TEACHING MATHEMATICS AND SCIENCES IN ENGLISH IN PILOT INTERNATIONAL STANDARD HIGH SCHOOLS IN INDONESIA

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ABSTRACT

One of the ways to improve the quality of education in Indonesia is by initiating the program called *Rintisan Sekolah Bertaraf Internasional* (Pilot International Standard School-ISS). This program provides grants to selected schools to implement the teaching and learning process to comply with the international standards as in the developed countries. Some subjects, including Mathematics and Sciences are taught by using English as a medium of instruction in the classroom. Textbooks for these subjects have been prepared in both Indonesian and English. However, the teachers are not yet ready to conduct the teaching and learning activities in English, so there seems to be some problems in the classroom due to the lack of English proficiency among the teachers. With respect to this issue, the school can adopt Content-Based Instruction in which the students would learn the language as a by-product of learning about real-world and encourage the collaboration between subject matter teachers and English language teachers.

Key words: International Standard School, Mathematics, Sciences

INTRODUCTION

Act No. 20/2003 on National Education System is the legal basis for the implementation and reform of national education. Article 50 mentions that the government and/or local government runs at least one school at all levels to be developed into an international standard school. Also, Guidelines of International Standard School (ISS) Program requires the school to conduct Mathematics, Sciences and English classes by using English as means of instruction.

For English classes, using English as means of instruction would not pose complicated problems for many schools, but for Mathematics and Science classes it requires good planned and integrated preparation between schools, local governments and Ministry of National Education.

By using English as a medium of instruction for Mathematics and Sciences, it is expected that the graduates of Pilot International Senior High School would be able be prepared for further study in the university level both inside Indonesia or overseas because they will be able to prepare themselves for the university entrance test, to understand English textbooks, and to take part in the lectures presented in English.

This article describes the theoretical background that justifies the government regulation about the implementation of Pilot International Standard Schools, discusses the advantages and disadvantages of using English as a medium of instruction for Mathematics and Sciences, and recommends some best practices in the school level.

INTERNATIONAL STANDARD HIGH SCHOOL IN INDONESIA

Responding to the continuous criticism on low quality of Indonesian Education and the influx of

franchise imported education programs such as IB, Indian, Singaporean, Australian and some other foreign curriculum, the Indonesian government launched a program, that is establishing International Standard School. It started by intervening 100 high schools in Indonesia, which were considered to have had good or developed culture with the best practices in education to be Pilot International Standard High Schools (Rintisan SMA Bertaraf International) in 2005. The government disbursed block grants for the schools to develop their culture and practices toward high standard practices that have been set by Directorate of High School Development of Ministry of national Education. The government supplies assistance, training and monitoring for the selected schools to meet the requirements. In 2007 additional 100 schools were included in the program, and more 120 schools were added in 2009. So by this time, there were 320 senior high schools taking part in the program. At the end of 2009 the first 100 schools were evaluated and by 2010 they would be assessed whether they qualify to hold International Standard High Schools or would remain to qualify as National Standard Schools. The government does the same program for Vocational Schools, Junior High and Elementary Schools.

TEACHING MATHEMATICS AND SCIENCES IN ENGLISH

One of the set-standard for curriculum development in International Standard High Schools is the use of English for teaching Mathematics and Sciences. As stipulated by the government that International Standard High Schools have to comply with at least two different standards concerning Mathematics and Sciences. Firstly, concerning the learning process, "the quality of learning process must be developed, supported by the application of Information Technology for all subjects and by using English as a means of instruction for Mathematics and Sciences for the Sciences Program" (Direktorat Pembinaan SMA 2009:25). Secondly, about the standard of Mathematics and Sciences teachers, "teachers of Mathematics and Sciences use Indonesian and English language in the teaching and learning activities; and the proportion of the use English in the classroom should be gradually increased to 100% within 4 years" (Direktorat Pembinaan SMA 2009:37).

Teaching Mathematics and Sciences by using English can be traced back to the earlier practice of content-based and Immersion Models for Second and Foreign Language Teaching. (Snow in Celce-Murcia.2001:303). It is the integration of language teaching with subject matter instruction. The rationale of the content-based instruction, as claimed by Krashen in Allwright, (1991), is that second language acquisition occurs when the learner receives comprehensible input, not when learner is memorizing vocabulary or completing grammar exercises. Therefore, the methods that provide students with more comprehensible input will be more successful." He further suggests that comprehensible subject-matter teaching is language teaching, since learners acquire language when they understand messages in that language.

Although Mathematics and Sciences are dominated by scientific terms and concepts, the acquisition of the subject matter concepts must take the sociocultural theory of learning. Related to that theory, Vygotsky (in Celce-Murcia, 2001) points out that speaking and thinking are ways of acting on the material and social world. In Vygotsky's analysis, the social tools that exist in "Speaking and Thinking" are transformed into

individual tools of thinking and problem solving. The process is not automatic but requires active engagement by children in social interaction with peers and supportive adults. In social interaction, the child uses speech and gesture to regulate joint attention, to identify and label objects, to classify, to elaborate experiences, and to offer explanations. It is the socially situated use of language that enables the child at a later time to recapture, reflect on, and transform experience. The opportunity to use speech as a means of making sense of experiences with other participants is a crucial step, therefore, towards independent intellectual functioning.

Snow (in Celce-Murcia, 2001) shows that Vygotsky inspires the work to promote first language (L1) literacy development in multicultural elementary school settings and offers the promise for enhancing their understanding of second language (L2) learning. Vygotsky proposes the notion of (1) the zone of proximal development (in which learners are assisted by teachers or "more capable peers" in their development) and (2) inner speech (internally directed speech as strategies for problem solving and rehearsing) can be effectively realized in content-based settings where students have opportunities to negotiate not just language, but content as well, in increasingly complex ways.

Content-based instruction should take societal needs into account. Group and individual attitudes towards the learning foreign language determines the success of the program. "Student with positive attitudes towards the language will appreciate and respect it. Positive attitudes towards the acquisition process will reflect high personal motivation for learning the language, a feeling of self fulfillment and success" (Dubin: 1992:13-14). The combination of positive attitudes by the individual and group will lead the best result of the acquisition. To implement the program an ISS should address the motivation of the students and teachers as individual and group. The curriculum development of the school level should involve the teachers and address the students' real need on graduation and afterwards.

Content-based instruction is conducted in some different models. As proposed by Met (in Celce-Murcia:2001:305-309), this instruction varies from Content-driven model at one end of the continuum, to Language-driven model at the other side of the continuum with 3 others lies in between. Met explains that from Content-Driven to Language-Driven, they lie Total Immersion, Partial Immersion, Sheltered Courses, Adjunct Model, Theme-Based Courses, Language Classes with Frequent Use of Content for Language Practices.

Immersion Education

The Immersion model can be considered as the prototype of content-based approach. It was firstly established in Canada in 1965. It is done since Canada is predominantly inhabited by English-speaking and Spanish-speaking community. For English-speaking students (of an Elementary School), content-based instruction is given in Spanish and vice versa. The research done on the program show that the immersion children consistently perform at or above grade level scholastically compared to monolingual peers in English language development, and at the end of elementary school they become functional bilingual.

Partial Immersion

This model is done in Content-Enriched Foreign Language in Elementary Schools in USA. In this model, teachers find points of coincidence with the standard school curriculum which can be

paired with the objectives of the foreign language curriculum. Terms and structures for describing people are related to historical figures. Explanation Text is related to the topic of Growth in Biology, etc. There are some advantages of this model. First, the students have more relevant, meaningful context for language learning. Second, since the students have been exposed to their first language, the content-enriched model gives them richer context for use of the foreign language for meaningful communication.

Sheltered Courses

It is done in University of Ottawa, where the students can take the course either in English or in second language. All the instruction in the sheltered class is given in the second language by content faculty members. It is also done as "ESL Math" or "ESL Social Studies" in elementary and secondary schools in the United States. When properly conducted, sheltered courses can offer an effective approach to integrating language and content instruction for intermediate ESL students whose language skills may not yet be developed enough for them to cope up with demanding content courses.

Adjunct Model

The Adjunct Model is a content-based approach in which students are enrolled in a language class and a content course at the same time. It is successfully applied in the University of California and a California high school. A key feature of the adjunct model is the coordination of objectives and assignments between language and content instructors. The EFL classes focused on general academic skills development before the content professor arrival and coordinated with the content course once it was under way as stated by Snow in (Celce-Murcia: 2001:309)

Theme-Based Model

The theme-based model is a type of content-based instruction in which selected topics or themes provide the content from which teachers extract language learning activities. Those learning activities consists of theme, topics, texts, threads, tasks and transition.

Themes are the central ideas that organize major curricular unit. Topics are the subunits of content. Texts are defined in a broad sense as the content resources; threads are linkage across units that create greater curricular coherence, while tasks are the day-to-day instructional activities and at last Transition are planned action which provide coherence across the topic in a thematic unit and across the tasks within topics.

The assumptions about the nature of language must be taken into account in the Content-Based Instruction. As Richards, Jack C. and Theodore S. Rogers (2003:207-208) argue that (1) Language is Text- and Discourse-Based. CBI addresses the role of language as a vehicle for learning content. The focus of teaching is how meaning and information are communicated and constructed through text and discourse; (2) Language use draws on integrated skills. CBI views language use as involving several skills together. The students are involved in activities that link the skills, as they are generally involved in real world, (3) Language is purposeful. Language is used for specific purposes, that can be academic, vocational, social, or recreational. It gives direction, shape and meaning to discourse and texts.

In discussing the CBI, it is relevant to highlight Halliday's notion of Development of a register of mathematics (Halliday:1994). He explains that the development of a new register of mathematics involve the introduction of new "thing-names": ways of referring to new objects

or new processes, properties, functions and relations. It can be done by (1) interpreting existing words, (2) creating new words out of native word stock, (3) borrowing words from another language. This method also applies in sciences. In interpreting existing words, for example, we can have *set, point, field, row, column, weight, stand for, sum, even (number) and random*. Due to the development of t*echnology, a lot of created new words appear, such as* download, surrogate, transplant. While Biology, for instance use a lot of Latin words, such as *species, fungus, ovary*, etc. As a lot of those words mentioned previously that have been familiar to us, CBI will further enlarge the students acquisition on new technical terms that will be needed in understanding subject matter texts in university.

In relation with Halliday's idea on a register of mathematic, Renshow highlighted Davydov's proposal on Mathematics Curriculum that takes the key sociocultural concepts of the content of curriculum, which was previously ignored. Renshow further cited that the sociocultural perspective suggests that learning is a process of appropriating 'tools for thinking', that are made available by social agents who initially act as interpreters and guides in the individual's cultural apprenticeship (Rogoff, 1990). It is not just that the child learns from others in social contexts and during social exchange, but rather that the actual means of social interaction (language, gesture) are appropriated by the individual (internalised and transformed) to form the intramental tools for thinking, problem-solving, remembering, and so on (Wertsch, 1985).

A different article on CBI witnessed that learning English while using it to learn a content can be quite successful. Bower was surprised by his previous student who found difficulties in his class and was quite fluent only within six months, within which he had been studying vehicle maintenance at a local adult education centre in Great Britain. The course was entirely conducted in English and his high level of interest in anything to do with cars and car engines meant that he was highly motivated and eager to learn.

The CBI is basically an English teaching with certain content. In this technique, the students learn the language in order to understand language and how it works and understand how people do with it. (Halliday:1985,p 44). For that purpose, the class interaction employs interpersonal and ideational component or metafunctional component. The language does something and it is about something. There is also the third metafunctional component in language as a resource for ensuring that what is said is relevant and relates to its context, as it is labeled by the Textual metafunction. While Martin (1992) claims that language is as resource of meaning (functional linguistic) which is represented by the MOOD system. The system is related to process through the concept of realization. The realization statement specifies the manifestation of MOOD option.

It is true that the implementation of using English in teaching Mathematics and Sciences requires well-planned and integrated program. However, we can not wait until everything is ready to begin with the program. When English is used in early phase, the teacher and the learners will simplify their interaction both in spoken and written English. The use of English will serve as point of departure and later it develops to achieve complexity in using the language.

ADVANTAGES OF USING ENGLISH IN TEACHING MATHEMATICS AND SCIENCES

Due to the urgent need on high functional English for the senior high school graduates, both to pass the university entrance test and to face

advanced-content courses in the university, there must be a breakthrough for EFL teaching in senior high schools in Indonesia. Using English as a means of instruction in teaching Mathematics and Sciences in International Standard High Schools in Indonesia gives challenges and opportunities for the students, teachers and community at the same time.

The advantages of the program can be in the form of

- Students of EFL have more chance to communicate in the target language. Language contains great potential for communicating meaning.
- Students of EFL will likely achieve functional bilingual faster than the traditional methods.
- Students of EFL will experience conducive atmosphere of English using that will help them understand advanced-content courses in universities.
- Mathematics and Science teachers will have more chance to access the latest knowledge concerning their fields since their English is getting better and it will be easier for them to understand the latest development of their fields.
- Better understanding of the subject matter for the teachers will further improve their quality of teaching, at the same time will improve the quality of learning.

DISADVANTAGES OF USING ENGLISH IN TEACHING MATHEMATICS AND SCIENCES

Since the existing 320 Prospective International Standard Senior High School are of quite wide range in quality, either the resources or the facilities, this program could not be implemented at a sudden without thorough need analysis, self appraisal, school reform and teacher training. The carelessness in implementing the program will be contra productive for the students, teachers, schools and government.

CONCLUSION

The enactment of the regulation on using English as a means of instruction of Mathematics and Sciences in International Standard Senior High School in Indonesia must be tailor-made with school-based curriculum (KTSP). In developing the school-based curriculum, the school should integrate all subject matters, including the adopted components of the curriculum contents from developed countries, as assigned by the standards for curriculum development of ISS.

RECOMMENDATION

In implementing the program of using English as a means of instruction in ISS, there must be certain strategies to apply.

- Some workshops should be conducted at the school level to integrate all subject matters and school programs. As proposed by Littlewood (1991:22), regarding the functional communication activities, the teachers of Mathematics and Sciences must be trained to a level that they can structure the class situation so that learners have to overcome an information gap to solve the problem.
- Some workshops should be conducted at the subject matter level to translate the adopted curriculum into day-to-day teacher's program, class activity, evaluation, remedial and enrichment programs.
- Regular meetings among subject-matter teachers should be conducted at the school level to coordinate the program and to cope up with emerging difficulties.
- The teachers should be trained in Classroom English and Instructional English.

- Assistance should be given to the subject matter teachers for the content mastery in English.
- Teachers are encouraged to join seminars or short courses abroad to motivate them to improve their English, at the same time to challenge the others to perform better.
- Wide range selections of resources should be provided for the teachers.
- Self appraisal for better implementation should be made regularly.

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