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Teaching mathematics and science in English in Malaysian classrooms: The impact of teacher beliefs on classroom practices and student learning

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Abstract

In 2003, after more than thirty years of using Bahasa Malaysia (BM) as the medium of instruction for all subjects, the Malaysian educational system switched to using English to teach Mathematics and the Sciences in its schools. This new policy is known by its BM acronym, PPSMI. To ease transition, bilingual high-stakes exit exams are being used as an accommodation measure, with the objective of eventually having English-only exams. This paper examines the perceptions and beliefs of upper secondary Math and Science teachers (MST) whose students are the first and second cohorts to learn Mathematics and Science in English. Results from surveys, teacher interviews and classroom observations illustrate how MST perceptions and beliefs influence classroom practices. The data shows that exam policy, teacher perceptions and their beliefs interact to encourage the use of translation and an emphasis on keywords during teaching. These practices enhance the learning of academically and linguistically strong students but negatively impact the content and language development of weaker students. These methods may also increase the content comprehension of students over the short term, but limit the development of their speaking and writing abilities. In closing, measures to improve students' learning of EAP are proposed.

Keywords: EAP; Content-based instruction; Teacher beliefs; English Language learners; Linguistic accommodation; High-stakes assessment

1. Introduction

For many developing countries, ensuring that their graduates can function in English in the workplace is a major issue (Hyland & Hamp-Lyons, 2002); as one of these countries, Malaysia is no exception. In 2003, after more than thirty years of using Bahasa Malaysia (BM) as the medium of instruction for all subjects, the Malaysian educational

Abbreviations: BM, Bahasa Malaysia or Malay, Malaysia's national language; PPSMI, a new language of instruction policy that uses English as the Language of Instruction for Mathematics and Sciences; MST, Mathematics and Science Teachers; ELL, English Language Learners, a term used to designate ESL or EFL students; MMOE, Malaysian Ministry of Education; SPM, A high-stakes exit exam taken by all Form Five students for secondary school certification.

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system implemented a policy that made English the medium of instruction for Mathematics and the Sciences. This policy is commonly known by its Malay acronym, PPSMI (Pengajaran dan Pembelajaran Sains dan Matematik dalam Bahasa Inggeris). In English, it means "English as the Language of Instruction for Mathematics and Sciences". The policy has two main objectives: to produce a new generation of students who are scientifically and technologically knowledgeable *and* fluent in English. These youth can continue accessing scientific and technological knowledge, even after leaving school. They therefore become a workforce capable of continued learning, contributing to the economic growth and development of the country.

PPSMI had simultaneous entry points at three levels in the school system: Standard One, Form One and Lower Form Six. Mathematics and Science teachers (MST), therefore, became change agents responsible for ensuring that their students would be competent enough to function in these subject domains in English: MST are now expected to play the role of *teachers of English for Academic Purposes (EAP)* in their classrooms. This poses quite a challenge in the Malaysian context since English is not the first language of the teachers themselves, or that of their students. They are all English Language Learners (ELL). Moreover, even though many MST have been given short, in-service training to improve their English proficiency, in terms of teacher education, MST are trained principally as subject specialists, not language teachers.

What further complicates the issue is that due to socio-historical and economic factors linked to its past as a British colony, English is a language which is more present in urban contexts, and is rarely used in less developed regions. The implementation of the PPSMI policy, however, applies equally to all schools in Malaysia, regardless of the socio-linguistic environment. Teachers and students from non-urban areas, therefore, are likely to face greater challenges in their teaching and learning process under this policy. Consequently, it is important to examine the impact that the geographic location of a school has on students' learning of mathematics and science within a policy that uses English as the language of instruction.

The educational system in Malaysia is very exam oriented, and the Malaysian Ministry of Education (MMOE) has harnessed the intense pressure of major public exams to speed up the implementation of the PPSMI policy and to promote change in teaching practices in the classroom. In order to do so, and as a measure to linguistically accommodate students who are not proficient enough to perform well uniquely in English, the Form Five high-stakes exit exams, called the SPM exams, for all Mathematics (Mathematics and Additional Mathematics) and Science subjects (Biology, Chemistry, Physics, Science) have been in bilingual format (BM and English) since 2003, even though the Form Five students sitting for the SPM exams at that time were still being taught in BM. When this study was conducted, only students in the Science streams were required to take an additional English course – English for Science and Technology.

This paper presents *partial* data drawn from a larger longitudinal study examining the classrooms of MST who are teaching Mathematics and Science in English at the Form Five level for the first time, to find out how MST view the policy and exams after five years of policy implementation. Their students are the first cohort to have been taught Mathematics and Sciences in English throughout their secondary schooling from Form One to Form Five. Note that while the SPM exams are bilingual, the MMOE mandates all MST to conduct instruction in English; they should only use BM if their students request clarification in that language. Schools must also carry out monthly internal assessments *solely in English*. The objective of the MMOE is to eventually have unilingual, English SPM exams.

In this context, therefore, it is important to examine what the perceptions and beliefs of MST are concerning the language of instruction and the bilingual exam. This paper examines the beliefs of MST and student comments from the perspectives offered by two bodies of literature. The first deals with teacher beliefs and how these inform their classroom practices. The second concerns the literature on teaching and learning languages in content classrooms, and more specifically, EAP in Mathematics and Science classes for ELL.

2. Literature review

2.1. Teacher beliefs and classroom practices

The literature in this field show that teacher beliefs and theories about teaching, learning and their subject matter are important factors in classroom decisions (Sato & Takahashi, 2004; Tsui, 2003). Studies across both language classrooms and subject matter classrooms demonstrate that teachers' views about these key areas are determinant in the planning of lessons, and the teaching and learning activities that happen in the classroom (Cole, 2009; Sato &