Kajian Malaysia, Jld. XXV, No. 1, Jun 2007

ATTITUDES AND ACHIEVEMENT ORIENTATIONS OF STUDENTS TOWARDS LEARNING OF SCIENCE AND MATHEMATICS IN ENGLISH

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This study examines the policy of teaching science and mathematics in English in the Malaysian educational system by focusing on the attitudes and achievement orientations of secondary school students towards the learning of these two subjects. Attitudes and achievement are two important outcomes of learning that will determine the effectiveness of an education policy. This study is based on a sample of 400 secondary school students selected from four non-premier schools. It looks into the students' general attitudes and achievement orientations towards learning of science and mathematics as well as their variations according to four background variables, i.e., gender, ethnicity, types of feeder school and English achievement grades. It also examines the inter-correlations between the students' attitudes and achievement orientations. Findings from statistical analyses of collected data were supplemented by more in-depth interviews. This study shows that the students' general attitudes and achievement orientations towards learning of science and mathematics in English do not indicate that the policy has achieved its objective. However, their attitudes and achievement motivations vary according to the four background variables. The significant and positive inter-correlations between attitudes and achievement orientations towards learning of science and mathematics further confirm the causal relationship between these two important dimensions of learning.

Keywords: science, mathematics, attitudes, orientation

INTRODUCTION

One important development that is currently evolving within the Malaysian educational system is the newfound role of English as a medium of instruction. As of the beginning of 2003, science and mathematics are being taught in English in the national and vernacular primary schools and the secondary schools. This is being implemented in stages and will eventually cover all standards and forms in the primary, secondary and post-secondary classes by 2008. Significantly, this policy is a clear departure from former language policy, which was underpinned by the euphoria of linguistic nationalism as a notion of nation building. The partial reintroduction of English as a medium of instruction in place of the Malay language, the national language, is undeniably a market driven policy responding to the emergence of English as a global language in the era of globalisation. It is evident that English is now entrenched worldwide and Malaysia has to keep abreast of current global trends or risk losing its competitive edge in the global economy, which has been transformed by the massive increase in the flow of information in English via information and communications technology, as well as a new economic emphasis of turning this information into productive knowledge. Competency in English has now become a crucial aspect of human capital development, especially in the areas of science, engineering and technology. Thus, the implementation of the policy of teaching science and mathematics in English is in line with current development and ultimately, it is hoped that this would help to strengthen the students' proficiency in English, enabling them to access new frontiers of knowledge in science, engineering and technology. This then is the underlying rationale of implementing the policy of teaching science and mathematics in English.

Admittedly, the policy of teaching science and mathematics in English poses new challenges to students. There is a genuine concern that this policy might adversely affect the learning of these two subjects as Malaysian students generally lack proficiency in English to cope when English is used as the language medium through which science and mathematics are being taught. English was once used as a medium of instruction in the Malaysian educational system. But when English was phased out as a medium of instruction beginning in the 1970s, it was taught only as a subject in the school curriculum. As a result, standards of English have declined drastically (Gill, 2002). English has become

the weaker language for most Malaysians. It is only in big cities and amongst upper and middle class families that English is more widely spoken at home. In view of the importance of the policy to reintroduce the teaching of science and mathematics in English in the long-term interest of the nation, its impact, especially from the perspectives of those who experience its effects directly, i.e., the students, needs to be evaluated to find out what is really happening in practice, the discrepancy between the desired objective and what is actually achieved. As the policy is into its final stages of implementation and taking note of the fact that all teething problems would have been resolved by now, it is thus fair and timely to evaluate the policy. Any policy, which claims to be effective, has to be able to bring about the right kind of impact on the students' learning processes. In this respect, two important and closely related issues of learning, namely attitude and achievement orientation, are examined by this study. Attitude and achievement have often being cited as important and desirable educational outcomes. Thus, by examining these two key issues, this study aims to provide perceptive insights into the outcomes of the policy of teaching science and mathematics in English at the school level.

ATTITUDES AND ACHIEVEMENT ORIENTATIONS TOWARDS LEARNING

Attitude is a hypothetical construct. Triandis (1971) defines attitude as an idea charged with emotion, which predisposes a class of actions to a particular class of social actions. He identifies three main components attached to attitudes. First, a cognitive component, that is the idea which is generally some category used by humans in thinking, whereby categories are inferred from consistencies in responses to discriminably different stimuli. Second, an affective component, that is the emotion, which charges the ideas. Third, a behavioural component associated with a predisposition to action. However, it is difficult to separate out these three components, as they tend to interact and merge with one another. From another perspective, Baker (1988) defines attitudes as inferred, conceptual inventions hopefully aiding the description and explanation of behaviour. Seen in this context, attitudes are learned predispositions, not inherited or genetically endowed, and are likely to be relatively stable over time. Lewis (1981) offers another important insight into the nature of attitudes. He sees attitudes as mental sets, which are a cluster

of preconditions that determine the evaluation of a task, a situation, an institution, or an object before one actually faces it. Wenden (1991) sums up attitudes as learned motivations, valued beliefs, evaluation, or what one believes is acceptable.

It is generally true that attitudes of students towards learning of a subject have a significant impact on the outcome of their learning processes. It is equally important to note here that in any learning processes, attitude is not only a causal or input variable, it also needs to be thought of as output or outcome variable (Baker, 1988). Attitude conceived as an outcome of education is important because it may provide a complimentary or even alternative and more long-lasting effect than examination achievement. Thus, a positive attitude towards a subject may be a more enduring outcome than knowledge gained in passing examination.

There are many types of learning orientations that influence the learning processes of students, of which achievement orientation is a major concern for educators and policy planners. Achievement orientation is driven by achievement motivation. Achievement motivation as defined by Maehr (1974) refers, first of all, to behaviour that occurs in reference to a standard of excellence and thus can be evaluated in terms of success and failure. A second defining condition is that the individual must in some sense be responsible for the outcome. Third, there is some level of challenge and therewith some sense of uncertainty involved. Many studies have categorically shown that there is a strong relationship between attitude and achievement (Hough & Piper, 1982; Simpson & Oliver, 1990; Marjoribanks, 1976; Shauhnessy & Haladyna, 1985). Mager (cited in Foong, 1994) affirmed that the development of positive attitudes towards school subject is essential. Students with a positive attitude towards a subject are more likely to continue their learning in the area, both formally and informally, after the direct influence of the teacher has eroded. Marjoribanks (1987) highlighted the fact that in psychological models of educational performances, academic achievement is typically related to measures of ability and attitudes.

Thus, by examining the students' attitudes and achievement orientations towards learning of science and mathematics in English, this study can effectively evaluate the impact and outcome of the implementation of the policy of teaching science and mathematics in English, especially

from the perspectives of those who experience its effects directly – the students.

OBJECTIVES OF THE STUDY

This study is essentially a policy analysis. It is guided by the following three objectives. First, it examines the students' attitudes towards learning of science and mathematics in English and how these attitudes are influenced by their background variables, which include gender, ethnicity, types of feeder school and English achievement grades. Second, it examines the students' achievement orientations towards learning of science and mathematics in English and how these orientations are influenced by their background variables. Third, it examines the inter-correlations between the students' attitudes and their achievement orientations towards learning of science and mathematics in English.

This study is based on the premise that attitudes and achievement orientations determine outcomes of learning. In recent years, attitudes are increasingly being researched into as an important educational outcome. It has been proven in most research that attitudes towards school subjects influence academic achievement. Even at different ability levels, the increases in achievement were attributed to increments in attitude scores (Marjoribanks, 1976). Thus, by examining the attitudes and achievement orientations of students towards learning of science and mathematics in English, this study evaluates two important outcomes of the policy of teaching science and mathematics in English at the school level. This will then help us to assess the extent of impact brought about by this policy on the students' learning processes. This impact is seen from various perspectives based on the students' different background variables.

RESEARCH METHODOLOGY

This study surveyed four secondary schools located in two districts in a northern state of Malaysia. Although all the sample schools came from a single state, it was felt that this would not, in any way, undermine the objectivity of this study as the selection of the sample schools was based

on representative sampling whereby the characteristics of schools that fit into the design of this study formed the basis of selection. By and large, the findings of this study would be reflective of the state of affairs in schools in the states of Malaysia, which share the same characteristics as the sample schools.

All the schools sampled for this study were non-premier schools. In contrast to premier schools where selection of students is determined by the state education department based on academic credentials, non-premier or ordinary schools are schools where there is no selective intake (Lee et al., 1996). It was felt that non-premier schools would provide more insights into the issues examined by this study, as the problems of learning were more acute in these schools. Furthermore, the selection of non-premier schools was also based on the premise that non-premier schools are mainstream schools in Malaysia and thus the findings obtained from this study would be able to reflect the situation in most secondary schools. The selection of sample schools also took into consideration, the four background variables of the students examined by this study:, namely gender, ethnicity, types of feeder school and English achievement grades. In order to accommodate the first three variables, the sample schools were multi-racial and co-educational schools. The inclusion of gender as a background variable was based on the premise that there were gender preferences in learning of science and mathematics as indicated by many studies (Collis & Williams, 1987; Finn et al., 1979). As to the background variables of ethnicity and feeder schools, it is important to point out here that the Malaysian educational system allows three types of primary school that use different media of instruction to coexist, namely Chinese primary school, Tamil primary school and national school. Most Chinese in Malaysia attend Chinese primary schools that use Mandarin as the main medium of instruction. However, the situation is quite different for the Indians in Malaysia. Not all Indians go through Tamil primary education. Slightly more than 50% of Indian students, especially those from upper and middle class families, attend national schools, which use the Malay language as the main medium of instruction. As for Malay students, most of them attend national schools, although of late, an increasing number of Malay parents are sending their children to Chinese primary schools. The background variables of feeder school and ethnicity may show a certain degree of overlap, especially in the case of the Chinese and Malay students, however, they are relevant to the Indian students, especially

those who attend national school rather than Tamil primary school. Thus, significant findings may arise out of comparison of these two background variables for the Indian students. With regards to the selection of English achievement grades as one of the background variables, it was felt that the mastery of the language medium is crucial in the learning processes of science and mathematics. Many studies have highlighted the importance of the grasp of language medium as a prerequisite for effective learning, notably Macnamara (1987). In the context of this study, English achievement grades of the students in the Primary School Assessment Test or *Ujian Penilaian Sekolah Rendah* (UPSR), a public assessment test conducted at the end of the final year of their primary educations, are used as yardstick to gauge their levels of English proficiency. The students were divided into three groups based on their English achievement grades: namely good, average and poor. It is also important to point out here that at the time of the study, the students in this sample had not learned science and mathematics in English at the primary level. It was only at the secondary level that the policy of teaching science and mathematics in English was imposed on them. Thus, the sample in this study could also provide meaningful insights into the problem of language medium transition.

This study employed a combination of quantitative and qualitative research methodologies whereby generalisations obtained from quantitative data were supplemented by qualitative analysis during in-depth interview. During the first stage, respondents were drawn from Form One (Secondary Year One) students for quantitative analysis. It was felt that these students were at the initial stages of secondary education and whatever problems encountered by them would have a lasting impact on their subsequent years of schooling. A total of 400 students, i.e., 100 students from each sample school, were randomly selected. One set of questionnaire consisted of three sections, was administered to the students to gather quantitative data pertaining to issues raised by this study. The first section focused on background information of the students. The second section dealt with attitudes and achievement orientations of students' towards learning of science. The third section concentrated on attitudes and achievement orientations of students' towards learning of mathematics. The second and third sections of the questionnaire consisted of similar sets of items, one each for science and mathematics. Altogether 17 items, rated on a 6-point Likert Scale (from strongly disagree of 1 to strongly agree of 6), were

developed. Out of the 17 items, 9 items were on attitudes of students, while the other 8 items were on achievement orientations. The items on attitudes were adapted and modified from items that were originally used by Baker (1993) and Gardner (1985) to assess attitudes towards language. The items on achievement orientations were adapted and modified from the six-country study of Little et al. (1987) on students' learning orientations. All the items in the questionnaires were translated into the Malay language and validated by Malay language experts. A pilot test involving 50 students was conducted to check the reliability of the items as well as to rephrase some of the items, which were ambiguous.

The second stage involved in-depth interviews with students, teachers and administrators. Face-to-face interviews were conducted by the researcher based on semi-structured questions that aimed to elicit opinions on the statistical findings obtained from the first stage of research and also other relevant issues. Interviews involved 60 students, 20 science and mathematics teachers and eight administrators selected from all the sample schools. Data collected from the interviews were then cross-examined to draw conclusions.

FINDINGS AND DISCUSSIONS

Attitudes Towards Learning of Science and Mathematics

The two 9-item scales that were being used to assess the attitudes of students towards learning of science and mathematics were evaluated for their internal consistency by using Cronbach's alpha coefficients. The two scales showed high reliability coefficients, i.e., 0.8992 for science and 0.8916 for mathematics.

The students' general attitudes towards learning of science are found to be negative, while their attitudes towards learning of mathematics are slightly negative. This was clearly indicated by the mean scores of the attitudinal scales, which were 2.2625 and 2.7175 for science and mathematics respectively (for interpretation of mean scores, see Table 1).

Table 1: Interpretation of Mean Score for Attitudes.

1.0000 – 1.8333	Very negative
1.8334 – 2.6667	Negative
2.6668 – 3.5001	Slightly negative
3.5002 – 4.3335	Slightly positive
4.3336 – 5.1669	Positive
5.1670 – 6.0000	Very positive

Table 2 shows that the attitudes of the students towards learning of mathematics are more positive than their attitudes towards learning of science ($t = 7.902$, $df = 399$, $p = 0.000$). Findings from interviews have revealed that students face more learning difficulty in science than in mathematics. Most students are unable to understand fully abstract science concepts that are being taught in English. Apparently, this has affected their attitudes towards learning of science. In the case of mathematics, the extent of difficulty is less severe as it involves more numeracy skills than abstract concepts in English. The perceptions of the students on the level of language difficulty in science and mathematics textbooks obtained from background information further strengthen the interview findings. 48.5% of the students indicate that the level of English in the textbook is difficult as compared with only 19.5% in the case of mathematics textbook.

Table 2: T-test for General Attitudes Towards Mathematics and Science.

Attitudes	N	Mean	SD	Mean difference	t value	df	p value
Mathematics	400	2.7175	1.29107	0.4550	7.902	399	0.000
Science	400	2.2625	1.22979				

Level of significance is at $p < 0.05$.

However, the attitudes of the students towards learning of mathematics differ significantly by gender. While there is no significant difference in attitudes towards learning of science by gender, there is a significant difference in attitudes towards learning of mathematics by gender as shown in Table 3. The attitudes of female students towards learning of mathematics are more positive than male students ($t = –2.322$, $df = 398$, $p = 0.021$). Interestingly, these findings have deviated from the well-established notion that male students are more inclined towards science and mathematics, which are seen by many as masculine subjects (see for

example, Collis & Williams, 1987; Finn et al., 1979). In the context of this study, gender preferences towards subjects have not emerged as an issue. Findings from interviews appear to attribute this difference in attitudes to the fact that female students are consistently more hard-working than male students and thus are able to cope better than their male peers in their learning processes. However, the mean score of the female students, which was 2.8711, indicates that their attitudes towards learning of mathematics remain slightly negative.

Table 3: T-test for Attitudes Towards Science and Mathematics by Gender.

Subjects	Gender	N	Mean	SD	Mean difference	t value	df	p value
Science	Male	206	2.1990	1.23138	–0.1309	–1.064	398	0.288
	Female	194	2.3299	1.22767				
Maths	Male	206	2.5728	1.27338	–0.2983	–2.322	398	0.021
	Female	194	2.8711	1.29523				

Level of significance is at $p < 0.05$.

The attitudes of the students towards learning of science and mathematics vary markedly by UPSR English achievement grades. Table 4 shows that the students' UPSR English achievement grades have a significant impact on their attitudes towards learning of science, $F (2, 397) = 30.244$, $p = 0.000$, and mathematics, $F (2, 397) = 17.445$, $p = 0.000$.

Table 4: ANOVA for Attitudes Towards Science and Mathematics by UPSR English Achievement Grades.

Subjects		Sum of squares	df	Mean square	f value	p value
Science	Between Groups	79.784	2	39.892	30.244	0.000
	Within Groups	523.653	397	1.319		
	Total	603.438	399			
Mathematics	Between Groups	53.729	2	26.864	17.445	0.000
	Within Groups	611.349	397	1.540		
	Total	665.078	399			

Level of significance is at $p < 0.05$.

Table 5 illustrates that students with good UPSR English grades have better attitudes than students with average and poor UPSR English grades towards learning of science and mathematics. Findings from interviews have revealed that the grasp of the language medium is a hotly debated issue among interviewees. One teacher puts it succinctly, "The whole policy of teaching science and mathematics in English is a flop. Students are hampered by the lack of competency in English as most of them do not come from English speaking family. As such, the language medium has become a barrier to them". It is important to note here that even the attitudes of students with good UPSR English achievement grades are slightly negative towards learning of science and mathematics in English as indicated by their mean scores of 3.4776 for mathematics and 3.2090 for science. While the students' attitudes towards learning of science and mathematics may also be influenced by other factors, there is no doubt that many students in this sample face the problem of inadequate grasp of the language medium, especially in learning of science. Apparently, the levels of English proficiency acquired by them through learning of English as a subject at the primary schools are inadequate for them to use English as an effective tool for learning. The adverse impacts of such problem on the students' learning processes have been well documented by Macnamara (1966, 1967), Cummins (1978) and Baker (1993). It has to be stressed here that the language used in science is often context-reduced. This brings to the fore the importance of cognitive-academic language proficiency (CALP), which includes the ability to engage in abstract thought in cognitively highly demanding circumstances (Ovando & Collier, 1985). It seems that most students in this sample do not have the required CALP of English to enable them to study science effectively. At best, they could only manage to acquire the basic interpersonal communicative skills (BICS), i.e., context-embedded and cognitively undemanding face-to-face communication skills.

The attitudes of the students towards learning of science and mathematics were also compared with the types of feeder school that the students came from. Table 6 indicates that there is a significant difference between the mean score of the students' attitudes towards learning of science, $F(2, 397) = 4.692$, $P = 0.010$, and mathematics, $F(2, 397) = 5.062$, $p = 0.007$, by feeder schools.

Table 5: Post Hoc Scheffe Test for Attitudes Towards Science and Mathematics by UPSR English Achievement Grades.

Subjects	English achievement grades		Mean difference	Std. error	p value
Science	Good	Average	1.0430	0.15862	0.000
	(N = 67)	Poor	1.3829	0.18446	0.000
	Average	Good	–1.0430	0.15862	0.000
	(N = 241)	Poor	0.3399	0.14075	0.055
	Poor	Good	–1.3829	0.18446	0.000
	(N = 92)	Average	–0.3399	0.14075	0.055
Mathematics	Good	Average	0.8220	0.17139	0.000
	(N = 67)	Poor	1.1515	0.19930	0.000
	Average	Good	–0.8220	0.17139	0.000
	(N = 241)	Poor	0.3295	0.15208	0.097
	Poor	Good	–1.1515	0.19930	0.000
	(N = 92)	Average	–0.3295	0.15208	0.097

Level of significance is at $p < 0.05$.
Note: N= number of students

Table 6: ANOVA for Attitudes Towards Science and Mathematics by Feeder Schools.

Subjects		Sum of squares	df	Mean square	f value	p value
Science	Between groups	13.935	2	6.967	4.692	0.010
	Within groups	589.503	397	1.485		
	Total	603.437	399			
Mathematics	Between groups	16.539	2	8.269	5.062	0.007
	Within groups	648.539	397	1.634		
	Total	665.077	399			

Level of significance is at $p < 0.05$.

Table 7 shows that the mean score of students from national schools is higher than students from Chinese primary schools where learning of science is concerned. In the case of mathematics, the mean score of students from national schools is higher than students from Tamil primary schools. In both cases, students from national schools show better attitudes than students from Chinese and Tamil primary schools. Apparently, it is the Indian students enrolled in national schools that

have a significant impact on the findings. We will come back to this point shortly. However, the attitudes of students from national schools towards learning of science and mathematics remain poor. The mean scores of 2.4579 for science and 2.8947 for mathematics show that their attitudes are far from positive towards the learning of these two subjects. One important implication of the above findings pertains to students from Chinese primary schools. As students from Chinese primary schools are generally known for their strengths in science and mathematics, it appears that they have lost out when these two subjects are being taught in English. A check on the background information has revealed that students from Chinese primary schools perform much better in science and mathematics than students from other types of primary school in the UPSR. For example, 40.9% of them scored grade A in science as compared with 15.3% for students from national schools and 21.3% for students from Tamil primary schools. In the case of mathematics, the number of students from Chinese primary schools scoring A (70.1%) in the UPSR far outnumbered students from national schools (24.7%) and Tamil primary schools (30.4%).

Table 7: Post Hoc Scheffe Test for Attitudes Towards Science and Mathematics by Feeder Schools.

Subjects	Types of feeder school		Mean difference	Std. error	p value
Science	NS	CS	0.3847	0.12988	0.013
	(N = 190)	TS	0.3275	0.20024	0.264
	CS	NS	−0.3847	0.12988	0.013
	(N = 164)	TS	−0.0573	0.20331	0.961
	TS	NS	−0.3275	0.20024	0.264
	(N = 46)	CS	−0.0573	0.20331	0.961
Mathematics	NS	CS	0.2545	0.13623	0.176
	(N = 190)	TS	0.6339	0.21003	0.011
	CS	NS	−0.2545	0.13623	0.176
	(N = 164)	TS	0.3794	0.21325	0.207
	TS	NS	−0.6339	0.21003	0.011
	(N = 46)	CS	−0.3794	0.21325	0.207

Level of significance is at $p < 0.05$.
Note: CS = Chinese primary school, TS = Tamil primary school, NS = national school
N = number of students

Table 8: ANOVA for Attitudes Towards Science and Mathematics by Ethnicity.

Subjects		Sum of squares	df	Mean square	f value	p value
Science	Between groups	8.856	2	4.428	2.956	0.053
	Within groups	594.582	397	1.498		
	Total	603.438	399			
Mathematics	Between groups	0.390	2	0.195	0.116	0.890
	Within groups	664.687	397	1.674		
	Total	665.077	399			

Level of significance is at $p < 0.05$.
Note: N = number of students

Findings on the attitudes of the students' towards learning of science and mathematics by ethnicity provide some noteworthy information. As shown in Tables 8 and 9, there are no significant differences in the students' mean scores by ethnicity for both subjects. However, these findings, when compared with earlier findings by feeder schools, have demonstrated the contrasting impact of the two background variables. It is important to note here that out of the 190 students from the national school sample, 48 of them are non-Malays. Out of these 48 students, 46 are Indians and only two are Chinese. Thus, Indian students constitute the majority of non-Malays in the national school sample. This group of students, when taken out of the national school sample and put under the category of Indian, has clearly influenced the findings of attitudes by ethnicity. Findings from interviews have revealed that most of these students are from English-speaking middle class families. They are found to be very supportive of the policy of teaching science and mathematics in English. Commenting on the policy, one student from this group has this to say, "I am comfortable with the use of English as medium of instruction to teach science and mathematics." This group of students has in fact benefited most from the policy of teaching science and mathematics in English as they have a good command of English. Apparently, their presence in the national school sample has increased the mean score to the extent that the mean score is significantly different from the mean scores of students from other types of feeder school. On the other hand, the findings on the students' attitudes towards learning of science and mathematics by ethnicity further confirm the fact that students from Chinese primary schools (most of them are Chinese) have undoubtedly lost their competitive edge in science and mathematics.

Table 9: Post Hoc Scheffe Test for Attitudes Towards Science and Mathematics by Ethnicity.

Subjects	Ethnicity		Mean difference	Std. error	p value
Science	Malay	Chinese	0.2074	0.13989	0.334
	(N = 142)	Indian	–0.1684	0.16379	0.590
	Chinese	Malay	–0.2074	0.13989	0.334
	(N = 166)	Indian	–0.3759	0.15906	0.063
	Indian	Malay	0.1684	0.16379	0.590
	(N = 46)	Chinese	0.3759	0.15906	0.063
Mathematics	Malay	Chinese	0.0587	0.14791	0.924
	(N = 142)	Indian	–0.0106	0.17317	0.998
	Chinese	Malay	–0.0587	0.14791	0.924
	(N = 166)	Indian	–0.0693	0.16818	0.919
	Indian	Malay	0.0106	0.17317	0.998
	(N = 92)	Chinese	0.0693	0.16818	0.919

Level of significance is at $p < 0.05$.
Note: N = number of students

Achievement Orientations Towards Learning of Science and Mathematics

The two 8-item scales that were being used to assess the students' achievement orientations towards learning of science and mathematics were also tested for their internal consistency. The items on science have moderate reliability with a Cronbach alpha of 0.6951, while the items on mathematics have fairly high reliability with a Cronbach alpha of 0.7380.

Table 11 shows that the mean scores of the students' achievement orientations towards learning of science and mathematics, which were 2.5650 and 2.7400 respectively, indicates that the students in general are low in their achievement orientations towards learning of science and slightly low towards learning of mathematics (for interpretation of mean scores, see Table 10). However, their achievement orientations towards learning of mathematics are higher than that of science ($t = 2.706$, $df = 399$, $p = 0.007$). Most students interviewed are of the opinion that it is

easier to learn mathematics than science and as such they are more motivated to learn mathematics than science.

Table 10: Interpretation of Mean Score for Achievement Orientations.

1.0000 – 1.8333	Very low
1.8334 – 2.6667	Low
2.6668 – 3.5001	Slightly low
3.5002 – 4.3335	Slightly high
4.3336 – 5.1669	High
5.1670 – 6.0000	Very high

Table 11: T-test for Achievement Orientations between Mathematics and Science.

Attitudes	N	Mean	SD	Mean difference	t value	df	p value
Mathematics	400	2.7400	1.33861	0.1750	2.706	399	0.007
Science	400	2.5650	1.21839				

Level of significance is at $p < 0.05$.

However, Table 12 shows that the students' achievement orientations in mathematics differ significantly by gender. Female students are higher in their achievement orientations than male students ($t = –2.439$, $df = 398$, $p = 0.015$). Again, this difference is due to the fact that female students tend to put in more effort in their studies than male students. Nevertheless, the mean score of female students, which was 2.9072, indicates that they are slightly low in their achievement orientations towards learning of mathematics.

Table 12: T-test for Achievement Orientations Towards Science and Mathematics by Gender.

Subjects	Gender	N	Mean	SD	Mean difference	t value	df	p value
Science	Male	206	2.5097	1.21671	–0.1140	–0.935	398	0.350
	Female	194	2.6237	1.22057				
Math-ematics	Male	206	2.5825	1.28423	–0.3247	–2.439	398	0.015
	Female	194	2.9072	1.37771				

Level of significance is at $p < 0.05$.

Language proficiency is undoubtedly an important factor that has a significant impact on the students' achievement orientations towards learning of science and mathematics. Table 13 shows that there are significant differences between the students' UPSR English achievement grades and their achievement orientations towards science, F (2, 397) = 15.201, P = 0.000, and mathematics, F (2, 397) = 17.607, p = 0.000.

Table 13: ANOVA for Achievement Orientations Towards Science and Mathematics by UPSR English Achievement grades.

Subjects		Sum of squares	df	Mean square	f value	p value
Science	Between groups	42.133	2	21.066	15.201	0.000
	Within groups	550.177	397	1.386		
	Total	592.310	399			
Mathematics	Between groups	58.250	2	29.125	17.607	0.000
	Within groups	656.710	397	1.654		
	Total	714.960	399			

Level of significance is at $p < 0.05$.

Table 14 shows that students with good UPSR English achievement grades are more achievement oriented than students with average and poor UPSR English achievement grades towards learning of both science and mathematics. However, their levels of achievement orientations towards the learning of these two subjects differ as indicated by the mean scores. Their level of achievement orientation is slightly low in the case of science (3.2537) but slightly high in the case of mathematics (3.5075). There is also a significant difference in achievement orientations between students with average and poor UPSR English achievement grades. But this difference only applies to the case of mathematics. Students with average achievement grades are found to be more achievement oriented than students with poor achievement grades. Nevertheless, the mean score, which was only 2.6971, indicates that they are still slightly low in their achievement orientations towards learning of mathematics. It is not surprising that students with better UPSR English achievement grades are more achievement oriented than other students towards learning of science and mathematics. Obviously, due to their better proficiency in English, they are able to engage more fruitfully in the learning processes than other students.

Table 14: Post Hoc Scheffe Test for Achievement Orientations Towards Science and Mathematics by UPSR English Achievement grades.

Subjects	English Achievement Grades		Mean difference	Std. error	p value
Science	Good	Average	0.7600	0.16259	0.000
	(N = 67)	Poor	1.0037	0.18907	0.000
	Average	Good	–0.7600	0.16259	0.000
	(N = 241)	Poor	0.2428	0.14427	0.241
	Poor	Good	–1.0037	0.18907	0.000
	(N = 92)	Average	–0.2438	0.14427	0.241
Mathematics	Good	Average	0.8104	0.17736	0.000
	(N = 67)	Poor	1.2140	0.20657	0.000
	Average	Good	–0.8104	0.17763	0.000
	(N = 241)	Poor	0.4036	0.15762	0.039
	Poor	Good	–1.2140	0.20657	0.000
	(N = 92)	Average	–0.4036	0.15762	0.039

Level of significance is at $p < 0.05$.
Note: N = Number of students

Table 15: ANOVA for Achievement Orientations Towards Science and Mathematics by Feeder Schools.

Subjects		Sum of squares	df	Mean square	f value	p value
Science	Between groups	11.633	2	5.817	3.977	0.019
	Within groups	580.677	397	1.463		
	Total	592.310	399			
Mathematics	Between groups	30.988	2	15.494	8.993	0.000
	Within groups	683.972	397	1.723		
	Total	714.960	399			

Level of significance is at $p < 0.05$.

The types of feeder school that the students came from also have a significant impact on the students' achievement orientations towards learning of science, $F(2, 397) = 3.977$, $p = 0.019$, and mathematics, $F(2, 397) = 8.993$, $p = 0.000$, as shown in Table 15.

Table 16 shows that students from Chinese primary schools are more achievement oriented than students from Tamil primary schools towards learning of science. In the case of mathematics, students from Chinese primary schools are not only more achievement oriented than students from Tamil primary schools but also students from national schools. However, the mean scores of students from Chinese primary schools, which were 2.7256 and 3.1024 for science and mathematics respectively, indicate that they are slightly low in their achievement orientations towards learning of the two subjects. Paradoxically, while earlier findings have shown that the attitudes of students from Chinese primary schools towards learning of science and mathematics are no better than students from other types of feeder school, but when it comes to achievement orientations, they appear to have higher achievement orientations than those from national or Tamil feeder schools. Findings from interviews have revealed that most of the students from Chinese primary schools attend tuition classes and this has definitely helped them to achieve better than students from other types of feeder school. This is further confirmed by background information obtained from the students whereby the number of students from Chinese primary schools attending tuition classes in science and mathematics far outnumbered students from national schools and Tamil primary schools. Out of a total of 164 students from Chinese primary schools, 85 or 51.8% attended science tuition classes and 90 or 54.9% attended mathematics tuition classes. In the case of students from national schools, out of a total of 190 students, only 37 or 19.5% attended science tuition classes and only 44 or 23.2% attended mathematics tuition classes. Like students from national schools, the number of students from Tamil primary schools attending tuition classes was equally small, i.e., out of a total of 46 students, 9 or 19.6% attended science tuition classes and 12 or 26.1% attended mathematics tuition classes.

Table 16: Post Hoc Scheffe Test for Achievement Orientations Towards Science and Mathematics by Feeder Schools.

Subjects	Types of feeder school		Mean difference	Std. error	p value
Science	NS	CS	−0.2046	0.12891	0.285
	(N = 190)	TS	0.3471	0.19873	0.219
	CS	NS	0.2046	0.12891	0.285
	(N = 164)	TS	0.5517	0.20178	0.025
	TS	NS	−0.3471	0.19873	0.219
	(N = 46)	CS	−0.5517	0.20178	0.025
Mathematics	NS	CS	−0.4208	0.13990	0.011
	(N = 190)	TS	0.4201	0.21569	0.151
	CS	NS	0.4208	0.13990	0.011
	(N = 164)	TS	0.8409	0.21899	0.001
	TS	NS	−0.4201	0.21569	0.151
	(N = 46)	CS	−0.8409	0.21899	0.001

Level of significance is at $p < 0.05$.
CS = Chinese primary school, TS = Tamil primary school, NS = national school
Note: N = Number of students

The students' achievement orientations towards learning of science and mathematics have been influenced by ethnicity. Table 17 shows that there are significant differences between ethnicity and achievement orientations towards learning of science, $F (2, 397) = 3.251$, $p = 0.040$, and mathematics, $F (2, 397) = 11.080$, $p = 0.000$. Table 18 shows that Chinese students are more achievement oriented than Malay students towards learning of science. In the case of mathematics, Chinese students are more achievement oriented than Malay and Indian students. However, their mean scores of 2.7410 and 3.1024 for science and mathematics respectively indicate that their achievement orientations towards learning of the two subjects remain slightly low. Interestingly, as in the case of attitudes towards learning of science and mathematics, Indian students enrolled in the national schools again influence the findings on ethnicity. However, their impact on achievement orientations is only restricted to learning of science.

Table 17: ANOVA for Achievement Orientations Towards Science and Mathematics by Ethnicity.

Subjects		Sum of squares	df	Mean square	f value	p value
Science	Between groups	9.544	2	4.772	3.251	0.040
	Within groups	582.766	397	1.468		
	Total	592.310	399			
Mathematics	Between groups	37.797	2	18.898	11.080	0.000
	Within groups	677.163	397	1.706		
	Total	714.960	399			

Level of significance is at $p < 0.05$.

Table 18: Post Hoc Scheffe Test for Achievement Orientations Towards Science and Mathematics by Ethnicity.

Subjects	Ethnicity		Mean difference	Std. error	p value
Science	Malay	Chinese	–0.3466	0.13849	0.045
	(N = 142)	Indian	–1.1165	0.16215	0.773
	Chinese	Malay	0.3466	0.13849	0.045
	(N = 166)	Indian	0.2301	0.15748	0.345
	Indian	Malay	0.1165	0.16215	0.773
	(N = 46)	Chinese	–0.2301	0.15748	0.345
Mathematics	Malay	Chinese	–0.5813	0.14929	0.001
	(N = 142)	Indian	0.0972	0.17479	0.857
	Chinese	Malay	0.5813	0.14929	0.001
	(N=166)	Indian	0.6785	0.16975	0.000
	Indian	Malay	–0.0972	0.17479	0.857
	(N=92)	Chinese	–0.6785	0.16975	0.000

Level of significance is at $p < 0.05$
Note: N = Numbers of students

Relationship Between Attitudes and Achievement Orientations Towards Learning of Science and Mathematics

The students' attitudes towards science and mathematics were correlated with their achievement orientations. In both cases, the correlation

analyses show that there are significant positive correlations, though low between these two variables, indicating that students with more positive attitudes tend to be more achievement oriented. This finding supports the findings of other studies on attitudes and achievement. In the case of science, the Pearson correlation is 0.28 ($p < 0.01$), while the Pearson correlation in the case of mathematics is 0.348 ($p < 0.01$). The correlation is stronger in the case of mathematics than science. Findings from interviews seem to point to the language factor as a major intervening factor. Even students who have better attitudes towards science are unable to translate their attitudes into higher achievement orientations. As one student puts it, "I love to study science but the language problem kills my interest towards science." There is a general agreement among the teachers interviewed that the students' attitudes and achievement orientations are greatly jeopardised by their lack of mastery of the language medium.

CONCLUSION

This study clearly shows that the policy of teaching science and mathematics in English has not brought about the desired impact. The attitudes and achievement orientation of students towards learning of these two subjects are found to be wanting. The students in this sample encountered more learning difficulties in science than in mathematics. Although the students' attitudes and achievement orientations towards learning of science and mathematics vary according to the background variables, it appears that the grasp of the language medium is a major intervening factor that has emerged strongly out of this study. This finding is not entirely unexpected, as the students in this sample did not go through the policy of teaching science and mathematics in English at the primary level hence the problem of language medium transition. However, it remains to be seen whether students who go through the full implementation of this policy will show better attitudes and achievement orientations towards science and mathematics. Although the problem of language medium transition will be very much minimised, the bigger challenge relates to the strongly held view that children should begin their formative education in their respective mother tongues (see for example, Pattanayak, 1986; Todd, 1983; Cummins, 1979). Another factor that has a significant impact on the findings of this study is the feeder school factor. Students from Chinese primary school have

apparently lost their comparative strength in science and mathematics once these two subjects are being taught in English at the secondary school level. On the other hand, the group of Indian students who comes from English-speaking middle class families and enrolled in national schools has been very supportive of the policy of teaching science and mathematics in English. Another interesting finding that stems from this study is that there is no clear evident to support the generally held notion of gender preferences in the learning of science and mathematics. In the Malaysian case, it is individual's effort not inborn ability that matters most in the advancement of academic studies. In this respect, female students have persistently put in more effort than male students and this is translated into better attitudes and achievement orientations towards science and mathematics. It is then not unduly surprising that female students tend to performance better than their male peers in their academic endeavors. The overwhelming presence of female students in the tertiary education sector in Malaysia is indicative of their better attitudes and achievement orientations towards their studies that have allowed most of them to reach the highest level of education.

ACKNOWLEDGEMENT

This study was funded by short-term grant of Universiti Sains Malaysia (304/CDASAR/638027).

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