Embedding English in the Learning of Science

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ABSTRACT

The teaching of Science in English was introduced to counter detriments of the Malaysian's inability in keeping with the pace of developments in science and technology. The current Malaysian linguistic ecosystem is a result of historical events that eminently date back to pre independence dominance by foreign powers (the British). This dominance perpetuated the use of the English language for trade, government matters and education. A notable turn of events is the implementation of the 1963 National Language Act after independence which changed the character of language use in education. English as a medium of instruction was categorically replaced by the Malay language. However, a bilingual policy innovation is now a current feature in the Malaysian linguistic ecosystem. The emphasis given to English brings along a growing concern of the standard that needs to be achieved in the learning of science. Given this policy, the paper attempts to unfold the embedding of learning English through science by examining teacher attitude towards the teaching of science in English. Data is obtained from a critical analysis of a survey questionnaire and teacher interviews. Using the content analysis approach, the data is analyzed and categorized. Findings provide directions in on-going evaluations of a policy initiative which has generated much attention and discussion.

INTRODUCTION

As a response to the growing use of English as a medium of international and global communication, a substantial change was made to the language education policy in Malaysia in 2002. Education in general, and language education in specific, became a primary avenue used to achieve national cohesion and economic success in Malaysia. Given this identification of the role of education, it is to be expected that language education planning has to facilitate the achievement of the intended goals. The Malaysian government believes that language education policy should keep pace with developments in the economy and society, and that language learning is a tool that can be used to reap profits from the investment in human capital, both in social and economic terms (Chan and Ain, 2004)

Malaysia, after 50 years of independent nationhood, is now at a crossroad. In order to be increasingly competitive and survive in a borderless, highly competitive economic environment brought about by globalization, Malaysians will need to acquire skills such as proficiency in English. In line with this, the government, through a bilingual policy innovation, has made English the language of instruction for science and mathematics in all schools as technology is perceived to be the engine of economic growth. This is a pedagogical intervention that is long overdue. However, this change is unprecedented and viewed as drastic by many. Nevertheless, the government has firmly resisted attempts to

politicize the issue and by 2003, these two subjects were fully taught in English in Standard One, Form One, and Lower Six.

This language policy decision has also been embroiled in one controversy or another, fuelled by contrived notions of nationalism, political philosophy, and ideals of what it means to be a Malaysian. As is often the case in situations of language contact, attitudes towards the language are inextricably merged with attitudes towards the people who speak it and the government who initiate the policy. Despite the role of English as a language of wider communication on a global scale, in Malaysia, the English language is sometimes associated with the language of the nation's colonizers by national language loyalists. The truth though, is Malaysians do not need convincing on the need to be bilingual as many are already multilingual. "Apart from the linguistic neo-fascists among the Bahasa lobby, the massive hang up attached to the language of the former colonial masters should have been more than overcome" (NST 8 July, 2002).

The bilingual policy innovation was ushered on the initiative, or rather political will, of the then Prime Minister, Dr. Mahathir Mohammad. The timing was provided by the growing unemployment among graduates which is attributed to their fields of studies and their poor proficiency in English. He asserted that Malaysians must be competent in the English language if they were to compete in the international market. The call for a change was a calculated maneuver due in large part to the trends towards economic globalization and that English is the most widely disseminated and ubiquitous international language. Also, the need to be proficient in the use of English among non-native speakers has become a global phenomenon and educators are faced with the challenge of addressing the needs of the growing number of students whose primary language is not English (Gibbons, 2003). While mastering other skills and content in other subject areas, there is the necessity for these learners to gain proficiency in English.

The government is concerned of the continuing decline in English standards and that if the slide continues, the country could lose its competitive edge, thus the strive for improvement in English language ability. Already, more than 44,000 public university graduates remained unemployed largely due to their poor command of English (The Straits Times, Singapore, June 2, 2002). The government stressed that Bahasa Malaysia, as the national language, will continue to play its pivotal role of promoting national integration. Malaysians, however, need to be competitive and they need skills such as those relevant to information and communication technology (ICT). The English language is merely a tool to meet this objective. Language is also no longer seen as merely abstract grammatical rules, but of having direct applications in social and economic contexts. As such efficient language use especially in a ESL situation is primarily functional and pragmatic.

Changes to language planning and policy often invite controversy, and contentious public discussion, as it involves complex relationships between "cultural politics, curriculum, education practice and the modes of surveillance of the liberal state" (Pennycook, 1994:108). In language planning policy, a major influence may be ideology, and a strong secondary influence is pragmatics. Often, in fact, there is a complementary relationship

between both forces, as language policy is usually a result of ideological and pragmatic (or instrumental) considerations. The differing emphasis and interpretations accorded to the functions could lead to language planning initiatives being misunderstood, misconstrued, or exploited for specific purposes. Studying the interrelationships between language, power and inequality are central to the understanding of language and society (Tollefson 2002:4). The evaluation of the potential and actual impact of a language policy is a complicated task. Often, it is difficult to identify straightforward causal connections between the policy and economic progress and weak linkages between policy and planning could render many policies ineffective. For the Malaysian government, the reintroduction of English for teaching science and mathematics is a reactive policy but not an ad hoc declaration lacking planning and awareness of the implications of implementation.

THE STUDY

In view of the many contentions and controversies that surround the policy this study was conceptualized to investigate an essential area affected by the implementation and that is the Malaysian science teachers in primary and secondary schools who are grass root implementers of any education policy. Success of a policy is invariably connected to its implementation and the school is where it can begin and end to a great extent.

The paper attempts to unfold the embedding of learning English through science by examining teacher attitude towards the policy of teaching science in English and how they perceive the benefits and obstacles of the policy's implementation. The study also investigated the challenges and problems which emerged from the policy implementation and how effective the policy would be at improving English by identifying the teachers' needs and concerns regarding the current practice in the midst of rapid changes in the tempo of social and economic construction of a nation. As front line practitioners, teachers have direct experience on the needs and difficulties of students. Through an understanding of teacher concerns and attitudes, the co-operation between teachers and policy-makers could be enhanced and language policy innovations, curriculum, methodology and teaching materials could be more tailor designed to fit the body of needs.

Sample population
The sample population was fifty-two primary and secondary mathematics and science teachers in the Kuala Lumpur, Selangor, and Negeri Sembilan. 28 primary and 24 secondary school teachers responded to the questionnaire.

Instrument
Two instruments were used to collect data for the study. They were:
i.   a survey questionnaire which consisted of five parts
     Part 1: Respondent bio-data
     Part 2: Competence across the curriculum
     Part 3: Teacher concerns
     Part 4: Feelings about English

Part 5: Professional development

ii.   an interview
       The structured interview was used to gather information on (1) teacher strengths in
       the teaching of science and mathematics; and (2) areas they felt needed improvement.

The study thus employed both quantitative and qualitative approaches to gather
information. First, the respondents were asked to answer the questionnaire and then 25 of
the respondents were invited for an interview. The interviews lasted for a minimum of
twenty to forty-five minutes per respondent. The questionnaire and interview questions
were formulated based on an intensive related literature review. The interviews were
semi-structured   to allow the researcher to clarify and probe deeper into the answers of
the respondents. Respondents could choose BM or English as their medium of expression
and they were asked to state without inhibition their opinions and comments regarding
the questions. Before the actual interviews, respondents were informed that the
exchanges were to be tape-recorded. All interviews were done voluntarily and the
respondents were assured of the confidentiality of their answers.

ANALYSIS OF DATA AND DISCUSSION OF FINDINGS

In general teacher concerns do not seem to be related to the politics of language. Issues
such as being nationalistic, the debasing of the national language and the threat to
national identity are not issues that pose a great concern to them.   A more pressing matter
for teachers is the actual implementation of the policy innovation to use English to teach
science and the preparation that sat on their shoulders to facilitate the implementation.
The analysis of data and discussion of findings are as follows.

Part One: Respondent bio-data
The respondents' qualification and experience were found to vary as tabulated below:

Gender	19 male	33 female	
Race	21 Indian	19 Chinese	12 Malay
Degree	21 with bachelor's degree	31 without bachelor's degree	None with postgraduate degree
Teaching experience	Ranged from 2 to 33 years		

Table 1: Respondent information

Part Two: Competence across the curriculum

Respondents were asked to rate their confidence level on a scale ranging from *not
confident at all* to *very confident*.

Knowledge of subject matter
The responses from the respondents ranged from being confident to very confident when asked whether they could handle the contents and had the necessary knowledge of the subject matter. 79% noted that they were very confident of their knowledge of the science subject.   Only 4% reported that they were not confident and needed more help in learning the content. This revealed that teachers considered themselves well trained in content areas which should give a certain measure of intrinsic motivation in carrying out the task of teaching.

Confidence to teach science in BM
When asked about the teaching of science in BM, 77% stated that they were confident, 16% very confident, and 7% not confident.

Confidence to teach science in English
When asked about the teaching of science in English, 63% stated that they were not confident, 28% confident and 9% very confident.

What appears to be needed is greater collaboration between English and BM programs at all levels of the educational system to develop generic competencies in written and oral communication in both languages. With this collaboration the Malaysian teachers can increase their bilingual confidence. The informants agreed that reading in English was their best developed skill and that their capacity to speak it was very limited. This indicates the need for training in the oral skills which could serve as a primary inhibitor in the use of the English language.

There was no distinction in the gravity of the concern according whether the teachers were to use English to teach science at the primary or the secondary level. They expressed their need for a definite improvement in English language competency for teaching science in English if they were to be effective teachers. .   It indicates that there is a necessity to support teachers in improving their English language skills in order for them to effectively implement English language instruction for teaching science.

It may also be necessary to make teachers aware of learning and teaching principles that aid in the acquisition of both languages and how the languages may differ or are similar in their language properties. Other than general English, students must be aware of the structures peculiar to science. Teachers need to be immersed in the language 'culture' that characterizes science.

Part Three: Teacher concerns

Specifically, some instructional strategies are isolated as possible problem areas in the teaching of science in English.

	Problem areas	Percentage (%)
a	Encourage pupils to plan their own investigations	81
b	Use a range of questioning skills	94
c	Encourage and help pupils write lesson notes	83
d	Frequently revise earlier learning	79
e	Show pupils how classroom learning relates to the outside world	87
f	Encourage pupils to learn from each other	74
g	Explain to pupils how to break up a large problem into smaller parts	92

Table 2: Problem areas in instructional strategies

In learning science teachers need to believe that science activities can provide meaning-making experiences about the physical environment. Similarly this value has to be transferred in English. In order for new knowledge to be acquired - in science and in language - it must be an active, meaning-making process. The science classroom can also provide an excellent atmosphere for developing the kinds of social behaviors students need in order to find solutions to local and global problems. In science, language becomes the tool for communicating meanings and solutions to problems in the outside world. The general concerns of the teachers indicate that they believed that good instruction leads to better student understanding. They also seem to express their emphasis on the quality of understanding, rather than the quantity of information presented as important for successful science and language learning.

As for their general concerns about teaching science in English, all respondents stated that they had some concerns.   Their concerns are reported below.

	Teacher general concerns	Percentage (%)
a	The ongoing need to upskill myself in the knowledge of science or mathematics	65
b	The ongoing need to upskill myself in English	92
c	The need to change my teaching style	87
d	Keeping up to date with new developments (such as education policy)	48
e	Lack of time to cope with it all	87

f	Lack of administrative support		74
g	Too much change, too quickly		94
h	Lack of training to teach science and mathematics in English		92
i	My suspicions are that teaching science and mathematics in English don't actually improve proficiency in English		83
j	I feel I am already too far behind to learn to do anything new		63
k	Lack of teaching materials in English to teach science and mathematics in English		79

Table 3: General concerns

As one can easily imagine, it has not been easy for teachers to catch up with such rapid policy changes. In many cases, teachers who have not been trained to teach science in English are being asked to do so. Moreover, since English language education in Malaysia has traditionally focused on reading, writing, and grammar, oral communicative skills have traditionally been considered to be one of the weakest skills among teachers as well as students. And it is precisely these skills that teachers need to focus on in their science classes when coming to grips with the new language policy innovation.

Part Four: Feelings about English

	Feelings about English	**%**
a	I think I am good at speaking English	27
b	Learning English may be important to my goals, but I don't expect it to be much fun	79
c	My language learning aptitude is high	25
d	I don't have any idea about how to go about learning the English language	68
e	I think that I could learn any language I really put my mind to, given the right circumstances	85
f	I worry a lot about making mistakes when using English	79
g	I'm afraid people will laugh at me if I don't say things right	77
h	I end up trembling and practically in a cold sweat when I have to talk in English in front of people	81
i	I don't like the idea of using English to teach science and mathematics	73
j	English is a language which belongs to our colonial ~~masters~~	12

	masters		
k	Proficiency in English helps in the teaching of science		92
l	Malaysia is a bilingual country		29
m	English is replacing Bahasa Malaysia in schools		33

Table 6:   Feelings toward English

The teachers seem to support the presence of English in Malaysia, even though there was no unanimity regarding its status within the curriculum. The sample was not too divided among those who felt that English belonged to our colonial masters (12%), and those who felt that proficiency in English helps in the teaching of science (92%). However, only 27% of the teachers felt that they were proficient in the English language. The data also revealed that the teachers did not consider Malaysia to be a bilingual country.   This implies that English would not gain a similar status as Bahasa Malaysia in schools, that is, English was seen not as a second language, but rather as an auxiliary language. This requires a re-think of prevailing techniques of teaching English as a second language. If it is just auxiliary, then should the language education take on amore focused functional approach?

Part Five: Professional development

	Participation in professional activities	Yes (%)	No (%)
a	In-depth study of your main subject area (i.e. science and mathematics)	29	71
b	Methods of teaching your main subject area	27	73
c	Applications of technology to teaching mathematics and science	17	83
d	English language courses	79	21

Table 7: Professional activities

First and foremost, there was a practical concern as to whether there are sufficient teachers fluent in English to teach these subjects within such a short notice of policy implementation. The issue of insufficient teachers to teach English as a subject, especially in rural schools, is a recurrent one. However, the problem would now be compounded by an acute shortage of teachers capable of teaching Science in English. The key variables in any national development equation are human resources, natural resources, scientific knowledge, and technological know-how set in motion by national consciousness or nationalism.   However, it is not sufficient to have an abundance of human and natural resources for development to take place.   Available human resources must be transformed into knowledgeable, specialized or skilled manpower by an education or training process in order for them to be useful in the national development equation. In other words, of all the elements in the national development equation, human

resources are the most important.   This is evident from the fact that while most African countries are very rich in natural resources, they are still yet under-developed.   Many Arab countries, with their enormous oil wealth, are nevertheless also quite underdeveloped.

Only a human population possessing knowledge and skills, acquired through education and training, can serve as agents of change, to convert raw materials (natural resources) to finished products for consumption in the national economy. If rapid access to knowledge (information) is to be guaranteed, then language should not constitute a barrier to information and knowledge, as lack thereof would negatively affect productivity. All things being equal, once there is continuity between multilingual education and training, on the one hand, and language practice in the workplace, or on the production floor, economic development could be expected to be triggered. It does seem that national development cannot occur in Malaysia unless an appropriate language policy, which includes the functional use of a national language, indigenous languages together with a language of wider communication, is integrated into the national development plan. Clearly, economic development is a central feature of national development, hence the link with language.

The respondents were also asked whether they had been involved in any other activities related to the teaching of science in English. The teachers with the most contact with English indicated the most positive attitudes towards bilingualism and characterized themselves as more   proficient in English. It is not known if the fact of being more proficient in English attracted them to interact more in English or if the experience in English speaking environments stimulated them to acquire more English. Probably there exists a symbiosis in which the two nurture each other. In any case, it is likely that such teachers have a more integrative rather than an instrumental orientation toward English which has positively affected their attitudes towards teaching science in English.

	Participation in teaching related activities	Yes (%)	No (%)
a	Developed or piloted new curricula	8	92
b	Formally mentored beginning teacher(s)	4	96
c	Conducted in-services or workshops for teachers	4	96
d	Made observational visits to other schools	10	90
e	Represented the school or district on an instructional reform project	4	96

Table 8: Participation in teaching related activities

Some efforts appeared to have been made to train teachers to teach science in English prior to the implementation of the policy. However, an important response focused on budgetary issues that are important in training and administration. The implementation of the policy innovations is certainly an expense, and resources are always scarce and subject to alternative uses. They felt that there should be more avenues for professional

development but this was often reserved mainly for senior teachers and the number was always small.

Interviews
The interviews complemented the questionnaire survey.   The following information were obtained

Strengths
Some of the respondents were asked to consider their strengths as a teacher of science focusing on the areas of content mastery, language proficiency, and instructional strategies.   They listed them to be:
High proficiency in BM
Many years of teaching experience
Possess good content mastery of the subject (science)

Some comments made were:
i.   I think mastering basic expressions for classroom English is not that hard for me, perhaps. But it sounds awfully hard to give instruction to students and manage the class all in English.
ii.   The idea of teaching science in English is rooted in the belief that, as for most things in life, we get better at something if we do it often enough. A prolonged exposure to English beyond the language class will make our students more comfortable with it, and help them.

Areas for improvement
The respondents were also asked to consider areas of improvement in their teaching of science in terms of content mastery, language proficiency, and instructional strategies. Some areas that they felt they needed to improve included the following.
Level of proficiency in English, especially vocabulary
Method of incorporating ICT (such as e-learning)
Ways to enhance role of teacher as facilitator
Writing better text books
Better translations of science texts

There were a wide variety of responses among the teachers interviewed. Recurring themes were divided into positive/practical and negative (involving avoidance, insecurity or dislike).   The negative outnumbered the positive by a factor of nearly 4 to 1.   The most frequent response was the non-usefulness of English for the learning of science. Two related ideas - that English does not provide access to equality in the classroom, and to use English is not democratic were given in many formulations – 'we all need to make sacrifices – every one understands it', 'if we keep English no one can say their language is the best'.   Other recurring ideas included career prospects and personal improvement - 'I need English in my work ', and several cited the time taken to translate from one language to another.   Some negative responses tended to be despairing - 'we have to learn English, it's no use to speak *Bahasa Melayu* all the time', or resigned - 'I have learned to settle with the present ruling.'

A substantial majority of teachers from all language groups did not prefer English as a language of instruction.   The choice is most clearly expressed in response to the question which asked how they felt about the fact that the language of instruction for science was English.   95% of the total sample opted for 'very unhappy' and 'unhappy' rather than 'happy' or 'very happy'. Among a host of reasons given in response to the question was the fact that English is not the language most nearly understood by all (although to varying degrees). This provides a pressing practical consideration and cannot be ignored or overlooked by language planners and policy makers.

Some teachers also expressed that they felt insecure having to teach science using English. They stated that this fact is compounded even further when the text books, teaching modules and guidebooks are also in English.   It is important to stress that a large majority of the teachers surveyed do not display a high level of proficiency in English. The completed questionnaires confirm that such teachers come from rural areas and tend to prefer to choose *Bahasa Melayu* as a language of instruction. Some teachers expressed concern and even resentment at having to teach science in English.   Others avoid using English in multi-lingual situations, since they perceive themselves to be disadvantaged.

The teachers stated that introducing a multilingual context in schools introduced problems of a technical nature. The interpretation and translation services perform an essential task of mediation between the different languages, and without them the practice of institutional multilingualism would not be imaginable. However excellent they are, the linguistic services cannot solve all the problems created by the need for multilingualism, and it is inevitable that more or less serious difficulties will arise. Precision was cited as an important factor which could result in problems for the policy advance. The problems concerning precision were associated with several factors.

The first problem cited involved untranslatability. Teachers felt that there may be some terms that cannot be translated from one language to another.   The most immediate consequence of this is that it is not always possible to find the equivalent in one language of what the other expresses.   The other technical problem cited concerned precision. Teachers associated this problem with regard to the quality of material written non-mother-tongue writers. They explained further that however well the writers manage to produce such material; there will be inevitable interference between languages in the vocabulary and syntax. The result of all this may be a low quality of the original texts and uncertainty over the real lexical intentions of the author. Another technical problem cited by the teachers was the element of speed. They claimed that working in different languages slows down the work, especially when written texts need to be translated. The need for time to translate documentation can sometimes clash with requests to have it available urgently, or may even become a pretext to stop the work. Finally, the last technical problem that was expressed concerned apprehension towards the deterioration of style. They claimed that if they were to use a different language from their own, they generally would not be able to express themselves to the best of their abilities.

CONCLUSION

Despite the fact that language planning in Malaysia has been successful in achieving the government's sated aims, there are a lot issues and problems underlying the new language policy innovation. In order to clarify these issues and come up with solutions to the problems, the government and those in the teaching profession should co-operate with each other. Teachers should be given a chance to take on a more active role in influencing and designing any new language policy decision. After all, teacher concerns and attitudes towards teaching and their learners are pivotal to any successful implementation of a curriculum initiative.

Guaranteeing the availability of textbooks, resource persons, and teaching material in English are all efforts which are welcome. The findings of the study indicate that teachers as a whole do not have a positive outlook towards the use of English for science in primary and secondary schools. They also did not believe that using English as a medium of instruction for science would help to improve proficiency in the language. In short, their incompetence in English was of a great concern. Respondents also expressed some pedagogical concerns. They reported having high confidence levels in content mastery and instructional strategies when teaching science in BM. However, the reverse was indicated when posed with the situation of having to teach science and mathematics in English. In conclusion, time must be spent developing appropriate and effective implementation strategies to benefit the practitioners before the initiation and implementation of any new policy. Time is what they need but paradoxically time is not what they have if Malaysia wants to achieve their aspirations which are located in the *now*.

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