

MATHEMATICS AND SCIENCE IN ENGLISH: TEACHERS EXPERIENCE INSIDE THE CLASSROOM

Ong Saw Lan

School of Education Studies, Universiti Sains Malaysia,
11800 USM Pulau Pinang, Malaysia
E-mail: osl@usm.my

May Tan

Department of Integrated Studies in Education, McGill University
Education building, 3700 McTavish Street,
Montreal, Canada
E-mail: may.tan@mail.mcgill.ca

Abstract: In 2003, the Malaysian government implemented a new policy in the national education system; English is made the language of instruction in schools for the teaching of Mathematics, Science and technology subjects. These subjects had formerly been taught in the Malay language. The purpose of teaching Science and Mathematics in English is to enable students to acquire proficiency in English while learning the content. This study aims to provide more in-depth information concerning teachers' experiences and classroom practices in the implementation of the change in language of instruction for Mathematics and Science. To gather information on teachers' experiences with the policy change, classroom observation and semi-structured interviews were conducted with the four Mathematics and Science teachers. While teachers interviewed are supportive of the policy, they are still struggling with the realities of implementing this policy. Three factors appear to be salient in influencing how quickly a teacher can effect the transition into teaching entirely in English. They are the prior educational background of teachers, the linguistic environment in school and the linguistic abilities of their students.

Keywords: Language of instruction, Mathematics and Science teachers, linguistic environments, teachers experience, teaching practice

Abstrak: Pada 2003, kerajaan Malaysia memulakan dasar baru dalam sistem pendidikan Negara iaitu, Bahasa Inggeris dijadikan sebagai bahasa pengantar untuk mata pelajaran Sains, Matematik dan Teknologi. Sebelum itu, mata pelajaran tersebut telah diajar dalam Bahasa Melayu. Tujuan dasar itu adalah supaya pelajar dapat menguasai Bahasa Inggeris semasa mempelajari isi kandungan. Kajian ini cuba mendapatkan maklumat mendalam tentang pengalaman guru dan amalan di bilik darjah dalam pelaksanaan perubahan bahasa pengantar. Maklumat dikumpul melalui pemerhatian di dalam kelas dan temu duga separa struktur terhadap empat orang guru Sains dan Matematik. Walaupun guru yang ditemu duga menyokong dasar baru, mereka masih terkial-kial dengan pelaksanaannya. Didapati tiga faktor penting mempengaruhi penggunaan Bahasa Inggeris dengan sepenuhnya dalam bilik darjah. Faktor-faktor ini ialah latar belakang pendidikan guru, bahasa persekitaran sekolah dan kecekapan bahasa pelajar.

Kata kunci: bahasa pengantar, guru Matematik dan Sains, bahasa persekitaran, pengalaman guru-guru, amalan mengajar

BACKGROUND

Malaysia is a multicultural and multilingual country with Malay as the official national language. In order to unify the nation, a national education system with Malay as the medium of instruction is being adopted for all primary and secondary schools. In 2002, the government announced the implementation of a new policy in the national education system; English is made the language of instruction in schools for the teaching of Mathematics, Science and technology subjects. These subjects had formerly been taught in the Malay language. English as the language of instruction for Mathematics and Science (ELIMS or PPSMI as it is known in Malay) was implemented in stages, starting in 2003 for standard one (first grade of primary school), form one (first year of lower secondary) and the lower six (first year of upper secondary school). The decision to use English was based on the rationale that mastery of English is regarded as an important mechanism for direct acquisition of knowledge in the field of science and technology (Ainan, 2003).

ISSUES AND PROBLEMS IN IMPLEMENTING THE NEW POLICY

The purpose of teaching Science and Mathematics in English is to enable students to acquire proficiency in English while learning science. Many educational issues are crucial when learning takes place in students' second language. In Malaysia, most learners encounter English for the first time in school. This inadvertently impair students' learning abilities since learning in these subjects may be constrained within a complex linguistic classroom. The problem of learning Science through a second language is compounded by other factors, such as teachers who are not proficient in English and the lack of good Science textbooks (Ong, 2004). Learning in a second language is seen as unsuitable when children encounter difficulty in interpreting the meaning of Mathematics and Science discourse.

Malaysian students and teachers are multicultural and have multilingual backgrounds. The implementation of PPSMI created great concern among parents and educators on the quality of Mathematics and Science education as both teachers and students are not proficient in the English language (The Star, 2006). This is expected as Malay language has been the language of instruction for more than three decades. In addition, the teaching of non-Science and Mathematics subjects in schools continue to use Malay language. In a study to provide some baseline data for this concern, Juriah Long and colleagues (The Star, 2006) found that 60% of Mathematics and Science teachers were not fluent in the English language while only 45% said they are comfortable in using the language to teach. In addition, non-Malay students (majority residing in urban

areas) indicated their preference of the use of English in learning Mathematics and Science while the rural students, were not supportive on the use of English language.

TEACHER DEVELOPMENT IN EDUCATIONAL REFORM

The implementation of the PPSMI made Mathematics and Science Teachers (MSTs) the change agents responsible for ensuring that their students would be competent enough to function in these subject domains in English. The role of the teachers in the shaping of the policy they are to implement is clearly stated when Little (1999) explained that the progress of educational reforms rest in crucial ways on the capacity of teachers. For teachers to move successfully toward the visions of this policy, major changes in their knowledge and beliefs, as well as their instructional practices are required (Putnam & Borko, 1997). Based on the empirical investigations of educational change in Canada, England, and the US, Fullan and Hargreaves (1992) concluded that teacher development is central to successful change.

These transformations, and the learning that teachers require are not likely to occur without support and guidance (Putnam & Borko, 1997). To ensure the successful implementation of the educational reform, the Malaysian government provided adequate support for teachers' professional development. As a first step in the implementation of this policy, the Ministry of Education organised professional development course for MSTs, known as English for the Teaching of Mathematics and Science (ETeMS). However, the focus of the course was not on how subject content should be delivered in English, rather, it was to develop the MSTs' linguistic skills necessary for teaching Mathematics and Science in English (Ministry of Education, 2004). These teachers were also required to attend a training course on the use of teaching courseware supplied by the Ministry. More than 50,000 MSTs have gone through curriculum induction training and were provided with curriculum materials such as textbooks, teachers' guides and other auxiliary materials to help them. All MSTs were also given a laptop and LCD by the government to encourage the use of multimedia in their teaching. A financial incentive (5% of their basic pay every month) is given to MSTs to motivate them in using English in their teaching.

Like most in-service activities for teachers, the ETeMS program is a one-time event rather than an ongoing learning experiences. The general opinion among these MSTs was that it was not really effective in terms of increasing their language proficiency (Tan & Ong, 2007). The success of educational reform efforts is dependent upon creating opportunities for teachers' continual learning and providing sufficient professional development resources to support these

opportunities (Cohen & Ball, 1990; Darling-Hammond, 1990). Realising this, a Buddy System was set up in each school to provide an in-school support network for the teachers within their teaching environment. The MSTs are assigned a "critical friend" – someone who is proficient in English. This "critical friend" will be a resource person who can help them solve problems related to language use. So far, the MSTs seemed not to rely much on this system to improve their learning (Tan & Ong, 2007). The buddies find themselves simply too busy to set up meetings with their "critical friends."

Although policy makers certainly are crucial to reform, "teachers are the key agents when it comes to changing classroom practice. They are the final policy brokers" (Spillane, 1999: 144). The same opinion is expressed by Little (1999: 2), "the progress of reform appears to rest in crucial ways on the capacity of teachers, both individually and collectively." Clearly, if educational reform efforts are to succeed, it is imperative that teachers meet these challenges. In order to understand the new demands on teachers as they implement the mandated policy of PPSMI, this report presents the results from classroom observation on MSTs teaching Mathematics and Science in English in two Malaysian schools.

OBJECTIVES

This study aims to provide more in-depth information concerning teachers' experiences and classroom practices in the implementation of the change in language of instruction for Mathematics and Science.

This report focuses on two questions:

1. How are MSTs coping with the policy in the change in language of instruction?
2. How are their teaching practices being modified as a result of implementing the policy?

PARTICIPANTS

Four MSTs teaching form four and five in two secondary schools gave permission to be observed and interviewed. Two of the MSTs, Mr. Ang* and Pn. Salmiah* were teaching in a rural school while Mr. Ho* and En. Nasir* are in an urban school in Perak.

* Pseudo names are used

Each participant teaches a different subject; Mr. Ang* was teaching Chemistry, Mr. Ho* taught Physics, Encik Nasir* was teaching Additional Mathematics and Pn. Salmiah* taught Biology. Three of the participants are experienced Science teachers; Mr. Ang has more than 25 years of experience teaching Chemistry while Mr. Ho and Mr. Nasir each has 19 years of teaching experience. Whereas Puan Salmiah is a relatively new teacher with only six years of teaching experience.

DATA COLLECTION PROCESS

Teachers were approached individually for permission to observe and interview them. To gather information on teachers' experiences with the policy change, semi-structured interviews were conducted with the four MSTs. All interviews were audio taped and then transcribed. In-class observation of the teachers varies in length from about 40 minutes to one hour and 20 minutes. Classroom observations were also videotaped and then transcribed. The interviews were conducted during MSTs' free periods in the school staff room or any other available room. The observations were generally conducted before the interviews, but due to the teachers' time constraints, this order could not always be respected.

RESULTS

Data from interviews and observations with four secondary four and five MSTs are described in this section.

Mr. Ang, a Chemistry teacher in a rural school, was educated when English was still the language of instruction in Malaysian schools. However, before the introduction of PPSMI, he had always taught in Malay. He has more than 25 years of experience teaching Chemistry and is completely comfortable teaching it in English. He welcomes this policy with open arms: "I think it's good for the country, and it's good for the children long term, long term because we're going towards globalisation and English is one of the international language." However, he is confronted with a large continuum of English proficiency in the classes he teaches. Although the classes he teaches are considered "good classes," there can be students who are proficient, average and not proficient at all in the same classroom. Therefore, he needs to take into account not only the students' content knowledge but also their language proficiency when teaching. This, of course, involves extra planning and preparation in order to support their learning. His teaching experience and ease in English (and also Malay) come through in the classroom. He is able to explain in simple and clear English to his students,

and often emphasises an important point by repeating it. He also made sure that students understand by asking them to re-phrase what he said or asking them to demonstrate his instructions. He spontaneously translated key terms into Malay for his students during his teaching as well. His students, on the other hand, did not appear very comfortable using English although they made efforts to do so. In order to answer his questions, some students resorted to reading the textbook, line by line or would take a long time to formulate their answers.

Mr. Ho is a Physics teacher who has 19 years of teaching experience. He underwent all of his education, from primary school to university, in Malay. Consequently, unlike Mr. Ang, he has had to undergo an arduous learning and adjustment process when this policy began at the upper secondary level. He describes how he relied on CD courseware provided by the Ministry of Education to deliver his lesson in English in the beginning because, "Otherwise, I dare not to stand in front and teach in English." However, he considers himself lucky that senior MSTs in his school helped him to improve his level of English. He mentions how he was able to ask these colleagues for help concerning terms and the proper way to pronounce specific words. When he was observed, he spoke throughout the lesson in English and used the CD only for approximately ten minutes during two periods of teaching. It was somewhat difficult to gauge students' reaction to his teaching because the students were very quiet and passive throughout the lesson. Only a small group of three or four boys, who were obviously good in Physics, posed brief questions in English and asked for clarification. In fact, since this is the first year both the form four and form five Mathematics and Science subjects are being taught in English, he still needs more time than before to prepare for classes though.

Mr. Nasir, in contrast, prefers the former policy of teaching in Malay language. He feels that after 19 years of teaching in Malay, with the new policy he has to start from scratch. However, in line with the policy, he has willingly worked on improving his own English by reading a lot of books and newspapers in English and also watching television. He has the opinion that the policy has a differential effect, depending on the student's linguistic ability: "If they're good in English it, so, there won't be any problem about the question in English. But some of the students, if their English not very good, really affects, really affects. Their understanding to the question, first..." He mentions how, in order to compensate for his students' weakness, he has taken on the role of translator in class. "For the class that are not very good, I have to speak English. Then I have to interpret in Malay, that for sure. Otherwise they all don't know what's going on." What is interesting, given his own reservations about his level of proficiency, is that when observed, he valiantly taught the entire lesson in English, using Malay only sporadically, despite hesitations, grammatical mistakes and difficulty in finding

the right words. On the other hand, he did not seem particularly at ease teaching in the language. His students were attentive but unwilling to participate in English. Mr. Nasir often ended up answering his own questions. However, when whole class instruction was completed and students were working out the sums he assigned, he would walk around the class and provide explanations in Malay to those students who did not understand.

Puan Salmiah is a fairly new teacher. She has six years of teaching experience and has taught only at this urban school. Having been educated entirely in Malay, from primary to university level, she finds that it has not been easy for her to teach in English:

Yang paling sukar sekali bagi guru, bagi saya, secara personal, untuk berkomunikasi dengan pelajar. Kita sebenarnya tidak boleh menggunakan perkataan-perkataan yang canggih mengikut buku...kita kena gunakan *simple sentence*. Jadi ini bermaksud guru kena belajar balik, pada asalnya, pada peringkat awalnya, dalam Bahasa Inggeris, bagaimana untuk membina ayat-ayat yang senang.

[translation: The hardest thing for the teacher, for me personally, is to communicate with the students. We cannot really use sophisticated words like those in books...We need to use simple sentences. So this means that the teacher has to learn again, right from the start, from the early stages, how to make simple sentences in English.]

However, she has taken the initiative to surf the internet for English teaching materials in order to improve her own teaching and also to become more comfortable with the language. In fact, when she was observed, she carried out the lesson mainly in English with an occasional translation of important terms or explanations in Malay when students requested it. Even though not all her students could speak English well (some of them responded to her questions in Malay), they generally understood her explanations and actively participated in class activities. She has learned as well that she needs to target her lessons at three different categories of pupils in order to successfully implement PPSMI: those who are fluent in English and have a good grasp of basic concepts, those who understand the concepts but who do not necessarily want to work on their linguistic skills and those who have neither an understanding of concepts nor a good command of English. For her, the challenge then is not only to master the English language but also to find ways to motivate the latter two categories of students.

DISCUSSION AND CONCLUSION

While teachers interviewed are supportive of the policy, three of them, Mr. Ho, Mr. Nasir and Puan Salmiah still struggle with the realities of implementing this policy.

Three factors appear to be salient in influencing how quickly a teacher can effect the transition into teaching entirely in English. One of these is the prior educational background of teachers. As can be seen in the profiles of Mr. Ang, who are very much in support of and very comfortable implementing this policy, the fact of having been educated in English gives him much greater confidence that he can successfully negotiate this change in language of instruction. The other MSTs, who were educated in the Malay medium, all spoke of difficulties especially in their efforts to convey concepts and ideas to their students verbally.

The linguistic environment in school and consequently, the peer support available in terms of linguistic mentoring, can also be determinant in terms of the way and the speed at which teachers learn how to use English in their teaching. With help and mentoring from his more proficient colleagues, Mr. Ho has developed in linguistic proficiency and in self-confidence in terms of implementing PPSMI. From someone who absolutely needed to use the teaching courseware provided by the Ministry, he has become a teacher who can choose when and where he uses them, and even then, only as teaching aids.

Finally, the linguistic abilities of their students are crucial in deciding to what extent teachers can implement PPSMI. All the MSTs interviewed spoke about their main concern when teaching in English – making sure that students could understand the lesson. It is almost a reflexive action among MSTs that as soon as their students look lost or seem unable to comprehend, they resort to translating the terms or specific portions of that lesson. Therefore, in classes where the majority of students are academically able and linguistically proficient, MSTs will teach their lessons entirely in English. However, with weaker classes, these teachers will use much more Malay in class, by way of translation. As a result, instead of teaching Mathematics and Science in English, many teachers end up teaching these subjects in English and Malay. This pedagogical response has much to do with the pressure that teachers feel about "covering the syllabus" within specific timelines so that students will be ready for school exams and mandated public exams. These exams take place at set times during the school year. This being the case, on the spot translation offers them the fastest route to achieving their goal of increasing students' comprehension.

IMPLICATION ON SCIENCE AND MATHEMATICS EDUCATION

The consequence of change in language of instruction inevitably leads to change in teaching practice. In order to compensate for students' weakness in the English language, one teacher (Mr. Nasir) mentioned that he has taken on the role of a translator in class. He described his teaching in the class as using first the English, then repeat the explanation again in Malay for the benefits of those who have low English proficiency. More time will be needed to convey the same concept compared to when Malay language was used as the medium of instruction. Teaching time for Science and Mathematics may need to be increased in view of the PPSMI. It is recommended that teachers continue to carry out code switching when conducting their Science and Mathematics lessons. In addition, teaching strategies may need to be modified so that students will not be denied a quality Science and Mathematics education.

The results raise some issues about the measures designed to promote PPSMI. So far, much of the thrust of this policy has focused on upgrading the linguistic skills of teachers and providing them with technical support. What these MSTs are experiencing in their classrooms show, however, that perhaps much more attention should be paid to improving the proficiency of the students as well. Even extremely proficient and experienced teachers cannot teach their subjects entirely in English if students are incapable of understanding them. This finding is supported by the information released by the Ministry of Education based on the mandated national level public examinations for all form three students (The Star, 2005). They found that despite learning Science and Mathematics in English for three years, only 33% of the Science candidates and 27% of the Mathematics candidates used English to answer questions. Most of the candidates, however, preferred to answer in either Malay or a mixture of both languages. For valid assessment of Science and Mathematics, the use of dual-language test-booklet as a language accommodation (which is being adopted now) need to continue to ensure students are assess on their Science and Mathematics achievement and not their language ability.

ACKNOWLEDGMENT

The findings in this paper has been presented at the 2007 Northeastern Educational Research Association annual conference, Rocky Hill, Connecticut. The authors would like to thank Patricia Ann Marcellino and two anonymous reviewers for their comments and insightful suggestion for revising the article.

REFERENCE

- Ainan Abdul Samad. (2003). *English as a tool for science and technology acquisition: Bilingual assessment instruments as a transitional measure*. Paper presented at the International Association of Educational Assessment (IAEA) Conference Manchester, United Kingdom, 5–10 October.
- Cohen, D. K. and Ball, D. L. (1990). Relations between policy and practice: A commentary. *Educational Evaluation and Policy Analysis*, 12, 330–338.
- Darling-Hammond, L. (1990). Instructional policy into practice: "The power of the bottom over the top." *Educational Evaluation and Policy Analysis*, 12, 233–241.
- Fullan, M. G. and Hargreaves, A. (1992). Teacher development and educational change. In M. Fullan, and A. Hargreaves (eds.). *Teacher development and educational change*. London: The Falmer Press, 1–9.
- Little, J. W. (1999). *Teachers' professional development in the context of high school reform: Findings from a three-year study of restructuring schools*. Paper presented at the annual meeting of the American Educational Research Association, Montreal, 20–22 April.
- Ministry of Education. (2004). *The development of education: National report of Malaysia*. National reports at International Conference on Education, Geneva, 8–11 September.
- Ong, S. L. (2004). Preparing preservice teachers to teach Science in English. *Diges Pendidikan*, 4(1), 23–31.
- Putnam, R. and Borko, H. (1997). Teacher learning: Implications of new views of cognition. In B. J. Biddle, T. L. Good and I. F. Goodson (eds.). *The international handbook of teachers and teaching*. Dordrecht, The Netherlands: Kluwer, 1223–1296.
- Spillane, J. P. (1999). External reform initiatives and teachers' efforts to reconstruct practice: The mediating role of teachers' zones of enactment. *Journal of Curriculum Studies*, 31, 143–175.
- The Star (2005). *Students still prefer to use Bahasa*. 23 December.
- The Star (2006). *Poor English impedes lessons*. 10 December.
- Tan, M. and Ong, S. L. (2007). *Educational change in exam-oriented contexts: The implementation of English as the language of instruction for Mathematics and Science in Malaysian secondary schools*. Paper presented in Redesigning Pedagogy: Culture, knowledge and understanding, Centre for Research in Pedagogy and Practice, Singapore. 28–30 May.