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KNOWING, LEARNING AND DOING: THE EFFECTS OF TRAINING AND TEACHING AMONGST TEACHERS TEACHING MATHEMATICS AND SCIENCE IN ENGLISH IN MALAYSIAN SECONDARY SCHOOLS

FATIMAH PUTEH
FARUK MUHAMMAD
HAMIDAH ABDUL RAHMAN
AMINAH AHMAD KHALID
SITI FATIMAH BAHARI
AZIZ NORDIN
MUKHETA ISA
NORAZMAN ABDUL MAJID
SHUFAAT TUMIN
ZURIHANMI ZAKARIYA

INTRODUCTION

To achieve “world-class education”, the Government has the vision of producing a generation who practises critical, creative and innovative thinking, able to compete as global players towards the development of knowledge, society, culture, race and the nation (Zain, 2002). Science and Mathematics are integral subjects in education, and have made a huge impact on human civilisation over the centuries in such that they not only contribute towards



the invention of new products but their uses and application have transformed many areas of our lives. Science and Mathematics are undeniably two very important and dynamic areas of knowledge that assist in laying the foundation in many areas of studies at the tertiary level of education. With the presence of the Internet within the last three decades, users are provided access to a huge virtual library including the knowledge of Science and Mathematics and the new discoveries and latest inventions. Therefore, it is imperative that everyone should take advantage of these available resources. However, many of these resources are written in the English language; a language which many of the younger generation in the country today have lesser exposure to and command of. In realising the availability of the huge virtual resources on the Internet, the depth of knowledge that the younger generation can utilise from this virtual library, the importance of Science and Mathematics in realising Vision 2020, the need to produce versatile individuals driven by the k-economy, competitive as global players in the international arena but handicapped by the language gap in utilising the available knowledge, the Government took the bold and challenging step of implementing the policy of teaching Mathematics and Science in English (PPSMI) in Malaysian schools. This was introduced in 2003 with the hope that through learning Science and Mathematics in English, students will be exposed to the language and will then be able to enhance their command of the English language.

The implementation of PPSMI in schools in Malaysia posed a big challenge not only to the Ministry of Education (MOE) but also to students and, especially, the teachers. Just like any other new directives introduced in the past, in its early implementation, people, including the general public, parents, and even teachers who had been entrusted with the responsibility of teaching Science and Mathematics in English were rather sceptical of the move, raising

a lot of doubts if the decision to switch the medium of instruction into English is a right move. With the knowledge that many of the teachers teaching Science and Mathematics in schools today have had very little exposure to the subjects in English, both in learning the subjects and teaching the subjects, it is therefore important that the implementation of the policy is closely observed and monitored. To facilitate and assist these teachers in teaching Science and Mathematics in English, the Ministry of Education has introduced several support mechanisms and meaningful programmes aimed at preparing the teachers to teach the subjects in English. The courses and training specifically aimed at preparing teachers with the necessary skills to teach in English include ETeMS Phase I and ETeMS Phase II.

This chapter aims to report the findings of a survey on the evaluation of the teaching of Science and Mathematics in English in Malaysian secondary schools with specific reference to the perception of the teachers on their English language competency, the effects of trainings given and the exposure to teaching the subjects in English.

RESEARCH METHODOLOGY

The discussion in this chapter is part of a wider study on the evaluation of the teaching of Science and Mathematics in English in Malaysian secondary schools, adopting both qualitative and quantitative methods of data collection. The data for the study were collected from six different zones in East and West Malaysia where each zone was represented by a particular state. The details of the different states representing the six different zones with the number of respondents from each zone are as shown in the table below:

Research Zone	No.	%
Northern Zone - Kedah	98	17.0
Eastern Zone – Kelantan	91	15.8
Southern Zone – Johor	97	16.9
Western Zone – Selangor	101	17.6
Sarawak Zone	96	16.7
Sabah Zone	92	16.0
TOTAL	575	100.0

Table 1: Distribution of Respondents According to Zones

A total of 575 respondents (286 from schools located in town areas, whilst 289 in rural areas) who are teachers teaching Science and Mathematics in English in Malaysian secondary schools participated in the study. The respondents were selected using the purposive sampling method. The instrument used for data collection was a questionnaire which was constructed and designed by the researchers using the CIPP model, introduced by Stufflebeam (1966) as a guide. The questionnaire was designed based on the objectives of the study, in line with what was proposed in the adopted model. A four-level Likert Scale (1967) was used in the research as a form of measurement of the respondents' responses. The four-level Likert Scale are represented as follows:

- 1 represents *Disagree* (24% and less)
- 2 represents *Somewhat Disagree* (25% - 49%)
- 3 represents *Agree* (50% - 74%)
- 4 represents *Strongly Agree* (75% - 100%)

The questionnaires were distributed, collected and later analysed using SPSS (Statistical Package for Social Science for MS Windows Release 10.05) software. The statistical analyses used

in the research were frequencies and percentages. The reliability (Alpha Cronbach) level of the questionnaire is 0.9224. The results of the study are as shown in Tables 1 to 10.

FINDINGS

In the implementation of PPSMI, the English language becomes a very important vehicle in assisting teachers to deliver the content, instructions and skills to students. To accomplish this, teachers need the necessary skills to use the language effectively in their teachings so as to help students to understand the subjects better and to instil positive traits in the students, such as interest to learn, positive attitudes towards the subjects, which will result in higher motivation to learn the subjects. In addressing the issue of teachers having limited exposure to learning and teaching the subjects in English as discussed in the Introduction, the Ministry of Education made a positive move of providing training and courses specifically aimed at preparing teachers with the necessary language skills to teach in English.

Distribution of Respondents According to Language-Related Courses Attended

As part of the requirements for teaching Science and Mathematics in English, teachers are required to attend courses to equip themselves with the relevant skills and language to deliver lessons in English. Some teachers however, are given exemptions based on their level of proficiency in the English language, exposure to the English language or exposure to Science and Mathematics in the English language. The distribution of the respondents according to their exemption from attending the courses given by the ministry will be discussed later.

The following table shows the distribution of respondents according to the different types of language training that they had attended in preparing them for the task of teaching Science and Mathematics in English. The language-related courses given by the ministry are ETeMs Phases I and II.

In the study, 57.9% of the respondents had attended Phase I of ETeMS whilst 53.6% of them had attended Phase II of ETeMS, as shown in Table 2.

No.	Names of Courses		Yes	No
1.	ETeMS – Phase 1	(n)	333	242
		%	57.9	42.1
2.	ETeMS – Phase 2	(n)	308	267
		%	53.6	46.4

Table 2: Distribution of Respondents According to Courses Attended

Respondents' Reasons for Not Attending ETeMs Courses

Some teachers were given the exemption from attending the ETeMS courses organised by the ministry. Table 3 shows the distribution of respondents according to reasons for not attending the courses.

No.	Reasons for Exemption		
1.	English language option	(n)	6
		%	1.0

2.	Obtained credit in the English language at SPM/MCE or its equivalent	(n)	125
		%	21.7
3.	Obtained certificates in English language courses at international/national levels from any institutions related to the teaching and learning of English	(n)	3
		%	0.5
4.	Obtained certificates in the teaching and learning of Mathematics and Science in English organised by the Ministry of Education, Malaysia or any institutions certified by the ministry	(n)	20
		%	3.5
5.	Others	(n)	6
		%	1.0
6.	Not Stated	(n)	415
		%	72.2

Table 3: Reasons for Not Attending ETeMS Courses

Results of the study show that only 21.7% of the respondents obtained a credit score for their English language at SPM/MCE level and another 3.5% had been exempted because they obtained certificates in the teaching and learning of Science and Mathematics in English organised by the ministry. Hardly 1% of the respondents had been exempted from attending ETeMS courses for having certificates in English language courses at international/national levels from any institutions recognised by the ministry.

Respondents' Perception of the ETeMS Courses Attended

Table 4 shows the respondents' perception towards the ETeMS courses that they have attended.

	Item		Disagree	Somewhat Disagree	Agree	Strongly Agree
1.	Assist in the implementation of PPSMI.	(n)	11	58	271	121
		%	1.9	10.1	47.1	21.0
2.	Increase the use of English in teaching and learning	(n)	13	77	254	118
		%	2.3	13.4	44.2	20.5
3.	Improve English language proficiency to be used in the job	(n)	13	101	263	85
		%	2.3	17.6	45.7	14.8
4.	Improve skills in using teaching and learning tools	(n)	17	92	241	111
		%	3.0	16.0	41.9	19.3
5.	Improve pedagogical skills in teaching and learning	(n)	13	109	279	62
		%	2.3	19.0	48.5	10.8
6.	Improve knowledge of the subjects in PPSMI	(n)	13	128	248	73
		%	2.3	22.3	43.1	12.7
7.	Increase motivation in teaching and learning	(n)	13	91	273	85
		%	2.3	15.8	47.5	14.8

Table 4: Respondents' Perception of the ETeMS Courses Attended

Results of the study show that, in general the majority of the respondents have very positive perception of the ETeMS courses they had attended. 68.1% of the respondents agreed that the ETeMS courses have assisted them in implementing PPSMI whilst only 12% of the respondents expressed disagreement towards the statement. As a result of attending the ETeMS courses, 64.7% of the respondents agreed that the courses have helped them to increase their use of English in their teaching and learning whilst 61.5% agreed that they have improved their English language proficiency. Another 55.8% of the respondents agreed that ETeMS courses have helped them to improve their knowledge in the subjects and 62.3% agreed that the courses have improved their motivation in teaching and learning.

Content of the ETeMS Courses

The study also looked into the perception of the respondents on the content of the ETeMS courses. This is as shown in Table 5.

	Items		Disagree	Somewhat Disagree	Agree	Strongly Agree
1.	EteMS Courses	(n)	17	121	258	62
	are relevant to the content of PPSMI	%	3.0	21.0	44.9	10.8
2.	ETeMS Courses	(n)	33	186	198	32
	are sufficient for PPSMI.	%	5.7	32.3	34.4	5.6

Table 5: Distribution of the Respondents' Perception of the ETeMS Courses

Based on the data obtained, 55.7% of the respondents agreed that ETeMS courses are relevant to the content of PPSMI for the teaching of Science and Mathematics in English. However, 38% of the respondents still felt that ETeMS courses are still not sufficient to equip them with the necessary skills and techniques to teach Science and Mathematics in English.

The respondents' level of perception on the ETeMS courses is as shown in Table 6. Results of the study show that 47% of the respondents have an average perception on the effectiveness of the content of the courses. At the same time, 19.5% and 9.6% respectively have a low and high perception on the effectiveness of the content of ETeMS.

Level	Frequency	Percentage
Low	112	19.5
Average	270	47.0
High	55	9.6
Total	437	76.0

Table 6: Respondents' Level of Perception on the Content of ETeMS

English Language Competency of the Respondents: Speaking Ability

The ability to speak in the English language is very important if one is to teach any subject in English. This is because in teaching, the speaking skills of the teacher can help to determine whether or not students are able to understand the content of the teaching. The way we speak, the way we explain and elaborate things, the way we ask and answer questions and others will assist our students in grasping any concepts taught. Table 7 shows the respondents' perception of their spoken ability in English.

Results of the study show that the majority of the respondents have an average level of competency in spoken English. 53.6% and 18.8% respectively agree and strongly agree that they are confident with their pronunciation of the English terms in Science and Mathematics. Another 53.5% either agree or strongly agree that they can use good English grammar in their teaching. This rather average score could be associated with the fact that PPSMI is still at its infancy stage where the most number of years teachers have had the opportunity to teach the subjects in English is three years while the majority of them have taught the subjects either for one or two years. Given more practice and exposure to the language, the teachers may have a different perception in their ability to use good English grammar.

The study also looked into the respondents' perception in their ability to explain processes of Science and Mathematics in English. The results show that a good percentage of 71.3% agrees that they have the ability to explain processes in Science and Mathematics in English.

Items			Disagree	Somewhat	Agree	Strongly Agree
			Disagree			
1.	I am confident with my pronunciation of English terms in my teaching.	(n)	5	152	309	108
		%	0.9	26.4	53.6	18.8
2.	I am able to use good English grammar.	(n)	19	248	236	72
		%	3.3	43.1	41.0	12.5

6.	I am able to explain processes of Science/ Mathematics in English.	(n)	9	148	292	118
		%	1.6	25.7	50.8	20.5
8.	I am able to use transitional markers in my teaching of Science / Mathematics in English	(n)	5	168	295	69
		%	0.9	29.2	51.3	12.0
9.	I am able to ask questions in English	(n)	-	68	366	139
		%	-	11.8	63.7	24.2
10.	I am able to use English in my teaching	(n)	14	233	222	100
		%	2.4	40.5	38.6	17.4
11.	I am able to explain features of objects in English	(n)	10	144	316	99
		%	1.7	25.0	55.0	17.2
12.	I am able to discuss results of experiments in English	(n)	21	152	282	93
		%	3.7	26.4	49.0	16.2
13.	I am able to give verbal instructions in English	(n)	5	69	372	121
		%	0.9	12.0	64.7	21.0

Items	Disagree	Somewhat	Agree	Strongly Agree
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Disagree

14.	I am able to give details on steps of Science / Mathematics in English	(n)	9	116	331	111
		%	1.6	20.2	57.6	19.3
15.	I am able to give opinions in English	(n)	14	186	269	102
		%	2.4	32.3	46.8	17.7

Table 7: Respondents' Speaking Ability in English

Other language skills are also looked into in the study. Results of the study show that 63.3% of the respondents have the ability to use transitional markers, 87.9% have the ability to ask questions in English, 72.2% are able to explain features of objects in English, 65.2% are able to discuss results of experiments in English, 85.7% are able to give verbal instructions in English, 76.9% are able to give details of steps in Science and Mathematics in English and another 64.5% are able to give opinions in English.

Considering the fact that a good majority of the respondents in the study have had minimal exposure to Science and Mathematics in English both in their years of study and training and the fact that not many respondents had been given the exemption from attending the courses organised by the Ministry of Education, results of the study still shows that the respondents have positive attitudes towards PPSMI with many perceiving themselves to have at least an average level of competency in spoken English for PPSMI.

English Language Competency of the Respondents: Reading Ability

Reading is also an important skill required of teachers so that they will be able to know beyond the information given in the textbooks to supplement their teachings. Through reading, one is able to gather more information through various available resources such as journals, magazines, reference books, the Internet and the like.

Table 8 shows the respondents' reading ability in English to gain information for classroom use.

Items		Disagree	Somewhat Disagree	Agree	Strongly Agree
3.	I understand Science/ Mathematics terms in English	(n) 1 % 0.2	86 15.0	356 61.9	130 22.6
4.	I am able to use reference books in English	(n) 6 % 1.0	49 8.5	349 60.7	170 29.6
5.	I am able to access materials in English from the Internet	(n) 12 % 2.1	120 20.9	297 51.7	140 24.3

Table 8: Respondents' Reading Ability in English

Results of the study show that 84.5% (Item 3) of the respondents understand scientific and mathematical terms in English, another 90.3% (Item 4) are able to use reference books in English whilst 76% (Item 5) are able to access materials in English from the Internet. The high recordings for items 3 and 4 could be associated

with the fact that some of those teaching the subjects in the study are non-optionists where they have been trained to teach English language but due to their good command of the language, they have been assigned to teach Science and Mathematics.

English Language Competency of the Respondents: Writing Ability

The ability to write in the English language is also a necessity in PPSMI. Teachers will be required to prepare lesson plans, examination questions, monthly test questions, and above all, teaching and learning notes to be shared with the students in order to ease the flow of the teaching, especially during this transitional period of learning Science and Mathematics from Bahasa Melayu to English language. All these require good writing skills on the part of teachers to enable them to carry out their duties systematically, meaningfully and effectively.

Items		Disagree	Somewhat Disagree	Agree	Strongly Agree
16. I am able to prepare examination questions in English.	(n)	8	110	334	121
	%	1.4	19.1	58.1	21.0
17. I am able to give written instructions in English	(n)	7	80	361	124
	%	1.2	13.9	62.8	21.6
18. I am able to prepare teaching notes in English	(n)	8	91	356	117
	%	1.4	15.8	61.9	20.3
19. I am able to prepare lesson plans in English	(n)	4	48	374	148
	%	0.7	8.3	65.0	25.7

Table 9: Respondents' Writing Ability in English

As shown in Table 9, the results of the research revealed that 79.1% of the respondents are able to prepare examination questions in English, 84.4% are able to give written instructions in English, 82.2% are able to prepare teaching notes in English whilst another 90.7% are able to prepare lesson plans in English. This data clearly shows that only after slightly more than two years of exposure to the teaching of Science and Mathematics in English, many of the respondents felt that they now have the necessary skills, be it speaking, reading or writing, to deliver their teachings in English.

Results of the study also indicate that majority of the respondents surveyed stated that their confidence level in PPSMI has improved (Item 1), they are comfortable teaching the subjects in English (Item 2), have the ability to ask questions and respond to students' questions spontaneously (Items 3 and 4), are able to explain mathematical and scientific concepts correctly and systematically (Items 5, 13 and 14), are able to search for information from a variety of sources (Items 7 and 8) and the majority are able to teach Science and Mathematics in English (Items 6, 10, 11, and 12). The details are as shown in Table 10.

Items		Disagree	Somewhat	Agree	Strongly Agree	MIN/ SP	
		Disagree					
1.	Confident teaching in English	(n) 9	92	277	186	3.13	
		% 1.6	16.0	48.2	32.3	0.74	
2.	Comfortable teaching in English	(n) 24	139	261	139	2.92	
		% 4.2	24.2	45.4	24.2	0.81	
3.	Able to answer questions spontaneously in English	(n) 12	121	294	136	3.02	
		% 2.1	21.0	51.1	23.7	1.12	

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4.	Able to ask questions spontaneously in English	(n)	6	97	321	140	3.06
		%	1.0	16.9	55.8	24.3	0.68
5.	Able to explain scientific and mathematical concepts in English	(n)	16	118	314	116	2.94
		%	2.8	20.5	54.6	20.2	0.73
6.	Able to prepare notes in English	(n)	10	94	343	114	3.00
		%	1.7	16.3	59.7	19.8	0.66
Items			Disagree	Somewhat Disagree	Agree	Strongly Agree	MIN/ SP
7.	Able to access information in English from the Internet	(n)	22	129	276	133	3.03
		%	3.8	22.4	48.0	23.1	1.90
8.	Able to access information in English from other sources	(n)	10	80	309	156	3.15
		%	1.7	13.9	53.7	27.1	1.45
9.	Proficiency in the English language is better	(n)	9	84	328	141	3.07
		%	1.6	14.6	57.0	24.5	0.68
10.	Fluent in speaking English	(n)	16	140	287	119	2.90
		%	2.8	24.3	49.9	20.7	0.75
11.	Able to discuss in English	(n)	16	161	278	109	2.85
		%	2.8	28.0	48.3	19.0	0.76
12.	Able to understand articles written in English	(n)	7	71	350	136	3.09
		%	1.2	12.3	60.9	23.7	0.64

13.	Mastery of Science and Mathematics in English	(n)	10	70	351	133	3.08
		%	1.7	12.2	61.0	23.1	0.65
14.	Able to use scientific and mathematical terms precisely in English	(n)	6	84	345	125	3.05
		%	1.0	14.6	60.0	21.7	0.64
15.	Improve professionalism in the educational field	(n)	10	61	329	157	3.14
		%	1.7	10.6	57.2	27.3	0.67

Table 10: The Distribution of Respondents' Perception after Teaching PPSMI

CONCLUSIONS

The findings of the study show that the majority of the respondents had attended ETeMS courses organised by the Ministry of Education of Malaysia as a preparatory training for the teachers who will be teaching Science and Mathematics in English. With many respondents lacking the necessary language qualification to teach the subjects in English, the move to introduce ETeMS courses as a measure to bridge the language gap of the teachers is seen as a correct and an effective move as the results of the study show that there is a marked increase in the language skills, including speaking, reading and writing of the teachers teaching Science and Mathematics in English. The respondents who attended the ETeMS course also indicated that the courses were relevant to their needs

and the content have in many ways helped them in their teachings. The findings also revealed the respondents' perception towards their language skills after just over two years of the implementation of PPSMI in Malaysian secondary schools. The results show that there is also a boost in their confidence level in using the English language in their teaching, including their ability to ask and answer questions posed by the students spontaneously, their ability to explain scientific and mathematical concepts and terminologies precisely, their ability to access information from a variety of sources and prepare relevant notes to supplement their teachings. The respondents also expressed their confidence to prepare examination questions in English, participate in oral discussions related to their fields of expertise in English and to understand articles written in English.

In short, results of the study show that the combination of their knowledge of the subject regardless of the language used in learning and training, the ETeMS courses attended and the exposure to teaching the subjects in English have somewhat improved their language ability and attitude and perception towards PPSMI.

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