

PROBLEMS AND CHALLENGES OF LEARNING THROUGH A SECOND LANGUAGE: THE CASE OF TEACHING OF SCIENCE AND MATHEMATICS IN ENGLISH IN THE MALAYSIAN PRIMARY SCHOOLS

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In 2003, there was a significant change in the language policy in the Malaysian education system whereby the Malaysian government decided to introduce English as a language medium to teach science and mathematics at all levels of the education system in stages. The aim of the policy was to arrest declining standards of English among Malaysian students. The implementation of this policy was most contentious at the primary school level involving two different models of implementation: bilingual model for the Chinese primary school and maximum exposure model for the national school and the Tamil primary school. This paper examines the problems and challenges of implementing the policy of teaching science and mathematics in English in the Malaysian primary schools, which entails learning through a second language. It looks at some of the theoretical constructs pertaining to choice of language as well as learning through a second language. These theoretical constructs offer some perspective lights on the implementation of the policy of teaching science and mathematics in English in the Malaysian primary schools by highlighting its strengths and weaknesses. Based on these theoretical constructs, this paper posits the bilingual model adopted by the Chinese primary schools as a better model to facilitate learning through a second language during the early years of schooling.

Keywords: science, mathematics, education system, second language

INTRODUCTION

Choice of language medium during the early years of schooling is a much debated issue. Most scholars argued strongly for the use of mother tongue as the language medium as this is the language, which the child is most familiar with. Thus, when a second language is introduced as a language medium in the primary school years, it goes against the universally held notion of the mother tongue as the best language medium to begin education at the primary school. It brings to the fore the ability of the child to cope with learning through a second language as the second language is often their weaker language. The use of a second language as a language medium during the early years of schooling, for whatever reasons, will inevitably lead to learning difficulties arising out of language barrier. However, such problem does not override the crucial need to acquire a second language, especially one that has immense instrumental value. Increasingly, the bilingual approach has been adopted to facilitate learning through a second language with mother tongue playing a supplementary role. Viewed against this background, the implementation of the policy of teaching of science and mathematics in English in the Malaysian primary schools provides an interesting case for discussion.

It is important to note here that there are three types of primary schools in Malaysia: national school or Malay medium primary school, Chinese primary school and Tamil primary school. All these schools are being conducted in the mother tongue of the three main ethnic groups in Malaysia. National schools are mainstream schools that cater to all races. However, in the main, they fail to attract non-Malay students and thus are predominantly attended by Malay students. The implementation of the policy of teaching science and mathematics in English in the primary schools has brought about a different dimension of learning to the students. It entails learning of science and mathematics through a second language as English is not the home language of most Malaysians. Its main aim is to ensure that students can acquire the required proficiency in English to fulfill the needs for employment in the private sector as well as to access scientific knowledge. Interestingly, it involves two different approaches. One that uses English as the sole

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language medium to teach science and mathematics, which is adopted by the national schools and the Tamil primary schools, while the other uses the mother tongue of the students and English as the language media, which is adopted by the Chinese primary schools. These two approaches reflect two different models of learning through a second language, one that is monolingual or the maximum exposure model, while the other provides for the use of bilingual instruction. These two models are underpinned by different assumptions with regard to the acquisition of a second language. The maximum exposure model is frequently invoked against the bilingual model. It posits the notion that students with limited proficiency in a second language need as much exposure as possible. However, during the early years of schooling, the bilingual model that uses the mother tongue of the students and a second language as language media is preferred over the maximum exposure model. On the one hand, it has taken into consideration the strength of mother tongue as a language medium that could be used to supplement the learning through a second language. On the other hand, it has also taken into consideration the lack of proficiency in a second language that might hamper the learning processes among students. This paper begins with the rationale underlying the implementation of the policy of teaching science and mathematics in English and followed by issues compounding its implementation. It then explores some theoretical constructs relating to the choice of language medium as well as learning through a second language. These theoretical constructs will provide some perspectives on the implementation of the policy of teaching science and mathematics in the Malaysian primary schools.

THE IMPLEMENTATION OF THE POLICY OF TEACHING SCIENCE AND MATHEMATICS IN ENGLISH: RATIONALE, REACTIONS, APPROACHES AND PROBLEMS

In 2003, the Malaysian government introduced English as a language medium to teach science and mathematics at all levels of education. This policy is being implemented in stages. At the primary school level, it involved Year One students. At the secondary school level, it involved Form One (Secondary One) and Lower Six (First Year pre-university) students. This policy would be fully implemented at all levels of the national education system by 2008. The main aim of this policy is to improve the standard of English among Malaysian students. Given the

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importance of English as an international language and declining standards of English among Malaysian students, the introduction of this policy is certainly justifiable. However, its implementation at the primary school level has been problematic, as it involves a host of issues relating to choice of language medium as well as grasp of the language medium. More importantly, it has invoked deeply felt positions among advocates of mother tongue education.

Rationale of the Policy

Since the phasing out of English as a language medium in the Malaysian education system beginning in the 1970s and with English being relegated to a second language in the school curriculum, standards of English have declined drastically. English has become the weaker language of most Malaysians. Not only that, the number of English-speaking families has been considerably reduced. It is only among the small group of middle and upper class families in urban areas that English continued to be used as the preferred home language (Ambigapathy, 2001: 73–74). As for the rest of the population, especially those from the rural areas, English has become an entirely foreign language (Benson cited in Phillipson, 1993: 24).

The results from public examinations provide a clear indicator of the poor mastery of English among Malaysian students. For instance, in 1994, 45.5% of primary school students failed to acquire the minimum level of competency (A, B and C) in English in the Primary School Achievement Test or *Ujian Pencapaian Sekolah Rendah* (UPSR) conducted at the end of the final year of their primary schools (Kementerian Pendidikan Malaysia, 1994: 2). Equally alarming is the command of English among secondary school students. For instance, in 1994, 41.8% of the students who sat for the Lower Secondary Assessment or *Penilaian Menengah Rendah* (PMR) at the end of Secondary Three failed to achieve a minimum level of competency (at least a D) in English (Kementerian Pendidikan Malaysia, 1994: 14).

As for upper secondary students who sat for the Malaysian Certificate of Education (the equivalent of O-levels) or *Sijil Pelajaran Malaysia* (SPM) at Secondary Five, their standard of English is also a cause of concern. From 1995 to 1999, the passing rates of English in SPM were

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not too encouraging as they ranged from 62% to 66% (Kementerian Pendidikan Malaysia, 2001).

Several measures had been taken by the government to arrest the decline in the standards of English among the students. First, the format of the English language paper for the SPM examination was changed in 1995 to increase its level of difficulty by incorporating some elements from the 1119 English paper, which is a paper based on an O-level syllabus set by the Cambridge Examination Syndicate in England (Lee, 2002: 56). Second, English for Science and Technology (EST) was introduced as an elective subject for Secondary Four and Five science stream students. Third, the Malaysian University English Test (MUET) was introduced as a compulsory subject for pre-university students in 1999 (Ambigapathy, 2001: 76). The MUET test was to ensure that pre-university education prepared students for the eventual use of English as an instrument of research and knowledge in their undergraduate studies.

However, all these measures did not bring about the desired impact. Most alarming of all, the sharp decline in the standards of English has become a major problem as school leavers and graduates from the public institutions of higher learning often find themselves at a disadvantage when they seek employment in the private sector and face the possibility of unemployment. The problem of unemployment caused by the lack of English proficiency became acute during recent years. With the transformation of higher education in Malaysia from elitist to mass higher education beginning in mid 1990s, more graduates were produced each year and as such, competition for employment had become very intense and only those who could fulfill all the needs of the private sector, including proficiency in English, were successful in their search for employment.

The problem of graduate unemployment had caught the attention of Dr. Mahathir Mohamad, the then Prime Minister. On May 2002, he expressed deep concern at the high number of unemployed graduates – some 44,000 of them according to figure given by the Human Resource Ministry (Lee, 2004: 102). Most of them were Malay graduates who held degrees in Arts and Islamic Studies. According to Dr. Mahathir Mohamad, these graduates had difficulties finding jobs because they lacked proficiency in English. Notwithstanding the fact that there are other factors contributing to graduate unemployment, the lack of

proficiency in English is certainly one major factor that affects their chances in securing employment, especially in the private sector. Realizing the urgent need to improve the standards of English among Malaysian students, Dr. Mahathir subsequently called for more emphasis to be given to English in schools and universities. He even floated the idea of re-introducing English medium schools (Lee, 2004: 103). However, such idea was contentious as it contradicted the national education policy, which only allowed for Malay to be used as the main medium of instruction. Eventually, he opted for the policy of teaching science and mathematics in English. The reason for choosing science and mathematics was clearly underpinned by the fact that Malaysia needs a population that could access knowledge in science and technology to spur its industrial development. Significantly, it is in the areas of science and technology that English is the undisputed dominant language. English is, in fact, the *de facto* international language of science and technology (Baker, 1995: 198). As noted by Wright (2004: 151), “when we come to the medium in which flows of information on cutting-edge science take place, then English does dominate exclusively and in every sphere. The research community has come to inform itself, debate and publish in English, even where innovation originated from other speech communities”.

While the implementation of the policy of teaching science and mathematics in English was driven by the need to resolve graduate unemployment arising from the lack of proficiency in English, it was also a timely response to the emergence of English as a global language in the era of globalisation. Although globalisation is not a new phenomenon, the advances of information and communications technology (ICT) during recent times have accelerated the pace of globalisation to the extent that the world is now borderless. In most peripheral-English countries, English is fast replacing other languages (Phillipson, 1993: 23–31). Significantly, English is shared as an official language by some sixty-three nations (Mackey, 1984: 434). Current development shows that the acquisition of English in peripheral-English countries has reached a new height. For instance, since China opened up its door to the West in the 1970s, English is being extensively studied – an estimated 50 millions are currently learning English (Pride and Rushan cited in Phillipson, 1993: 30). It is evident that English is now entrenched worldwide and Malaysia has to keep abreast of current global trend or risk lagging behind and losing its competitive edge in the

global economy, which has been transformed by the massive increase in the flow of information in English via ICT, 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 it is hoped that this would help to strengthen the students' proficiency in English enabling them to access scientific knowledge. As argued by Hafriza (2006: 24), "In this age of industrialisation and internationalisation, we cannot deny future generations the ability to access new frontiers in science and technology simply because of their poor English". Also, the implementation of the policy of teaching science and mathematics in English in Malaysia seems to reflect Mackey's view on the issue of choice of language medium. Mackey (1984: 45) stresses that, "From the point of view of the state, access to information and technology in international languages may be necessary in order to implement an overall policy of economic or commercial development". Looking from these two perspectives, it is clear that apart from addressing the problem of graduate unemployment, the implementation of policy of teaching science and mathematics in English in Malaysia is also underpinned by the immense economic value of a second language that could help to spur her development. However, the implementation of this policy has become a daunting task for policy-makers in Malaysia. They have to grapple with issues concerning learning through a second language, especially during the early years of schooling.

Reactions Towards the Policy

The implementation of the policy of teaching science and mathematics is not without controversies. It had aroused intense debates from concerned parties, especially Malay nationalists and non-Malay advocates of mother tongue education. Malay nationalists, for instance, felt betrayed by what they saw as a *volte-face* policy in that it has compromised the importance of the national language (Maznah, 2003: 153). However, leaders of the United Malays National Organization (UMNO), the main Malay political party in the coalition government, tried to convince the Malays that this policy would not jeopardise the status of Malay as the national language. Instead, by acquiring another language, they argued that this would give Malays an added advantage in the era of

globalisation. However, Malay nationalists remained unconvinced and continued to oppose the policy. In the case of the Indians, only pockets of resistance were raised by non-governmental organisations (NGOs) such as the Malaysian Tamil Education Research and Development Foundation (MTERDF) (Cheong, 2006). The Malaysian Indian Congress (MIC), which is the main political party representing the interests of the Indian community in the coalition government, came out openly in support of implementing the policy of teaching science and mathematics in English in the Tamil primary schools.

It is altogether a different scenario for the Chinese primary schools. The Chinese educationists affiliated to Dong Jiao Zong voiced their resentment against the policy of teaching science and mathematics in English. Dong Jiao Zong is an acronym representing two bodies championing the interests of Chinese education in Malaysia: the United Chinese School Committees' Association (UCSCA or Dong Zong) whose members are drawn from the powerful Board of Governors of the Chinese schools and the United Chinese School Teachers' Association (UCSTA or Jiao Zong) whose members are comprised mainly of Chinese schools' teachers. Among the main reasons cited by the Chinese educationists was that efforts to improve the standard of English among Malaysian students should focus on teaching of English as a subject rather than teaching of science and mathematics in English. They insisted on upholding the status of mother tongue as the best language medium. Apparently, the Chinese educationists were worried that this policy might drastically erode the character of the Chinese primary schools, which revolves around the use of Chinese as the main language medium in the school curriculum as well as the language of wider communication. By and large, the Chinese educationists were able to galvanize popular support amongst the Chinese community in defense of their stand. This prompted the leaders of the Chinese-based political parties in the coalition government, Malaysian Chinese Association (MCA) and Gerakan Rakyat Malaysia (Gerakan), who were ambivalent in their earlier stand, to throw in their support. But things came to a head when UMNO perceived this as a challenge to the government's policy initiatives. Subsequently, heated arguments were exchanged by both sides through the print media culminating in the heightening of ethnic tensions. This unexpected development forced MCA and Gerakan to reconsider their stand. They then proposed a bilingual model as a compromise solution to teach science and mathematics in the Chinese

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primary schools, which was accepted by the government. Despite strong opposition from the Chinese educationists, it was eventually implemented. In a desperate attempt to safeguard the character of the Chinese primary schools, the Chinese educationists insisted that the use of English as language medium should be restricted to the teaching of terminologies. However, when the Chinese primary schools were supplied with the same science and mathematics textbooks used by national schools and Tamil primary schools, it became clear that the teaching of these two subjects were not confined to terminologies. The Chinese educationists were further alarmed by the decision of the government to set the UPSR science and mathematics papers on a bilingual mode—the papers carried the Chinese and its English translation. The Chinese educationists were worried that if more students chose to answer the two papers in English rather than in Chinese, the government would then use this as a reason to switch the language medium of the two subjects to English. In an attempt to block such possibility, they strongly appealed to the Chinese primary schools to call upon their students to answer the two papers in Chinese rather than in English. It was ironic that the policy of teaching science and mathematics in bilingual instruction in the Chinese primary schools was turned into an issue that threatened the character of these schools instead of looking at the positive effect of such instruction on the acquisition of a second language.

Two Different Models of Implementation

As indicated earlier, the implementation of the policy of teaching science and mathematics in English at the primary school level involves two different models. The first is the maximum exposure model adopted by both the national school and the Tamil primary school. The second is the bilingual model adopted by the Chinese primary school. This bilingual model is guided by a clear principle of language separation. It is being implemented in two different phases. The first phase involves Year One, Year Two and Year Three students. Apart from the normal teaching of six periods of science and three periods of mathematics in Chinese, a formula of 2–4–3 is adopted to enhance the students' proficiency in English and to incorporate the teaching of science and mathematics in English. This formula allots two periods for the teaching of English, 4 periods for the teaching of mathematics in English and three periods for the teaching of science in English. The second phase

involves Year Four, Year Five and Year Six students. The number of periods allotted for the teaching of science and mathematics in the mother tongue instruction remains the same. A different formula of 4-2-2 is adopted, whereby four periods are allotted for the teaching of English, while two periods are each allotted for the teaching of science and mathematics in English. The two different models adopted by the primary schools in Malaysia in the implementation of the policy of teaching science and mathematics in English provide an interesting theoretical comparison over their strengths and weaknesses in facilitating the acquisition of a second language.

Problems of Proficiency in the Language Medium

One of the main concerns arising out of the implementation of the policy of teaching science and mathematics in English is the ability of primary school children to use English as an effective tool to acquire knowledge. The lack of proficiency in English among Malaysian students has been clearly illustrated in the foregoing section. Suffice it to say here that Malaysian students do not have the linguistic capacity to engage in English instruction. This problem is even more acute in the case of teaching of science and mathematics as the language used in these two subjects is often context-reduced, which involves cognitive-academic language proficiency (CALP). CALP includes the ability to engage in abstract thought in cognitively highly demanding circumstances (Ovando & Collier, 1985). Most Malaysian students, more so at the primary school level, do not have such high levels of English proficiency to enable them to learn science and mathematics effectively. Although they have attended two years' of preschool education in the kindergartens, they would have at best only acquired the basic interpersonal communicative skill (BICS) in English in such a short span of time. BICS involves context-embedded and cognitively undemanding face-to-face communicative skills, which includes the ability to handle complex conversation using contextual cues such as paralinguistic feedback from other speakers (e.g., gestures and intonation) and situational cues to meaning (Ovando & Collier, 1985: 63). Context embedded language skills can be easily acquired within two years (Kerr & Desforges, 1988: 41). In contrast to BICS, a longer period of seven to eight years is needed to acquire the CALP of a certain language. In addition, high level of exposure to the language and motivation are also required (Cummins, 1984: 143). Thus, suffice it to say that the short

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period of time Malaysian children spend in the kindergarten is not sufficient for them to acquire the CALP of English to enable them to learn science and mathematics in English when they start their formal education at the primary school level.

The implementation of the policy of teaching science and mathematics in English is also hampered by the inability of most Malaysian teachers to teach in English as they lack the required level of competency in English. The current batch of teachers is the product of the national education policy of 1970s. They have gone through Malay medium education with English being taught only as a subject. In order to overcome the problem of lack of English competency among teachers teaching science and mathematics, the government had undertaken several measures, chief among which was the preparation of multimedia teaching courseware to facilitate the teaching and learning of these two subjects through the use of ICT (Sharifah, 2004). Teachers were also sent for in-service courses to equip them with the necessary skills to handle ICT as well as to improve their competency in English. However, there was much doubt over the effectiveness of such measures. For one thing, ICT-assisted pedagogy can never replace the need for interactive communication between teachers and students, which forms the core of classroom teaching. There was also strong reservation over the effectiveness of the short-term in-service courses in enhancing the linguistic skills of teachers. These courses were not conducted by the Teacher Training Division of the Ministry of Education but by facilitators who are senior science and mathematics teachers. While these teachers may be competent in English, the training of teachers to teach in a second language would require more than linguistic skills as it involves a host of other issues related to teaching through a second language. It was reported that many teachers had not picked up the required competency in English. In a desperate attempt to ensure that teachers have the required competency in English to teach science and mathematics, a test was being conducted by the Teacher Training Division of the Ministry of Education to establish their levels of English competency (*The Star*, 22 January 2007). It appears that the government has underrated the magnitude of the problems that it faced in implementing the policy of teaching science and mathematics in English. However, the government is determined to see through the policy. To date, some RM31 million had been spent by the government on various measures undertaken to facilitate the implementation of the

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policy, of which about RM6 million was spent on monetary incentives for teachers, about RM3 million was on teaching software and the largest amount, RM22 million went to teaching hardware (*Nanyang Siang Pau*, 15 May 2008).

THE IMPLEMENTATION OF THE POLICY OF TEACHING SCIENCE AND MATHEMATICS IN ENGLISH: THEORETICAL PERSPECTIVES

From theoretical perspectives, the policy of teaching science and mathematics in English in the Malaysian primary schools involves issues pertaining to choice of language medium during the early years of schooling as well as complications that stem from using a second language as a language medium. The discussion of these issues will shed some perspective lights on the policy of teaching science and mathematics in English in the Malaysian primary schools, especially in relation to its strengths and weaknesses.

Choice of Language Medium: Mother Tongue Versus Second Language

The implementation of the policy of teaching science and mathematics in English in the Malaysian primary schools has clearly deviated from the well established notion that mother tongue is the best medium to begin primary education. The strength of mother tongue as the language medium is exemplified in the United Nations Educational, Scientific and Cultural Organization (UNESCO) statement that “it is axiomatic that the best medium for teaching a child is his mother tongue” Cummins, 1979: 223). This statement, contained in a report on *The Use of Vernacular Languages in Schools* published by the UNESCO in 1953, is based on the following assumptions:

Psychologically, it is a system of meaningful signs that in his mind works automatically for expression and understanding. Sociologically, it is a means of identification among members of the community to which he belongs. Educationally, he learns more quickly through it than through an unfamiliar linguistic medium (Todd, 1983: 165)

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The UNESCO's stance on mother tongue education is further reiterated by Gudschinsky (Cohen, 1978: 21) who provides penetrating insights into the pedagogical, social and psychological assumptions of using mother tongue as a language medium. From a pedagogical perspective, he argues for the exploitation of the student's fluency in his/her own language, which can be transferred to the second language and thus increase his/her degree of exposure to the second language. From the sociological and psychological perspectives, he argues that the use of vernacular language minimises cultural shock, augments the student's sense of personal worth as well as helps him/her to establish the habit of academic success. Baker (1993: 178) explains the adverse psychological impacts on the schooling processes of minority children when the home language is not used as the language medium:

When the home language is used in school, there is the possibility that a child's self-concept will be enhanced. The child may perceive that the home language, the home and community culture, parents and relations are accepted by the school when the home language is used. In comparison, a language minority child who is mainstreamed is vulnerable to the loss of self-esteem and status. The home language and culture may seem disparaged. The school system and teachers may seem latently or manifestly to be reflecting the child's home language and values. This may affect the child's motivation and interest in schoolwork and thereby affect performance.

Although Baker's observation is primarily based on minority children, it is also applicable to other children who have to learn through a dominant second language. The use of mother tongue as a language medium is further supported by Pattanayak (1988: 9) who sees this as underpinned by the sound educational principles of step-incremental learning and progression from the familiar to the foreign.

Whilst most scholars favor mother tongue as the language medium, there are also differing views on this issue. Mackey (1984: 44–45), for instance, posits the need to use a second language that is of international standing as a language medium. He is of the opinion that many nations throughout the world are faced with the unpleasant dilemma of making

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the right choice of language medium. He argues that if, for ethnic or nationalistic reasons, they promote an unproductive tongue, they may to that extent, diminish the potential of their people for economic and scientific development. On the other hand, if they failed to develop their national languages, these will always remain secondary instruments of communication. Mackey puts the question of choice of language medium quite starkly: Do you want to save the language or do you want to save the child? Although Mackey highlights the dilemma in choosing between a strong international language and an unproductive national language as language medium, the same dilemma also confronts the choice of language medium between the mother tongue of the students and a second language of significant value as in the case of the implementation of the policy of teaching science and mathematics in English in Malaysia. There is only one way out in resolving such dilemma, i.e. through the provision of bilingual education where the use of both languages can be accommodated.

Inadequate Grasp of the Language Medium

The implementation of the policy of teaching science and mathematics in English in the Malaysian primary schools entails learning through a second language. The main issue in relation to learning through a second language is the grasp of the language medium. As second language is generally the weaker language of most children, it follows that an inadequate grasp of the language medium is the norm rather than the exception. From the foregoing discussion, it is evident that Malaysian children do not have the required competency to use English as an effective language medium and thus face the problem of inadequate grasp of language medium. Many scholars have highlighted the adverse effects of learning through a weaker language. Macnamara (1967: 123) offers detailed insights into this problem:

The student's difficulty in following courses in his weaker language might seem at first sight to lie solely in his ignorance of certain words, phrases or syntactic structures. However, there is probably more to it than that. Those of us who read a second language poorly will probably from time to time have experienced difficulty in following the meaning of complex passages in that language, even though we could have translated

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each individual word and expression used. This we may have attributed to inadequate grasp of language.

The impact of learning through a second language among students is even more damaging if it is introduced without due consideration of the need to adapt to its usage as language medium. This will further complicate the problem of inadequate grasp of language medium faced by the students. The introduction of a second language as a language medium should be gradual in nature. As pointed out succinctly by Dabene (1994: 50), “an educational institution should assign itself to ensure a harmonious transition from the family context to that of the school by trying to reduce the gap separating the two linguistic worlds.”

It is undoubtedly true that inadequate grasp of the language medium can lead to serious retardation in the learning of subject matter in school. Baker (1993: 198), for instance, attributes the low academic achievement among minority children in the United States of America and the United Kingdom to their poor mastery of English. Jeffcoate (1984: 54) maintains that minority students from working-class parentage do not enjoy equal opportunities in education due to their lack of competence in the language medium, which affects their educational attainment. Brint (1998: 295) is of the view that children cannot learn unless their basic language skills are adequate. Cummins (1984: 141–142) observes that most children characterised as learning disabled or learning disordered encounter language and academic problems, which are usually confined to context-reduced cognitively demanding situation. Taken together, all these are indicative of the destructive nature of a poor mastery of the language medium. As a result, children who lack the linguistic skills, but are otherwise intelligent and capable scholastically, may not be able to realise their full academic potentials. Macnamara’s (1966: 137) statement on the research findings on using a second language to teach mathematics puts the problem in the proper perspective.

The Irish findings relating to the teaching of other subjects through the medium of a second language are particularly discouraging. For it seems that the teaching of mathematics, at least through the medium of the second language does not benefit the second language, while it has a detrimental effect on children’s progress in mathematics.

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Commenting on a similar situation in the Philippines where science is taught in the English language, Alvarez (1991) states that English is a poor substitute for an indigenous language, which is used by a child in and outside the school environment. He notes that the upper 10%–15% educated and intellectual group will be able to handle and be competent in the two languages. But the greater bulk of the population will need scientific information that is popularized using the native language. Is there a danger of some socioeconomic elite benefiting more than the general population on account of this policy?

In order to reduce the problem of inadequate grasp of the language medium, context-embedded pedagogy plays an important role. With reference to the case of teaching science and mathematics, Ovando and Collier (1985: 205) argue that context-embedded pedagogy by the way of demonstrations and hands-on experiences can serve as a link to the mastery of concepts presented in context-reduced form. They further argue that context-embedded pedagogy can result in both the acquisition of content-area objectives and an increase in proficiency in context-reduced communication. The use of context-embedded pedagogy is strongly supported by Cummins (1984: 141):

the more context-embedded the initial L2 [second language] input, the more comprehensible it is likely to be, and paradoxically, the more successful in ultimately developing the L2 skills in context reduced situations. A central reason why minority students have often failed to develop high levels of L2 academic skills is because their initial instruction has emphasized context-reduced communication.

Although the use of context-embedded pedagogy can help to a certain extent in reducing the problem of inadequate grasp of the language medium, it is by no means an ultimate solution in itself. This then brings us to the need of using bilingual approach to accommodate and facilitate learning through a second language.

While the above discussions have examined the problem of inadequate grasp of the language medium from the learner's perspective, attention must also be focused on the language proficiency and attitude of the teacher, which have a profound impact on the students' learning

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processes. As Malaysian teachers lack the required competency in English to teach science and mathematics effectively, it follows that this shortcoming will have an adverse impact on the students' learning processes. One of the major factors that influence how teachers feel about their teaching efficacy is the credentials they possess. It is important to note here that teachers in language programmes need to possess high levels of language proficiency as well as pedagogical skills in the language medium. The acquisition of such competencies usually requires considerable in-service and pre-service as well as classroom coaching (Lindholm, 2001). In the case of the training of science and mathematics teachers in Malaysia, the in-service courses need to incorporate a strong element of teaching through a second language. Lindholm (2001) is of the opinion that in order to be effective teachers, those who are required to teach in English must undergo training in second language development and instructional strategies in second language development, including how to implement a linguistic syllabus in their teaching.

Maximum Exposure Model Versus Bilingual Model

The implementation of the policy of teaching science and mathematics in English in the Malaysian primary schools involves two different models: maximum exposure model and bilingual model. As this paper will argue, the bilingual model is undoubtedly a better model.

Maximum exposure model in the acquisition of a second language relies on intensive instruction in the target language. It is grounded in the belief that development of linguistic skills is directly related to the extent of exposure to a language. On the face of things, this model is intuitively appealing. However, closer scrutiny reveals critical flaw in its assumption. As Cummins and Swain (1986: 80) so aptly put it:

Clearly, sufficient exposure to the school language is essential for the development of academic skills; however, equally or more important, is the extent to which students are capable of understanding the academic input to which they are exposed.

The problem highlighted by Cummins and Swain in relation to the maximum exposure model is particularly acute at the early years of primary schooling if a second language is used as a language medium. In many ways, it is linked to inadequate grasp of the language medium discussed earlier. In contrast to the maximum exposure model, the acquisition of a second language through the bilingual model is largely prompted by the conviction that the home language of the child must be given a significant role in the educative process (Bowen, 1977: 108). Bilingual education, which involves the use of the first language and the second language as language media has been advocated as a means to facilitate the learning through a second language. As mentioned by Cohen (1975: 20), bilingual education can be used as a stopgap measure until the second language is learnt. The strength of bilingual education has always lies in the complementary usage of two languages as language media. This strength is located in the developmental interdependence hypothesis postulated by Cummins (1979; 1984). This hypothesis builds on the premise of interdependence between the first language and the second language. Cummins (1979: 233) posits that the level of the second language competence, which a bilingual child attains, is partially a function of the type of competence the child has developed in the first language at the time when intensive exposure of the second language begins. This interdependence is based on the concept of common underlying proficiency, which is built on the assumption that experience with either language can promote development of the proficiency underlying both languages, given adequate motivation and exposure to both either in school or in the wider environment (Cummins, 1984: 143). All current linguistic research supports the theory that there is a common underlying proficiency in both languages. This common underlying proficiency makes possible the transfer of cognitive-academic or literary related skills across languages, which among others includes conceptual knowledge (Cummins, 1984: 144). For instance, a child who understands a certain concept in his or her first language needs only a new label in the second language for an already-existing concept. In contrast, a child who does not understand the meaning of a certain concept in his or her first language will find it difficult to understand it in the second language. By the same token, subject matter knowledge, higher order thinking skills, reading strategies, writing composition skills etc. developed through the medium of the first language could be transfer to the second language given sufficient exposure and motivation. To facilitate such transfer, there has to be a

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threshold level of linguistic competence that a bilingual child must attain in order to avoid cognitive deficits and to allow the potentially beneficial aspects of becoming bilingual to influence his cognitive functioning.

One important feature of bilingual education is that of language separation, whereby the usage of two language media is not mixed. Obviously, this is to avoid children from mixing the two languages indiscriminately, both by mixing words and phrases and by confusing word associations across languages. Some models of bilingual education involve repeated teaching of the same subject in both languages – e.g. one language is used in the morning while the other in the afternoon (Cohen, 1975: 18). There are also models, where different language media are used on an alternate day basis, i.e. teaching a subject matter in one language on one day and then continuing on to new content in that subject matter in the other language on the following day. Through language separation, it is hoped that children will eventually acquire the target language. As mentioned by Gonzales (1977) (cited in Cummins, 1979: 238), if languages are not separated, each will act as a crutch for the other with the result that the children may fail to develop full proficiency in either language. Krashen (1989: 75) is of the opinion that when the first language is used concurrently with the second language to teach a certain subject, this will hinder the acquisition of the second language. He cautions that:

The first language can be used improperly as well, in a way that discourages comprehensive input. This occurs when concurrent translation is used, a technique in which the teacher speaks a little in one language, then translates what was said into the other language. When this happens, students quite naturally listen to the message in their own language and pay no attention to the [second language] input.

Although language separation has its merits, it also has its shortcomings, especially when it is viewed against the problem of inadequate grasp of the second language discussed earlier. Thus, a certain degree of language mixing is sometimes necessary. Nevertheless, language mixing has to be carried out with the utmost care. It serves no practical purposes if simultaneous translation method is used indiscriminately, whereby the teacher translates word by word, sentence by sentence, or paragraph

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by paragraph. As pointed out by T'sou (1976: 46), straightforward translation and duplication of teaching strategies should be avoided as much as possible when the target language is used to reinforce the comprehension of the concepts first introduced in the base language. One example where language mixing is used in a rational manner is the case involving Hong Kong teachers who have to accommodate the switch of language medium from English to Chinese. English language is used consistently in text-dependent, formal and didactic context, while Cantonese is used in the text independent, informal, and explanatory purposes (Johnson, 1983 as cited in Tung, 1990: 530). Thus, when teachers wish to elicit a response from students, or to offer personal advice, they tend to speak Cantonese. In contrast, when teachers wish to issue formal instructions, or to direct students' attention to important terms and statements pertinent to written work, they are more likely to resort to the use of English. This approach has taken into consideration the different roles and status of the two languages in use.

DISCUSSION AND CONCLUSION

The implementation of English as the language medium to teach science and mathematics in the Malaysian primary schools has to address two major perplexing issues. The first issue pertains to the use of English, which is a second language to most Malaysians, as language medium at the primary school level. The second issue is the obvious lack of competence in English among teachers and students. These inter-related issues form the underlying concerns of this paper.

As mother tongue is generally considered as the most suitable language medium to begin primary education, the use of a second language at the primary school level has thus gone against this educationally sound view. Given the fact that second language is often the weaker language of most children, it follows that they do not possess the required level of CALP to use it as a language medium. It is precisely for this reason that mother tongue is strongly advocated as the language medium during the early years of primary schooling. The lack of CALP in the second language will definitely retard the learning processes. Although the use of multimedia teaching courseware will reduce to a certain extent the language barrier faced by students, it is by no means a replacement for linguistic skills needed for interactive teaching and learning, which is

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the basic requirement of classroom instruction. Viewed against these problems, the right choice of language medium at the primary school level is crucial. And in the implementation of the policy of teaching science and mathematics in English in the Malaysian primary schools, the policy-makers have tellingly overlooked this important linguistic factor. It remains to be seen whether this policy will bring about the desired policy impact.

It is evident that the bilingual model adopted by the Chinese primary school has its merits. It is clearly a case whereby the choice of language medium is accommodated to the best interests of the child. The way it is implemented augurs well for a gradual transition of home language to the school language. Transition of language medium has been a major issue confronting students from Chinese primary schools who already face the problem of transition to the Malay language medium upon entering national secondary schools. In a survey carried out by MCA in 2002 based on the cohort of Chinese primary school students who entered the national secondary schools in 1997, it was discovered that 25% of them failed to finish Form Five due primarily to their inadequate grasp of the language medium (*Nanyang Siang Pau*, 9 January 2006). This high dropout rate alarmed the MCA and a campaign, *Not One Less*, was launched to redress this problem. Thus, if the Chinese primary schools stick to their initial stand of not abiding by the policy of teaching science and mathematics in English, the problem of transition of language medium faced by the Chinese students will become even more acute upon entering secondary schools.

But then, the implementation of the policy of teaching science and mathematics in English in the Chinese primary school, which is based on the principle of language separation, has its shortcomings as well. Despite the fact that language separation helps to acquire the target language through immersion, during the early years of schooling where children have not fully acquired the CALP of the target language, there is obviously a need for language mixing. The insistence of the government on language separation has deprived the schools of the possibilities of a more flexible implementation of language mixing, which can be based on the Hong Kong model.

We can conclude that most Malaysian children enter primary schools without the required level of CALP in English to use it as an effective

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and functional tool to acquire knowledge. The policy of teaching science and mathematics in English in the Malaysian primary schools is a classic case whereby the economic value of a dominant second language has taken precedence over the pedagogical and psychological needs of learning during the early years of schooling. Unfortunately, the policy-makers are convinced that the use of multimedia teaching courseware is a solution to the language barrier faced by teachers and students. This seems to be an over-simplistic strategy, which is not based on any sound educational practices where learning through a second language is concerned. Ironically, the bilingual model adopted by the Chinese primary schools, which is more in tandem with the nature of learning through a second language is not favored by the government as the mainstream model. Instead, the maximum exposure model is the preferred choice. This, in a way, reflects the government's lack of theoretical insights in dealing with the nature of learning through a second language. It reflects a 'top-down' planning that fails to engage the sympathies of its intended recipients.

The ineffectiveness of the in-service courses conducted for science and mathematics teachers further complicates the implementation of the policy of teaching science and mathematics in English. These courses are not conducted by experts in the areas of teaching and learning through a second language. It certainly needs more organised and long-term efforts by the Ministry of Education to eventually produce teachers who are competent to teach science and mathematics in English.

There is now a move to reassess this policy in the light of the numerous comments, complaints and opinions that have appeared in the Malaysian dailies. At the Johor UMNO Convention on 6 November 2006, delegates voiced their concern over the use of English for the teaching of science and mathematics in schools. To this, the Minister of Education responded that a study was underway to gauge the efficacy of using English as the language medium for the teaching of these subjects. He said that the study would be completed by 2008. "We will then decide if we should continue or abort the programme" (*New Straits Times*, 7 November 2006).

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