need for more effective polices that seek to minimize the undesirable consequences of discrepancies in mathematics and science achievement. Government key policy deliberations must include formulating sound educational policies that provide appropriate support for parents, students, teachers and school, modifying curriculum, and adapting instructional practices. Educational policies could be designed that specifically take into account the school characteristics and family background characteristics of students. These policies will be crucial for a country like Malaysia that has been attempting to minimize the wealth inequality among ethnic groups. At the same times, it is equally important to generate positive attitudes towards mathematics and science among students. The critical concern is how to employ effective means to improve student’s motivation and parent’s support in order to promote awareness of the important and benefits of mathematics and science education. In addition, efforts aimed at enhancing women’s representation and involvement in mathematics and science education should be continued. Hopefully the results of this study will help the Ministry of Education (MOE), schools, teachers, and parents to identify ways to improve student's achievement in mathematics and science and in formulating policies pertaining to resource allocation in the improvement efforts in mathematics and science education.

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APPENDIX

Table 1: Variable Descriptions, percentages and means (sd), TIMSS 1999

Variables	Percent	Mean	SD
Ethnicity			
Malay (ref.)	58.20%		
Non-Malay	39.85%		
Immigrant	1.95%		
Sex			
Female (ref.)	55.26%		
Male	44.74%		
Family Socioeconomic Status			
Parent's Education		9.93	2.67
Family Structure			
Living with two parents	89.37%		
Single parent families	7.47%		
Stepfamilies	2.66%		
Living with others	3.16%		
Parental and Peers' Influence			
Mother's Expectation (Math)		1.25	0.46
Mother's Expectation (Science)		3.66	0.52
Peer Expectation (Math)		1.35	0.50
Peer Expectation (Science)		1.43	0.54
Do well to please parents (Math)		1.50	0.66
Do well to please parents (Science)		1.53	0.66
Student's Attitudes and Educational Expectations			
Highest grade expected		4.40	0.95
Self Expectation (Math)		3.82	0.40
Self Expectation (Science)		3.76	0.45
Do well to please self (Math)		3.42	0.69
Do well to please self (Science)		3.37	0.70
Do well to enter desired School (Math)		1.41	0.58
Do well to enter desired School (Science)		1.47	0.63
Do well to get desired jobs (Math)		1.45	0.60
Do well to get desired jobs (Science)		1.55	0.67
Like jobs involving Math		3.25	0.70
Like jobs involving Science		3.29	0.72
Shadow Schooling			
Extra lessons (Math)		1.90	1.06
Extra lessons (Science)		1.66	0.99
School Context			
Type of School Community			
Geographical Isolated Area	4.55%		
Village / Rural Area	38.17%		

Sub-Urban Area	16.41%		
Urban Area	40.87%		
Number of Full Time Teachers		78.23	27.84
Severity of Absenteeism		2.11	0.57

Table 2: Determinants of Mathematics Achievement, TIMMS-99

Variables	Model 1	Model 2	Model 3
Ethnicity			
Malay (ref.)			
Non-Malay	17.9248***	14.2623***	15.0041***
Immigrant	1.3925	2.6037	3.4889
Sex			
Female (ref.)			
Male	0.9082	4.8013**	4.0778**
Family Socioeconomic Status			
Parent's Education	0.9017**	0.6009**	0.5827**
Family Structure			
Living with two parents			
Single parent families	3.0457	3.6653	4.5005
Stepfamilies	-20.9248***	-19.8533***	-21.7654***
Living with others	-3.9989	-3.9630	-2.7039
Parental and Peers' Influences			
Mother's Expectation (Math)		1.1307	2.0324
Peer Expectation (Math)		11.5244***	10.8065***
Do well to please parents (Math)		8.768***	8.1444***
Student's Attitudes and Educational Expectations			
Highest grade expected		10.1178***	9.8658***
Self Expectation (Math)		15.4132***	16.5460***
Do well to please self (Math)		10.0682***	9.9965***
Do well to enter desired School (Math)		5.3531***	5.6033***
Do well to get desired jobs (Math)		2.8824**	2.6850*
Like jobs involving Math		7.9916***	7.3649***
Shadow Schooling			
Extra lessons (Math)		1.0131	0.9030
School Context			
Type of School Community			18.3611***
Number of Full Time Teachers			0.7033***
Severity of Absenteeism			-15.7187**
Constant	504.68***	300.16***	224.98***
Number of cases	5,435	5,317	5,163

Note: * Significant at 0.10, ** Significant at < 0.05, *** Significant at < 0.001

Table 3: Determinants of Science Achievement, TIMMS-99			
Variables	Model 1	Model 2	Model 3
Ethnicity			
Malay (ref.)			
Non-Malay	2.4170	1.0787	0.3820
Immigrant	-7.7686	-4.6645	-3.8050
Sex			
Female (ref.)			
Male	18.1955***	21.2889***	20.5098***
Family Socioeconomic Status			
Parent's Education	0.9873**	0.6127*	0.4182
Family Structure			
Living with two parents (ref.)			
Single parent families	-0.4799	0.0795	0.6127
Stepfamilies	-1.4109	1.9649	0.9877
Living with others	-5.2957	-4.8448	-6.6098
Parental and Peers' Influence			
Mother's Expectation (Science)		12.3133**	11.6633***
Peer Expectation (Science)		13.1167***	12.6916***
Do well to please parents (Science)		6.5299***	6.5415***
Student's Attitudes and Educational Expectations			
Highest grade expected		10.9199***	10.7230***
Self Expectation (Science)		7.7831**	7.9201***
Do well to please self (Science)		3.4726**	3.5341**
Do well to enter desired School (Science)		1.3170	0.6995
Do well to get desired jobs (Science)		4.6640**	5.4395**
Like jobs involving Science		6.4154***	6.0126***
Shadow Schooling			
Extra lessons (Science)		-1.4247	-1.8699**
School Context			
Type of School Community			14.0776**
Number of Full Time Teachers			0.5807***
Severity of Absenteeism			-11.4742
Constant	474.53***	286.68***	232.41***
Number of cases	5,435	5,307	5,157

Note: * Significant at 0.10, ** Significant at < 0.05, *** Significant at < 0.001

Figure 1: Conceptual Framework