Research Article

TEACHING SCIENCE SUBJECTS IN ENGLISH: A CASE STUDY OF HIGH-SCHOOL TEACHERS' PERCEPTION AND PRACTICE

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ABSTRACT

The study explored what high-school teachers perceive towards using English as medium of instruction (EMI) in teaching science subjects as well as to find out how EMI is implemented. Following case study research, semi-structured interviews were conducted at a gifted upper-secondary school in the Mekong Delta with two science teachers having participated in the training programs for teaching Mathematics in English. The interview questions mainly probed the teachers' perceived impact of the EMI approach, their teaching strategies, and their evaluation of the EMI program. The results showed that the participants' positive attitudes towards EMI, their efforts in making alterations to the new approach and their recommendations for a clear pathway in policy implementation might serve as foundations for further decision-making.

Keywords: English as medium of instruction, science subjects, perception, practice

INTRODUCTION

Globalization has driven the English language to establish itself as a lingua franca in the economic, social and cultural development in the world (Al-Qahtani & Al Zumor, 2016). This status of English has led it to be adopted as a medium of instruction in the educational systems worldwide. Throughout Europe, English as medium of instruction (EMI) is conducted for the sake of improving learners' language competence, cognitive ability and offering them future opportunities (Marsh, 2006).

In the context of Viet Nam, in line with Decision No. 1400/QD-TTg "Teaching and Learning Foreign Languages in the National Education System, Period 2008 to 2020" issued in 2008 by the Prime Minister,

the National Project 2020 was approved to boost the foreign language (FL) competence of Vietnamese people. Its main goal is that the majority of young people will be able to use a FL confidently and independently to communicate, study and work in an integrated, multilingual and multicultural context, which in turn serves the nation's aim of industrialization and modernization (MOET, 2008). Specifically, according to Decision No. 959/QD-TTg "Developing the Gifted Upper-Secondary School System, Period 2010 to 2020" (MOET, 2010), teaching content subjects, namely Maths, Physics, Chemistry, Biology, and Computer Science, in English as a medium of instruction will be first piloted in some gifted high schools during phase 1 (2010-2015); expanded to the others in phase 2 (2015-2020), and finally implemented in all gifted ones by 2020. With the issuance of those two policies by MOET (Ministry of Education and Training), EMI has been officially implemented in gifted high schools in Vietnam (MOET, 2008, 2010).

As a unit in the national educational system, Nguyen Thi Minh Khai gifted high school, located in Soc Trang province, has piloted EMI in four natural science subjects including Mathematics, Physics, Chemistry and Biology in two successive school years (2013-2014 and 2014-2015). The innovative approach has received a good deal of attention from the school management boards, teachers and students. However, no research has been conducted so far to explore the perceptions of the content teachers towards the EMI approach given the specific context of the school. Consequently, this study seeks to fill this gap and deepen the work in detail to find out what high-school science teachers perceive of using EMI in teaching science subjects and how EMI is implemented. The study aims to answer the following research questions: (1) What are high-school teachers' perceptions of using EMI in teaching science subjects? (2) In what ways do they implement EMI in teaching science subjects?

METHODOLOGY

Research Design

Since the objective of this study is seeking the answers to the descriptive question of 'what' and to the explanatory question of 'in what ways' for a particular educational program, it is found that a case study approach is an appropriate strategy to be adopted (Gay, Mills & Airasian, 2011)

Research Participants and Settings

The participants involved in the study were two mathematic subject teachers who have received training in teaching

Mathematics in English and have piloted their EMI lessons at classroom level. The two teacher respondents including one male and one female (henceforward T1 and T2) had at least six years of teaching experience at Nguyen Thi Minh Khai gifted high school and have got the Master of Science degree. On the part of their English proficiency, one reached B2 level while the other achieved B1 level according to the national foreign language competence framework of Viet Nam. The students that the teacher participants selected for piloting the EMI approach were in the tenth grade, specialized in mathematics and most had a good English competence.

Data Collection and Analysis

The primary instrument to collect data was in-depth semi-structured interviews with individual participants. The interview questions were divided into three sets focusing on (1) the teachers' perceived impact of the EMI approach, (2) their pedagogical strategies in coping with EMI, and (3) their evaluation of the EMI program. After piloting the interview questions with the first mathematics teacher, the tool was adjusted and modified to delve closer into answering the three research questions. Each interview lasted around an hour including a ten-minute break to ensure the validity of the data garnered and was conducted in Vietnamese. Then the data were analyzed following the six-phase thematic analysis suggested by Braun & Clarke (2006) According to these researchers, thematic analysis serves as a fundamental method in qualitative research with its flexibility. The six-phase guidelines were taken as follows: familiarizing with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report.

Literature Review

EMI is a worldwide educational trend; however, the term EMI itself has just appeared recently that there has been no universal agreement on its definition. According to Dearden (2014), EMI is 'the use of the English language to teach academic subjects in countries or jurisdictions where the first language (L1) of the majority of the population is not English'. It is somehow considered as a synonym of CLIL (content and language integrated learning). Yet the dual educational aim of concomitant developing both content and language is overtly stated in CLIL title whilst EMI just simply describes the situation in which English, as not being the mother tongue of a country, is used to teach academic subjects. In fact, EMI indicates the teaching of a subject using English as the medium of instruction, but in situations where

language learning aims are not focused explicitly and where English is not the national language (Madhavan & McDonald, 2014).

In this study, EMI is defined as an approach in which English as the foreign language of the country is used to teach science subjects for high school students and the teaching-learning activities are more content-oriented.

Science teachers' perceptions of the EMI approach

Many studies report that the dominant reason for the increasing adoption of EMI at many universities worldwide is internationalization (Doiz, Lasagabaster & Sierra, 2011; Jensen & Thøgersen, 2011; Kim, 2011; Tatzl, 2011). From Dearden (2014)'s view, internationalization can be seen as opening doors to welcome foreign students or attract cross-cultural experts, and on a broader sense it may refer to a university's effort in preparing its local students for a global world. When exploring the attitudes of the lecturers (n=1,131) at a large Danish university towards the arguments for and against EMI in higher education, Jensen & Thøgersen (2011) found that young lecturers and those with much teaching experience in EMI were more positive towards the increasing use of EMI. The majority of respondents also agreed that EMI helps push the institutional academic standards and international competitiveness, concurring with results in the studies of Tatzl (2011) and Doiz et al. (2011). When Tatzl (2011) investigated the attitudes of 8 lecturers at an Austrian university of applied sciences towards EMI, besides internationalization, the respondents believed that students' linguistic skills, especially subject-specific vocabulary, confidence building and access to learning resources in English were much promoted in EMI classes. These benefits of EMI mostly matched those reported by Channa (2012) who observed and interviewed the seven science lecturers towards EMI at a Pakistani university. The teachers in Pakistan agreed that great exposure to the English language improved EMI students' communicative competence, bolstered their self-confidence and facilitated them to delve closer into a myriad of scientific references which are only accessible in English.

Believing in the ability of oneself is just one of the reported positive characters that EMI has brought to learners in the study of Senapati, Patnaik & Dash (2012) who investigated the discrepancies in personality between the fourth grade children attending the English medium and Odia medium schools in India. Results showed that the EMI children are 'more outgoing, active,

emotionally mature, assertive, competitive, conscientious and independent-minded' than their Odia medium peers. These personality traits, significantly contributing to EMI learners' motivation and cognitive development, probably help clarify the positive perceptions regarding the English proficiency and communicative skills of most Arabian students (n=500) in a large empirical study conducted by Belhiah and Elhami (2015) in the United Arab Emirates. Though 67% of instructors surveyed (n=100) agreed that students' English skills were enhanced in general, the researchers found that students' ability to understand materials or exam instructions in English was indicated by only 48% of teachers and students' interaction in English just centered around basic communication. Those limitations in EMI may help explain why the majority of Arab teachers and students (75% and 62% respectively) preferred the bilingual model, partly concurring with those of Alhamami (2015). Researching the similar subjects with Belhiah & Elhami (2015), Alhamami (2015) explored the perspective of 27 scientists towards using Arabic (L1) and English to teach science subjects in a Saudi public university. Findings showed that a greater number of science lecturers chose Arabic as their preferable medium of instruction despite the existing policy of using EMI. The scientists reported several disadvantages of using EMI such as teachers' devotion of time and effort for explaining the content, students' insufficient gaining of scientific knowledge and low respect to their mother tongue due to the dominant role of English. These findings are consistent with those of others (Channa, 2012; Jensen & Thøgersen, 2011; Kim, 2011; Tatzl, 2011) in ways that students will gain the best academic achievement when learning in their mother tongue.

Science Teachers' Practice of the EMI Approach

In a case study conducted by Hu, Li, & Lei (2014) to examine the language practices of an EMI program at a mainland Chinese university with 5 lecturers and 10 students from both EMI and CMI (Chinese-medium instruction) programs, results showed that both the teachers and students had inadequate command of English to actively contribute to the process of knowledge construction. It was challenging for the lecturers to use English to explain subject-specific concepts, technical words or analyse complicated situations. To overcome the linguistic barriers, the professors reported to simplify the curricular content, repeat the information written in textbook, reduce spontaneous interaction and use code-

switching to present abstract concepts. The researchers claim that the language obstacles have prevented the EMI classroom from being conducive to language learning.

Linguistics problems are also concerns of EMI lecturers (n=29) in the university of Helsinki, Finland since it is impossible for them to give sufficient feedback for students (Lehtonen & Lönnfors, 2001). Regarding the adjustments they have made in teaching EMI classes, they considered varying teaching styles, clear and simple instructions, an awareness of different students' backgrounds, and language use corresponding to students' level. However, Lehtonen & Lönnfors (2001) argue that most Finnish instructors have probably not seen their teaching as language teaching but teaching in a situation where language learning may occur accidentally.

Contrary to the perspective of the Finnish lecturers on their role in EMI classrooms, when Uys, Van der Walt, Van den Berg, & Botha (2007) researched the capability and readiness of the EMI subject content teachers (n=79) from the primary and secondary schools in southern Africa towards their engagement in the teaching of the four language skills, many of them (66%) had agreed on that duty. Nevertheless, the language teaching is frequently associated with the more common areas such as reading skills or guidance for group work. Regarding the instruction on specific techniques, namely improving effective listening, skimming or scanning, just a small number of teachers viewed it as their job to teach. Besides, writing skills, language structures, grammatical functions and pronunciation were the areas that the teachers surveyed supported least. Instead, vocabulary seemed to be the focus of language teaching in the content classroom, echoing part of the findings reported by Tan & Lan (2011) in their study to explore what upper secondary Math and Science teachers (MSTs) perceive and believe towards EMI and how the MSTs' perceptions influence their classroom practices and student learning. The authors, through surveys, teacher interviews and classroom observations, has claimed that the popular deploying of translation and a strong focus on key terms learning in EMI classroom has resulted from an interaction among the exam policy, MSTs' perceptions and beliefs inclining to bilingual education. Though the MSTs believe that the weaker students could benefit more from the bilingual instruction, it does not mean that more translation from English to Bahasa Malaysia (BM) is a good choice. As Tan and Lan argue, if students can learn better in their mother tongue, they will not choose English to answer the exam questions; and since BM is

their native language, students can manage in the exams by themselves. Evidently, the issue of translation or L1 use in the teaching of non-language subjects through English has been the research topic in many studies (Karakas, 2016).

In sum, most studies towards EMI have been so far carried out at tertiary level whereas there is a dearth of empirical investigations into EMI at secondary level. It is still a question that how much the results of tertiary-based research regarding content teachers' perceptions and practice of EMI can be applicable to secondary contexts. Moreover, previous research just gives a general picture of EMI teachers' perceptions and practices, but does not elucidate in which ways EMI teachers' attitudes have impacted their teaching practices. For the above reasons, this present study is conducted.

RESEARCH RESULTS AND DISCUSSION

Research Results

High-school Teachers' Perceptions of using EMI in Teaching Science Subjects

EMI Impacts on the Learning and Teaching Activities

According to the second teacher respondent, she identified three different levels of EMI based on the amount of English used in EMI classroom. Specifically, at level 1, the teacher just uses a limited amount of English to introduce new terms or simple concepts. At level 2, bilingualism is favored and for level 3 all the teaching-learning activities should be conducted in English only. cT2, based on those different levels of EMI, elaborated more on the impact of EMI on the content learning of Maths students:

T2: If an EMI lesson is taught at level 1 or 2, it will not affect the students' knowledge acquisition too much, but the learning activities will be slow down. If students learn at level 3, only 70-80% of them can follow the lesson and conducting EMI at this level is not feasible for both teachers and students at our school.

T1 also concerned about the effect of the complete use of English in EMI classroom towards the subject learning of students:

T1: My first piloted lesson using English only might not cause much negative effect on the mathematic learning of the students. However, if 100% of English is used for the long term, the knowledge acquisition of EMI students cannot be guaranteed.

Regarding the effect of EMI on the English proficiency of both teachers and students, the two teacher respondents agreed that EMI facilitates them and their students in developing communication skills and the mathematical English vocabulary.

With respect to how EMI has impacted on the teaching methodology, T1 responded:

T1: The lesson is delivered at a slower speed, more simple and short questions are used, and the simple content is introduced.

The lesson content has been judiciously selected to facilitate the comprehension of the students which serves as a catalyst to motivate the learning attitude of high school learners:

T2: The majority of my students show an interest in EMI lesson. However, for some who are less proficient in English, they are more silent and passive.

T2 recognized that EMI is not a one-size-fits-all method, particularly inappropriate for students of weak linguistic skills. The concern here is that what role the science teachers are taking in EMI. Will their role change significantly and they appreciate it or not?

Perceived Role of the Subject Teachers in EMI

Both the two Maths teachers shared the similar view towards their role in EMI in that teaching the subject content is their primary duty and supporting students' linguistic skills is their secondary responsibility. However, they underscored they just helped students in learning specialized terminology in Mathematical English as T2 noted:

T2: For improving the other aspects of English for students, it is out of my ability. I think it is the job of the English teacher.

Successful Elements of an EMI Program

Concerning the most decisive components for the success of an EMI program, the informants agreed that the English competence of both teachers and students should be adequate enough to cope with EMI:

T2: The English proficiency of EMI teachers must be at high intermediate level and the English competency of EMI students should be good enough, well, at around A2 level of the national framework.

The other necessary factors added by T1 are teachers' preparedness, helps from the English teachers and mental encouragement from colleagues while T2 believed that teaching experience and learning need from students and parents are crucial for a successful EMI program:

T2: I think the students and parents' need towards EMI learning is the most essential factor which will in turn affect the other elements such as the English competency of teachers and students.

Future of EMI

When being probed whether the EMI program should be cancelled or

developed, both the teachers responded the program should be expanded for the sake of international integration:

T1: We are in the period of international integration which means that English is needed to communicate, find a good job, or enhance one's professional knowledge and lifelong learning.

T2: In the time of global integration, without English, people can do nothing.

High-school teachers' implementation of EMI in teaching science subject In order to prepare for an EMI lesson, the teachers surveyed reported that they have to do a wide range of activities from selecting the appropriate topic, teaching materials, building the lesson plan to choosing the students for piloting and working with the English teachers. They both shared the same opinion on the selection of a topic with less use of English for EMI teaching:

T1: I choose the content with moderate level of difficulty, more exercises, fewer theories, neither too easy nor challenging.

Searching for the teaching materials is another procedure that the teachers have paid a good deal of attention to. They consulted the bilingual and the English-only textbooks issued by Vietnam Education Publishing House to redesign their EMI lesson plan.

Furthermore, the informants expressed their great concern toward preparing a good lesson plan in which they underscored the support of the English teachers in checking the appropriacy of language use and pronunciation:

T1: I don't remember how many times I have work with him, a lot... We together edit the language use, then I read aloud my lesson plan so that he can correct my pronunciation.

T2 even sought help from a friend who has good English ability in preparing the prompting questions to students Each of the two science teachers so far has just conducted one piloting EMI lesson as they noted that preparing an EMI lesson is too much time-consuming. Nonetheless, they self-evaluated that their first EMI lessons have been successful. Discussing about the learning activities during their pilot EMI lesson, T1 responded:

T1: Things go smoothly. Students voluntarily raise their hands to answer my questions, but not many. I think some are shy with the presence of other teacher visitors and some are not confident in their English proficiency. Regarding the amount of English use in their demonstrative EMI lesson, they all noted that the lesson was conducted in 100% of English:

T1: It is my first EMI lesson, so I need to make it good. I just try my best to use English only and see whether it works for students or not.

However, in case the students cannot follow the lesson, the teachers used code switching as a strategy to overcome the language barriers:

T1: If students do not comprehend the lesson or cannot express themselves in English, they can switch to Vietnamese.

T2: When I explain the complex questions or concepts in English, if students do not understand, I can explain again in Vietnamese so that the lesson will not get stuck. Some other strategies are also taken to improve students' comprehension and motivation such as group work, playing games, joining national math competitions in English

Discussion

Regarding the answer to the first research question, it seems the teacher informants have positive perceptions towards the impact of the EMI approach on the teaching-learning activities. While the teachers surveyed in many studies worry that EMI may prevent students from fully understanding the subject-related concepts (Alhamami, 2015; Dearden, 2014; Kim, 2011), the teachers in this study expressed that the content learning of Maths students will not be affected much if EMI is conducted with the judicious use of L1. In other words, the bilingual model is more favored in terms of guaranteeing the knowledge acquisition of EMI students, which completely matches the result in the studies of Al-Qahtani & Al Zumor (2016) and Belhiah & Elhami (2015). The science teachers also noted that the practice of using English-only for EMI classes is impossible for both teachers and learners at their school because of low English proficiency. That rigid language practice has also been blamed by some teacher respondents in Namibia as an obstacle to learning and teaching (Simasiku, Kasanda & Smit, 2015)

Another benefit of EMI that the science teachers perceived is EMI has improved the four English skills of both teachers and students, corroborating partly with results of other studies in that teaching in EMI makes the teachers more confident in their English language and teaching skills (Hudson, 2009; Lehtonen & Lönnfors, 2001).

Teaching methodology and learning attitude are also influenced to some extent in EMI classroom. Slower speed of content delivery, selection of less complex content, short and simple instructions are often conducted by EMI teachers in this study and in previous research (Hudson, 2009;

Tatzl, 2011) as adjustment to the new approach, which in turn partly contributes to EMI students' higher motivation in learning English (Sultan, Borland & Eckersley, 2012). Nonetheless, the mathematic teachers concerned that for the students of low English proficiency, they are even more passive in EMI learning. A reduction in student participation in learning activities and less spontaneous interaction between teachers and students in EMI classrooms have also been noted in other research (Dearden, 2014; Williams, 2015).

With respect to the role of science teachers in EMI classroom, the teachers surveyed firmly believed their primary responsibility is teaching students the subject content and supporting students' linguistic skills is subsidiary to content teaching. Nevertheless, they underscored they just support students in learning mathematical specialized terminology which means the language teaching is mainly associated with the duty of language teachers. What the math teachers perceived of their role in this study concurred with the perception of the Finnish lecturers in the research of Lehtonen & Lönnfors (2001).

On the part of decisive elements for an EMI program to succeed, the informants mentioned the English competence of both teachers and students, well preparation of teachers, support from English teachers, mental encouragement from colleagues, teaching experience and the need of students and parents. These features were ranked differently based on the view of each teacher. T1 thought the language proficiency is the highest priority whereas T2 emphasized the most important role of learning need. When all above factors are listed in the same group, a dilemma situation is emerging in such a way that having a teacher competent in both the subject matter and linguistic skills is definitely challenging for most EMI situations. Findings from previous studies have demonstrated most teachers have inadequate command of English to effectively conduct EMI teaching (Hu et al., 2014; Williams, 2015) and students with low English competency have been 'handicapped' in learning science subjects in English (Yip, Tsang & Cheung, 2003). Despite the challenges, the high school teachers still hold a positive look on the EMI program that it should be continued to expand in the coming time.

Teaching science subjects in English is rather strenuous and demanding (Doiz et al., 2011) as it involves a wide range of procedures from out-class preparation to in-class practice. Selecting the topic of the lesson, finding teaching materials, building

the lesson plan, choosing the appropriate group of learners, and working with English teachers were the necessary activities that the science teachers carried out for their pilot EMI lesson. They scrutinized the subject content selected so that it would present less linguistic barriers to students, and sought help from the English teachers to check language appropriateness. The hard work might help elucidate why all the teaching-learning activities in their first EMI lessons went smoothly though they used English only in those classes. They explained it was their demonstrative lesson using the new approach, so they strived to make it the best. However, the teachers acknowledged that sole use of English in EMI will not work for their students in the long run and it is out of their ability too. Instead, they underlined the important role of L1 as the resort to overcome linguistic problems in EMI classroom, being consistent with the finding reported by Karakas (2016).

SUGGESTIONS AND RECOMMENDATIONS

Based on the recommendations of the teacher respondents, some implications for the policy makers and other stakeholders involved have been drawn. Firstly, more training courses on EMI teaching pedagogy and English competence for the science teachers should be organized on a regular basis since the last training was about two years ago. In order to optimize the efficacy of the EMI approach, some measures to support the practitioners in terms of financial incentives, teaching and learning materials, curriculum design, collaboration between the content teachers and the English teacher need to be taken into account. More to the point, a clear set of criteria regarding the qualifications of EMI teachers, EMI students and the objectives of the program is essential for EMI implementers at different levels.

There are indeed some shortcomings inherent in this qualitative research paper. Particularly, the practice of EMI at the high school involved was conducted quite a long time ago, hence the data collection tool is limited to semi-structured interview questions with the science teachers – EMI practitioners. As this paper comes from an on-going case study investigating the perception and practice of high school teachers using EMI in teaching science subjects, the findings are very preliminary, focusing only on the implementation of the Mathematics subject and data triangulation has not been conducted yet.

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