

AN INVESTIGATION OF TEACHERS' PEDAGOGICAL SKILLS AND CONTENT KNOWLEDGE IN A CONTENT-BASED INSTRUCTION CONTEXT

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Abstract: Advocates of the content-based approach believed that a language can be learnt effectively when it is the medium of instruction rather than just a subject. Integrating English and content as part of instruction has become one of the cornerstones of second language pedagogy. Researchers claimed that there are many benefits of integrating English and content instruction. Among the benefits are the increase in students' interest with content themes, meaningful input and understanding. In 2003, the Malaysian Ministry of Education introduced the teaching and learning of science and mathematics in English for Year One, Form One and Lower Six Form in all government public schools. This paper describes the challenges faced by teachers when they are required to teach content subjects such as science and mathematics in English. The focus of the paper is on the teachers' pedagogical skills and content knowledge which comprises subject matter content, pedagogical approach, classroom management, use of resources, assessment, preparation of teaching materials, managing students, teachers' compensatory communication strategies, use of first language and teachers' perspectives of teaching content subjects in English. Data were obtained from a self-report questionnaire administered to 495 secondary school teachers in West Malaysia. Results from the study provide implications for school administrators in making decisions in assignment of capable teachers to teach the various levels of classes. Suggestions for teacher self-development and life-long learning efforts are also provided.

Key words: Content-based instruction, ESL instruction, second language, first language and second language pedagogy

Abstrak: Pendukung dari pendekatan berbasis konten menyakini bahwa suatu bahasa dapat dipelajari secara efektif ketika bahasa tersebut digunakan sebagai bahasa pengantar daripada sekedar materi yang dibahas. Integrasi bahasa Inggris dan konten sebagai bahasa pengantar telah menjadi landasan bagi pembelajaran bahasa kedua. Para peneliti menegaskan bahwa banyak keuntungan yang didapat dari integrasi konten dan bahasa Inggris sebagai bahasa pengantar. Beberapa keuntungan yang bisa diraih diantaranya

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adalah peningkatan ketertarikan siswa terhadap tema dari konten, input yang lebih bermakna serta pemahaman yang lebih baik. Pada tahun 2003, kementerian pendidikan Malaysia memperkenalkan pola pengajaran IPA dan Matematika menggunakan Bahasa Inggris untuk tahun pertama sekolah menengah pertama (Form One) dan sekolah menengah atas (Lower Six Form) di semua sekolah negeri. Penelitian ini memaparkan berbagai kesulitan yang dihadapi oleh para pengajar ketika mereka diharuskan mengajar materi IPA dan Matematika dalam bahasa Inggris. Fokus penelitian ini lebih ditekankan pada kemampuan pedagogis dan konten para pengajar yang terdiri atas konten pelajaran, pendekatan pedagogis, manajemen kelas, penggunaan bahan ajar, penilaian, persiapan mengajar, penanganan siswa, strategi komunikasi pengajar, serta penggunaan bahasa pertama dan perpektif pengajaran konten dalam bahasa Inggris. Data penelitian diperoleh dari kuesioner yang diberikan kepada 495 guru sekolah menengah di Malaysia Barat. Hasil penelitian memberikan implikasi bagi para pengelola sekolah dalam membuat keputusan dan penugasan guru yang sesuai untuk mengajar berbagai tingkatan kelas. Selain itu, penelitian ini juga menyertakan berbagai masukan bagi pengembangan pengajar di kemudian hari.

Kata Kunci: Instruksi berbasis konten, ESL, bahasa kedua, pedagogi bahasa pertama dan kedua

The teaching and learning of science and mathematics in the English language was implemented beginning January 2003 for Year One, Form One and Lower Six Form in all government public schools (Ambigapathy Pandian & Revathi Ramiah, 2004; Hamidah et .al, 2005; Pillay, 2003). Since then, various research have been conducted examining topics that ranged from perceptions, attitudes, efficacy, teacher readiness, implementation problems, and other pertinent issues related to the teaching and learning of science and mathematics in English (Goh San San et .al, 2005; Lim Chap Sam & Hwa Tee Yong, 2003; Marlyna Maros & Kamariah Hassan, 2007; Mohini Mohamad, Aziz Nordin, & Rosnani Hashim, 2004 ; Noraini Idris et. al, 2007; Pillay, 2003). However, a review of the literature shows that there has yet to be research conducted to explore the challenges that teachers faced when teaching these content subjects in English and their pedagogical skills and content knowldge needed to help them teach effectively.

Because teachers are the implementors of educational policies developed by the government, in particular, in relation to pedagogical matters, thus it is imperative that these teachers who have been entrusted to teach the children science and mathematics knowledge, are able to fulfill their duties successfully.

Presently, various arguments and facts are put forth against the teaching of science and mathematics in English, even though schools have been implementing the “policy” since the

year 2003, a half a decade ago. Some quarters question the psychological, social, and cognitive implications of learning science and mathematics in English, especially when the language is a second/foreign language to the learners (Cummins, 1979, 1991, 1994; Marlyna Maros & Kamariah Hassan, 2007; Juriah Long et .al, 2005; Sau Cheong Loh & Selva Rane Subramaniam, 2007). Issues of misplaced and weak identity and detrimental effects of learning content subjects in a second or foreign language are frequently raised in past studies (Mohini Mohamad, Aziz Nordin, & Rosnani Hashim, 2004; Noraini Idris et .al, 2007).

Pedagogical content knowledge

Over the past 20 years, researchers have used pedagogical content knowledge to refer to a wide range of aspects of subject matter knowledge and the teaching of subject matter and have used it differently across and even within subject areas (Ball, Thames & Phelps 2008). These researchers refer pedagogical content knowledge as specialized content knowledge. Shulman (1986) and his colleagues refer to it as the study of teacher knowledge in ways that attend to the role of content in teaching. In other words, pedagogical content knowledge is an integration of teacher understanding that combines content (subject matter), pedagogy (instructional methods), and learner characteristics.

Shulman (1986) and his colleagues proposed a special domain of teacher knowledge which is referred to as pedagogical content knowledge. Shulman (1986) defined pedagogical content knowledge as:

The most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations and demonstrations – in a word, the most useful ways of representing and formulating the subject that make it comprehensible to others... Pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or difficult; the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons. (p 9).

It has been suggested that content knowledge is unique to teaching; a kind of subject matter specific professional knowledge. This notion of pedagogical content knowledge has continuous appeal as it bridges content knowledge and the practice of teaching. Pedagogical content knowledge is often not clearly distinguished from other forms of teacher knowledge. According to Magnusson, Krajcik and Borko (1999), pedagogical content knowledge is,

... a teacher's understanding of how to help students understand specific subject matter. It includes knowledge of how particular subject matter topics, problems and issues can be organized, represented and adapted to the diverse interests and abilities of learners and then presented for instruction.... The defining feature of pedagogical content knowledge is its conceptualization as the result of a transformation of knowledge from other domains. (p.96)

In other words, pedagogical content knowledge includes almost everything a teacher might know in teaching a particular topic, obscuring distinctions between teacher actions, reasoning,

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beliefs and knowledge. Teaching requires a special kind of content knowledge. Teaching involves showing students how to solve problems, answering students' questions and checking students' work – demands an understanding of the content of the school curriculum.

Teachers do various tasks to support the learning of the students. They include interactive work of teaching lessons in classroom together with all the tasks that arise in the course such as planning the lessons, evaluating students' work, writing and grading assessments. Teachers must know the subject they teach as the pedagogical content knowledge is immensely important to teaching.

In this paper, the pedagogical content knowledge in focus is the two subjects in school that is, science and mathematics. Knowledge of ideas, skills of reasoning, fluency with examples and terms are important aspects of teachers' pedagogical content knowledge. The paper explicates the challenges faced by teachers teaching science and mathematics in English. Specifically, it focused on teachers' pedagogical skills and content knowledge in the context of content-based instruction. The variables comprise subject matter content, pedagogical approach, classroom management, use of resources, assessment, preparation of teaching materials, managing students, teachers' compensatory communication strategies, use of first language and teachers' perspectives of teaching content subjects in English.

Research in teaching science and mathematics in English

In order to contextualize the present study, several studies conducted in Malaysia are reported and discussed. A research involving 575 teachers was conducted by Hamidah et. al. (2005) throughout the country to examine the effectiveness of the programs organized by the ministry and to gauge whether or not the trainings given were adequate and relevant to the needs of the teachers to teach the subjects in English. Questionnaires, which comprised of structured items to elicit information with respect to facts, perception, opinion and attitudes of the respondents were administered to the teachers. The findings revealed that the implementation of the teaching of mathematics in English in schools was at satisfactory level (53.4%). The respondents also agreed that they have improved their command of the English language and that their level of confidence to teach mathematics in English have also improved. However, the respondents also admitted that they lack the ability to teach science and mathematics in English.

Juriah et al. (2004) analysed the responses obtained from teachers and students involved in the program of teaching and learning of mathematics and science in English. Among the findings were the program failed to provide positive impact on the students' use of the English language. The teachers were not able to implement the teaching and learning of mathematics and science in the English language in an interactive manner because students did not participate actively in the teaching and learning process. It was also found that the students were not confident and ready, and their anxiety level was high during the program. The data revealed significant differences in the use of the English language in terms of the background,

ethnic groups and socioeconomic status of the students. The students that benefited from the program were the urban area students, non-Malay students, and higher economic status students. On the contrary, the rural area students, the Malay students, and the low socioeconomic status students did not benefit from the program.

Tan and Ong (2008) reported that teachers when interviewed, are supportive of the policy although they are still struggling with the realities of implementing this policy. The findings of the study concluded that factors such as prior educational background of teachers, the linguistic environment in school and the linguistic abilities of their students appear to be salient in influencing how quickly a teacher can affect the transition into teaching entirely in English. In addition, Bowering (2003) also examined the use of English in the mathematics and science classrooms. The findings suggested that total translation as an easy way out defeated the purpose of teaching the subjects in English. Teachers should be exposed to alternative instructional approaches so that the content taught is expressed to suit the proficiency level of the students. Based on these studies, it can be said that there are many aspects to be considered when using English to teach science and mathematics. Student and teacher factors are important variables which can affect the outcome of the learning and teaching process.

METHODOLOGY

The actual study employed a mixed method design which involved the use of multiple instruments; survey questionnaire, interview and the development of a competency test. For this paper, the discussion is based on the data collected using a questionnaire. A stratified random sampling of teachers was employed based on three zones: north, central and south of Peninsular Malaysia. For the northern zone, data were collected from respondents in the state of Kedah and Kelantan, central zone from Perak and Pahang and southern zone from Johor and Melaka. A total of 600 survey questionnaires were distributed and 495 questionnaires were returned (a return rate of 82.5%). The responses given by the respondents were collected and later analysed using SPSS (Statistical Package for Social Science for MS Windows Release 10.05) software. Data was analysed using frequencies and percentages. The Cronbach's alpha reliability index of the questionnaire is 0.80.

The respondents for the study are 495 secondary school teachers from the north, central and south zones of Peninsular Malaysia. In terms of gender, 78% are female while 22% are male teachers. These teachers represent the three main races in Malaysia, that is Malay (50%), Indian (30%) and Chinese (20%). Majority of these teachers have about 5 year teaching experience at a secondary school. In terms of subject matter expertise, 58% are Mathematics teacher while 42% are Science teachers. 43% of these teachers are teaching science or mathematics as their first option as they major in that subject during their tertiary level education. Based on the background information, 80% of these teachers have attended courses and in-service training pertaining to teaching these two subjects in English that were

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organized by the Malaysian Ministry of Education. Table 1 illustrates the details of the respondents' background.

TABLE 1 Respondents' Background Information

Demographic Information	Findings
Region	Northern region: 187 Central region: 123 Southern region: 185
Gender	78% female 22% male
Race	50% Malay 20% Chinese 30% Indian
Teaching experience	90% : never taught in primary school 75% : 0-5 years teaching in secondary schools
Subject matter	42% science teachers 58% Mathematics teachers 43% Mathematics as first option 43% Science as first option 80% have attended some form of EteMs course

FINDINGS AND DISCUSSION

The focus of the paper is on the teachers' pedagogical skills and content knowledge. In the following, the analysis of teaching aspects such as subject matter content, pedagogical approach, classroom management, use of resources, assessment, preparation of teaching materials, managing students, teachers' compensatory communication strategies, use of first language and teachers' perspectives of teaching content subjects in English will be discussed. In terms of subject matter content, majority of the teachers indicate that they are familiar with mathematical/scientific concepts in English (84%), confident to teach science/mathematics concepts in English (75.8%) and confident of their knowledge of science/mathematics (90.3%). Based on the information in Table 2, majority of these teachers agree that they are confident and well-versed in their subject matter content, in terms of knowledge and concepts.

Table 2 Teachers' Subject Matter Content

		Agree	Disagree
1.	I am familiar with mathematical/scientific concepts in English.	84%	16%
2.	I am confident to teach Science/Math concepts in English.	75.8%	24.2%
3.	I am confident of my knowledge of Science/Math.	90.3%	9.7%

For pedagogical approach, teachers are asked to examine the way they deliver their lesson. The range of percentage is 50.9% - 80.2%. The findings show that teachers are able to vary their teaching approach to match students' abilities (80.2%), give examples related to mathematical/scientific concepts using English (76.6%), manipulate statements and expressions with symbols and formulas in English (74.5%), draw relationships by making connections between concepts (74.5%) and guide students to define science and mathematics terminologies correctly in English (74.1%). However, 50.9% of the teachers are able to develop student's creative use of the language (making analogies, using metaphors, etc.), using English and 51.1% could use creative activities in English in their science/mathematics lessons such as role play and drama in English. Based on the details in Table 3, it can be said that these teachers are able to vary their pedagogical approaches in order to fit their students needs and abilities. Among the techniques employed are giving examples, using symbols and formulas and making connections between concepts.

Table 3 Pedagogical Approach: Delivery of lesson

		Agree %	Disagree %
1.	I am able to vary my teaching approach to match students' abilities using English.	80.2	19.8
2.	I am able to use creative activities in English in my Science/Math lessons such as role play and drama in English.	51.1	48.9
3.	I am able to explain mathematical / scientific concepts meaningfully in English.	70.5	29.5
4.	I am able to relate mathematical / scientific concepts to everyday life experiences in English.	72.3	27.7
5.	I am able to give examples related to mathematical / scientific concepts using English.	76.6	23.4
6.	I am able to give details of mathematical / scientific procedures accurately in English.	68.1	31.9
7.	I am able to guide students to draw conclusions based on mathematical and scientific procedures/experiments using English.	73.7	26.3
8.	I am able to instill positive scientific attitudes in my teaching using English.	71.3	28.7
9.	I am able to develop students thinking skills in my teaching using English.	64	36
10.	I am able to instill values in my teaching using English.	72.5	27.5

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		Agree %	Disagree %
11.	I am able to develop student's creative use of the language (making analogies, using metaphors, etc.) using English.	50.9	49.1
12.	I am able to manipulate statements and expressions containing symbols & formulas using English.	74.5	25.4
13.	I am able to guide students to define Science /Math terminologies correctly in English.	74.1	25.9
14.	I am able to draw relationships (making connections between concepts) using English.	74.5	25.4

In terms of classroom management, majority of the respondents agreed that they were able to handle it well. The results showed that they were able to reward their students appropriately in English (81.8%), deliver lessons in English within the specified time (81%), monitor students' activities in the science/mathematics classroom using English (73.1%), encourage student's participation using English (65.9%), handle student's disruptive behavior in an appropriate manner using English. (63.6%) and discipline the students using English (61.6%). In other words, these teachers were able to manage their classroom well using English as shown in Table 4.

Table 4 Classroom management

		Agree %	Disagree %
1.	I am able to deliver lessons in English within the specified time.	81	19
2.	I am able to discipline the students using English.	61.6	38.4
3.	I am able to encourage student's participation using English.	65.9	34.1
4.	I am able to reward my students appropriately using English.	81.8	18.2
5.	I am able to monitor students' activities in the Science/Math classroom using English.	73.1	26.9
6.	I am able to create a positive learning environment using English.	68.3	31.7
7.	I am able to handle student's disruptive behaviours in an appropriate manner using English.	63.6	36.4

For the use of resources, majority of the respondents indicated that they were able to make use of the various resources in English available in and outside the school. The results showed that the teachers were able to use various science/mathematics resources in English that are available in school (85.9%), develop science/mathematics teaching aids in English (68.3%),

make students aware of science/ mathematics relationship to real life via extra-curricular activities such as the Environmental Awareness Club, Science/ Mathematics Camp and Science/Mathematics Club, etc. (65.1%) and use various Science/Mathematics resources in English available outside of school (64.6%). It can be said that the teachers were able to utilize science and mathematics resources in English from inside and outside the school efficiently. Table 5 described the details of the results.

Table 5 Pedagogical Approach: Use of Resources

		Agree %	Disagree %
1.	I am able to use various Science/Math resources in English that are available in school.	85.9	14.1
2.	I am able to use various Science/Math resources in English available outside of school.	64.6	35.3
3.	I am able to develop Science/Math teaching aids in English.	68.3	31.7
4.	I am able to make students aware of Science/ Math relationship to real life via extra-curricular activities such as the Environmental Awareness Club, Science/ Math Camp and Science/Math Club, etc.	65.1	34.9

Part of being competent in the pedagogical approach, a teacher should be able to handle the formative and summative assessments of the students. In terms of assessment, the findings showed that teachers were able to ask questions in English (88.9%), construct test items in English (84.8%), identify learning problems when teaching in English (84%) and assign appropriate learning tasks in English (82%). This is due to their education background as most of them are knowledgeable and trained in their subject matter. However, 60-63% of the teachers agreed that they were able to trigger students' further thinking and encourage them to think critically in English. This is probably attributed to the teachers' lack of confidence in using English. Table 6 illustrates the analysis of the teachers' pedagogical approach in terms of assessment.

Table 6 Pedagogical Approach: Assessment (Formative and Summative)

		Agree %	Disagree %
1.	I am able to construct test items in English.	84.8	15.2
2.	I am able to correct students' errors in English.	79.2	20.8
3.	I am able to provide feedback to students using English.	80.8	19.2
4.	I am able to identify learning problems when teaching in English.	84	16
5.	I am able to assign appropriate learning tasks in English.	82	18

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		Agree %	Disagree %
6.	I am able to encourage students to think critically in English.	63	37
7.	I am able to trigger students' further thinking using English.	60	40
8.	I am able to ask questions in English.	88.9	11.1
9.	I am able to assess students' understanding in English.	78.2	21.8

Teachers are also required to be able to prepare their teaching materials competently. For the preparation of teaching materials, majority of the teachers agreed that they were able to use teaching resources in English provided by the school (91.3%), describe models used for teaching science/mathematics using English (81.8%), adapt teaching resources in English based on students' learning needs (88.1%), use supplementary materials that are in English (88.1%) and demonstrate the use of scientific apparatus and mathematics learning aids using English (81.6%). In other words, these teachers perceived that they had no problems in preparing teaching materials for science and mathematics in English as shown in Table 7.

Table 7 Pedagogical Approach: Preparation of Teaching Materials

		Agree %	Disagree %
1.	I can prepare teaching aids in English.	85.3	14.7
2.	I can use supplementary materials that are in English.	88.1	11.9
3.	I can integrate English language-based ICT materials in my lessons.	82	18
4.	I can access resources in English from the internet.	79.4	20.6
5.	I can use teaching resources in English provided by the school.	91.3	8.7
6.	I can adapt teaching resources in English based on students' learning needs.	88.1	11.9
7.	I can demonstrate the use of scientific apparatus /mathematical learning aids using English.	81.6	18.4
8.	I can interpret graphs and charts using English.	85.7	14.3
9.	I can describe models used for teaching Science/Math using English.	81.8	18.2

The questionnaire also examined how teachers managed students in science/mathematics classes by looking at the use of student language, attitude and motivation. For student language, the findings showed that teachers were able to understand their good students when they speak in English (90.9%), communicate in English (89.7%) and write in English (88.1%). In addition, they also indicate that they are also able to understand when their weak student

speak (86.3%) and write in English (83%). Thus, these teachers were able to understand their good and weak students when they speak and write in English as illustrated in Table 8.

Table 8 Student Language

		Agree %	Disagree %
1.	I can understand my weak students when they communicate in English.	85.5	14.5
2.	I can understand my good students when they communicate in English.	89.7	10.3
3.	I can understand my weak students when they speak in English.	86.3	13.7
4.	I can understand my good students when they speak in English.	90.9	9.1
5.	I can understand my weak students when they write in English.	83	17
6.	I can understand my good students when they write in English.	88.1	11.9

In terms of students' attitude, these teachers agreed that only 53.5% of their students like science and mathematics to be taught in English. Only about half of the students preferred to participate in class activities in English (48.5%), access materials in English from the internet (47.3%), read science/ mathematics materials in English (45.3%) and respond to questions in English (43.4%). In fact, only 45.7% of the teachers agree that their students prefer to given explanations in English. The results showed that teachers perceived that students' attitude towards learning the two subjects, science and mathematics in English was less encouraging. Table 9 illustrated the analysis of students' attitude towards learning science and mathematics in English.

Table 9 Student Attitude

		Agree %	Disagree %
1.	My students like me to teach in English.	53.5	46.6
2.	My students like to participate in class activities in English.	48.5	51.5
3.	My students prefer to respond to questions in English.	43.4	56.6
4.	My students prefer to read Science/ Math materials in English.	45.3	54.7
5.	My students prefer to access materials in English from the internet.	47.3	52.1
6.	My students prefer that I give explanations in English.	45.7	54.3

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Teachers also agreed that not many of their students were motivated to learn science and mathematics in English. Findings showed that only 51.3% of their students were interested to learn science and mathematics in English. In other words, the results showed that less than 45% of the teachers perceived that students make extra effort to use English in their learning (43.6 %), are interested to ask more questions in English (40.2%) and interact in English during science/ mathematics lesson (39.6%). Looking at the percentage, it can be concluded that majority of the teachers perceive that their students are less keen to study science and mathematics in English as shown in Table 10.

Table 10 Student motivation

iii.		Agree %	Disagree %
1.	My students are interested in learning Science/ Math in English.	51.3	48.9
2.	My students are interested to ask more questions in English.	40.2	59.8
3.	My students make an extra effort to use English in their learning.	43.6	56.4
4.	My students interact in English during Science/ Math lesson.	39.6	60.4

For teacher's compensatory communication strategies, the results showed a strong agreement towards the use of English based on the range of percentage (70.9% - 87.5%). This is because compensatory communication strategies could aid understanding and learning of the subject matter in English. Majority of the teachers agreed that they used Bahasa Melayu/mother tongue when they needed to help their students understand (87.5%), adjust the degree of formality of their English to help students understand (87.3%), translate from English to Bahasa Melayu or from Bahasa Melayu to English to clarify science/mathematics ideas/concepts. (85.7%), use many appropriate gestures in their teaching science/mathematics in English (81.8%), paraphrase explanations in their teaching using English (78.4%) and repeat their explanations in my teaching using English (72.9%). Table 11 provided the details of the analysis.

Table 11 Teacher's Compensatory Communication Strategies

		Agree %	Disagree %
1.	I use many of appropriate gestures in my teaching Science/Math in English.	81.8	18.2
2.	I paraphrase instructions in my teaching using English.	78.4	21.7
3.	I paraphrase explanations in my teaching using English.	73.9	26.1
4.	I repeat my instructions in my teaching using English.	77	23

		Agree %	Disagree %
5.	I repeat my explanations in my teaching using English.	72.9	27.1
6.	I use Bahasa Melayu/mother tongue when I need to help my students understand.	87.5	12.5
7.	I clarify ideas for my students using English.	73.7	26.3
8.	I simplify the ideas for my students using English.	70.9	29.1
9.	I encourage my students to guess meanings based on context using English.	74.7	25.2
10.	I can adjust the degree of formality of my English to help my students understand.	87.3	12.7
11.	I translate from English to Bahasa Melayu or from Bahasa Melayu to English to clarify Science/Math ideas/concepts.	85.7	14.3

The findings also showed that majority of the teachers used the first language between 60-70% of the time in teaching science and mathematics. These teachers rationalized that they used the mother tongue in teaching Science and Mathematics in order to help weak student (349), clarify ideas (293), explain ideas (259), discipline student (138), give instruction (132), demonstrate procedures/activities (130) and finally to praise students (82). Thus, the use of mother tongue will help teachers to provide assistance to student when they do not understand the use of English when learning science and mathematics as indicated in the findings based on the questionnaire.

The findings reported in this study revealed that they are many challenges faced by teachers when implementing the content-based instruction in the students' second language. In this study, the teachers are well equipped with the subject matter content of science and mathematics. In other words, these teachers have more than adequate content knowledge but they have to grapple with students' varying level of English language proficiency.

In a diversified second language literacy context, teachers must be well equipped with effective pedagogical skills and content knowledge to cope with the students' varying level. For the pedagogical approach, these teachers were able to vary the techniques of delivering the lessons and manage their classrooms well. They could also competently use resources from inside and outside the school, prepare teaching materials, use multiple forms of formative and summative assessment and also apply suitable compensatory communication strategies for their students. In other words, these teachers have the knowledge of the subject matter topics in science and mathematics and are able to organize, represent and adapt to the diverse interests and abilities of their learners and then present for instruction as advocated by Magnusson, Krajcik and Borko (1999) and Shulman (1986).

Although they have an adequate level of pedagogical content knowledge, these teachers need to deal with students who have varying level of English language proficiency. When the

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students' attitude and motivation toward learning science and mathematics in English were examined, it was found that most students were not as keen to learn the two subjects in English. Although these teachers were able to understand their good and weak students using English, about 50% of the students like to be taught science and mathematics in English. Less than 50% of the students do not show their preference to use, interact and make effort in English in their science and mathematics class. These teachers were able to employ numerous compensatory communication strategies using gestures, paraphrasing, clarifying, translating and so on to facilitate student learning in their science and mathematics class. In fact, the findings showed that teachers used the first language almost 70% of the time in teaching these two subjects to help the weak students, clarify and explain ideas and to give instruction and demonstrate procedures. They tried to apply as much assistance as they can to help students to learn science and mathematics in English.

As teachers and agents of change, they agree that English language proficiency is important to help them absorb and understand information and also deliver or transfer knowledge to students in the best possible manner. With a competent level of pedagogical content knowledge, teachers are able to facilitate and deliver relevant content knowledge to their students.

CONCLUSION

In general, these teachers have adequate pedagogical content knowledge as they are able to integrate their understanding by combining subject matter content, instructional methods and students' characteristics. As trained and experienced teachers, they realized the need to use a variety of teaching methods, resources and strategies to maximise student learning process in the content-based instruction. However, teaching content subject matter such as mathematics and science in English can be very challenging when students have varying levels of proficiency. Based on this scenario, there is a need to find ways to create a positive learning environment that will encourage and motivate students to like learning science and mathematics in English and at the same time improve their level of English proficiency. Getting support from the school, parents and surrounding community can further facilitate the process of learning science and mathematics in English. In line with Hamidah's et al. (2005) study, the implementation of content-based instruction in English in Malaysian schools can be further improved by providing numerous and consistent in-house training and workshops. Combined with teachers' pedagogical content knowledge and students' increased interest, attitude and motivation, the process of teaching and learning science and mathematics in English will be enhanced.

Results from the study could also be used to provide implications for school administrators in making decisions in the assignment of capable teachers to teach the various levels of classes for science and mathematics. Teachers who are well equipped with competent pedagogical content knowledge would be able to impart their subject matter content to their students

effectively. For those teachers who are not confident in teaching science and mathematics in English, they should be given more in-house training and courses. In addition, teachers could participate in their self and professional development programs so as to inculcate positive and life-long learning efforts in their pursuit to becoming a competent teacher for content based instruction.

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