

**BILINGUAL IN CALCULUS CLASS,
INTRODUCING STRATEGY TO CONDUCT BILINGUAL CLASSROOM IN
MATHEMATICS**

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Abstract

The use of English in mathematics and science classroom had been an issue in the recent years. Although legal implementation of such classroom had been diminished in public school, the challenge to conduct bilingual mathematics and science classroom may still emerge in the future. First year students of mathematics education program had calculus in Bahasa and English. As the Faculty aware that the implementation of reaching International standard should still an important issue, the bilingual classroom is still open. However, conducting bilingual classroom has never been an easy task to do. Since 2009, students of Calculus class showed their engagement within the Calculus topic which is delivered in English were vary. Several strategies in conducting the lesson were applied to promote students' understanding to Calculus and resulted in different ways. This paper will demonstrate that not only the language that had been used in the classroom make some differences, the strategies that applied within the language would also took part to bring the different. Based on qualitative approach, the study might become a powerful insight for any mathematics teacher who conduct mathematics classroom in bilingual.

Keywords: bilingual, first year students, calculus class.

INTRODUCTION

Since the year 2009, Mathematics Education Study Program (MESP) is conducting bilingual class for perspective teachers in mathematics. This program was conducting to respond the Indonesian Government initiative to provide International Standardized Schools around the nation. The initiative required teachers to promote their capability in terms of content as well as their capability in conducting the class using English. Teachers' capability to provide students with sufficient experience in mathematics as their tools and knowledge become important to risen the schools' quality around the nation. Another challenge for teachers within the initiative is using second language as the mean of academic communication. Thus, MESP Mathematics Department, State University of Jakarta piloting a bilingual classroom for pre service teachers of mathematics since they are in the first year of training in University to provide them with sufficient qualifications for teaching mathematics in second language.

In conducting the bilingual program, there are three aspects in which all the lecturer should take into attention. As mathematical content is the primary asset of mathematics teachers, then it is the first agenda during their academic experience (Bonham & Boylan, 2011). The second aspect of the program is teachers' pedagogical skills. Since teachers' strategy to engage students' learning is essential in shaping students' mathematical concepts (Bonham & Boylan, 2011), then teaching skill regarded as the second important aspect of pre service

training for the prospective teachers. The additional aspect of the learning process within the bilingual program is the language itself as the third attention of the program (Novotna & Hofmannova, 2000). Although it suggested to be the third focus of the program, in fact the second language use within courses throughout the program become problematic in some extends. In order to reduce the problem, MESP start to use bilingual in MESP within students' first year. One of the courses which are impacted from this program is Calculus. While Calculus is one of a key point to several courses in MESP, conducting bilingual in Calculus class should be managed by different learning strategy.

Unfortunately, conducting bilingual in Calculus class for first year students may not an easy task to do. For the first year college students, Calculus is a mean of new subject which is reasonably different to their school mathematics. Many concepts related to the material within Calculus and basic concept of other subject in advanced subject need to be acquired during this course. Hence, students' understanding of the material and their engagement with the learning process is crucial. On the other hands, using English as a mean of communication for academic purposes is a new thing for the students. Many of them had no experience to be in such situation when second language is used for learning in mathematics classroom. Therefore, lecturer should manage several strategies to respond the situation.

This article is a preliminary discussion of the next phase of study in bilingual mathematics classroom. With the novel idea of piloting bilingual in pre-service teacher training of mathematics, lecturer shall also develop their capability to conduct bilingual mathematics class. Especially in calculus class for the first year students, the strategy of conducting the lecture should be planned carefully. Thus, this paper will examines three important issues on conducting bilingual in calculus class among first year college students. Firstly, it will investigate about several learning strategies that had been implemented in bilingual calculus class in MESP. Secondly, this paper will explore into what extend thus the students perceived learning calculus via English shall be important for them. Finally, how the language affect their learning result would be discussed within this paper. It will promote our understanding to teacher preparation in conducting mathematics especially Calculus class throughout second language.

RESEARCH METHOD

The study was conduct in 2014 involving 6 participants; 5 from students of 2009 – 2011 and lecturer as the main participant of the study. Lecturer is the main source of the study as the lecturer hold information regarding the strategy of the courses she had in the calculus bilingual class including the objectives hold by the classroom activity. The other 7 participants who were taking the Calculus class in their first year hold the information whether the strategy was effective for them or not. They were coming from different batches who were taking calculus via bilingual instruction. Three participants are 2009 students. Two participants are from 2010 and two other are from 2011.

Using emailed questioner, the study employed qualitative approach. Emailed questioner as primary data is confirmed with lecturer's point a view as part of the participant of this study. Three selection criteria for the participants are: 1). good communication skill, 2). consistently maintain minimum absent during the class and 3). represents gender and age differences from the targeted population. The data collected were analyzed using big themes selection. Answers from the participants were classified into several themes focused on the three research questions. So, the discussion would sharply lead us to the conclusion. As the study were using qualitative approach, there is no generalization might conclude from the research (Shank, 2006; Willis, 2007). However, some particular findings may benefit to advance study related to this research.

FINDINGS

Literally, this study aimed to review some learning strategy that had been implemented by the lecturer of Calculus within her bilingual classes since 2009. Later, it will demonstrate how the language use in the class affects their learning. Moreover, we will examine how the participants think about learning within bilingual situation in MESP. Per-theme analysis hopefully will assist the reader to gain meaning from the research.

Learning Strategy, students – Lecturer Opinion

As lecturer, I was using two methods. Firstly, I called it as teacher centered activity. Secondly, it was student centered activity. Both of them contain of several techniques. The first technique was reading-explaining-discussion-practice for the first few meetings as the introduction of the concept within the course. The second technique was reading – discussion – explanation – practice for the next step of the course. The third technique was discussion – practice – explanation – practice. The last one was reading – presentation (by the students) – discussion – practice.

Based on who should lead the learning process, the first and the second techniques are teacher centered learning. Lecturer asked the students on how they should start the learning. Reading is mainly about introducing on how they could find important concepts by using their textbook. It also introduced most of the classroom member about how they should interact with their learning resources in the future study. Because most of the students had never been to bilingual class, the technique also suggests the students about how to classify information within the textbook in order to help them success in learning. This activity can introduce essential mathematics terminologies among the students. It seems that the participants agree that this method could help them to understand the concepts of calculus.

The student centered activity aimed to observe students' readiness to conduct individual learning. As the students had been introduced with how to gain information from textbook and other sources, they can practice their skill to acquire information and later present the information to their peer. The discussion which was happen during the presentation session would help the students to understand the concept and promote their confident in the related material.

According to the student participants, there were three ways of delivering the course by the lecturer. They were, using textbook, using power point presentation (PPT) and asking students to have a group presentation. The students were asked to read textbook either by themselves, guided by lecturer or combined. In some meeting PPT were used to guide the learning activity. While group presentation is mainly were used within the last 7 meetings in each course (Differential Calculus and Integral Calculus). Participants also mention that lecturer used to ask the students to read the textbook prior to their face to face interaction. They regarded this task help them to have an (small) insight about the topic of discussion for the coming meeting.

Language that Affect Learning

As a lecturer of prospective mathematics teacher, conducting learning activities using second language is not an easy task to do. In daily basis, I should consider three languages that literally affect the class (Favili, Maffei, & Peroni, 2013). The first language is Bahasa as the mother tongue of me and the students. The second one is English as the language that will be used in the classroom. The last one is the language of mathematics that specifically embedded to

mathematics itself.

However, in this regards, introducing definitions, axioms, symbols and its' terminology was important. Therefore, instead of considering Bahasa in preparing Calculus, I prefer to consider the language that specifically embedded to mathematics that students' should learn. As mathematical symbols are universal, I use this idea to reduce students' difficulty to understand Calculus concepts. In addition to that, I prepared some specific English terminology related to the topic of discussion. Into some extents, I tended to repeat those terms so students adapts to those terms and know how to spell and use it.

By this method I at least had been using around 20% to 25% of the class to introduce new and special terms. While the rest of the activity still using Bahasa, however, it has no significant information on the bilingualism about specific type of language in which is fit into certain character of education. According to the participants, lecturer was using 50% - 80% English as the mean of communication in the classroom. While students were using 30% - 60% English in the bilingual Calculus class.

As a lecturer, there are three reasons on the use of second language within the class. Firstly, the students should manage themselves to get used to use two languages as a mean of academic communication. It is because they were prepared to teach mathematics in bilingual class. Secondly, teaching mathematics specific content to students in English will make the students to use mathematics specific terminologies in daily basis. Finally, as a prospective mathematics teachers they might gain specific experience about being in mathematics bilingual class. Either they can improve or modify their version of bilingual mathematics classroom, I find that such experience were highly appreciate by the participants (according to their responds).

In addition to the three reasons about why lecturer should manage to consistently use English in their classroom, the study show another point on why English should be regularly applied in the class. The students within the bilingual Calculus Classroom will conduct their own mathematics classroom in the future. Giving them experiences to get example of bilingual atmosphere, could motivate them to conduct their bilingual classroom in the future. Another benefit is that giving them more confident to practice their English in other course and other situation.

However, learning mathematics in second language is not an easy task to do. According to the respondent, they struggle to understand the course at the beginning. They manage to overcome some difficulty to understand mathematics terminologies and lecturer's instruction. Lecturer's activity of reading and discussion reduce the problem. In addition, lecturer uses Bahasa to explain some parts of the material.

Students' Perception on the Bilingual Class

Bilingual classroom, in some extends bring another point of view of using English in learning. Although most the students had no experience learning mathematics in English, their attitude to this program is positive. Most of them were believe that bilingual Calculus class, help them adjust to the other course in MESP which are using Bahasa and English. Along with this thought, students believe that their experience within this course could help them to apply bilingual in their teaching career.

In MESP, there are at least two courses which are using bilingual program. Calculus is one of two first courses in the MESP that were using English and Bahasa. The students will continue to use this skill during their university experience. Student participants believe that their experience within the Calculus bilingual class, help them to adapt to other bilingual classroom.

Regarding their prospective career as mathematics teacher, bilingual experience can provide an overview about conducting bilingual classroom. The bilingual program indirectly

demonstrates a clear implementation on how to combine content and second language learning within a course. In addition students may get used to use simple classroom language in terms of teaching and learning activity of mathematics.

DISCUSSION

In this section I try to conclude the findings into several big themes. These themes are chosen to help me to conclude the study. In addition by the big themes selections the reader could gain new information from the research. I inserted some additional supporting arguments that seems to have relationship within this study.

Bilingual in Mathematics Classroom

“Bilingualism constitutes the presence of at least two languages within one and the same speaker” (Novotna & Hofmannova, 2000). This concept in education is updated as Content and Language Integrated Learning (CLIL). While bilingual only said that there are two language in use from one speaker, CLIL suggest that the two language used is proposed to be used in education (Novotna & Hofmannova, 2000). Instead of using language learning separated from specific content lesson, CLIL recommends the implementation both all at once.

Within this study, I use the terminology “bilingual” rather than CLIL to describe that the level of implementation in my Calculus classroom might still not satisfy CLIL yet. As the concept of bilingual classroom was newly introduced to our faculty which may still bring some uncertain form of two language utilization for many collages. However, this study is expected to be able to give an overview about specific classroom practice.

Result of the study suggest that content should come first. As acquiring concepts of Calculus is the main part of the learning, lecturer should consider the concept and the terms that directly attribute to the concept (ESOL, 2010). Thus, hopefully students also consider that it is important for them as well (Favili, Maffei, & Peroni, 2013). Novotna and Hofmannova (2000) also suggest that teachers should carefully pay attention to the three language used within the classroom. Hence, it is important both for the students and the lecturer to get used to the terminologies that specifically attributed to the concept that will be discussed.

As had been suggested by some studies (Novotna & Hofmannova, 2000; Pavesi, Bertocchi, Hofmannova & Kazianka, 2004; Naude, Engelbrecht, Harding & Rogan 2004) the language of mathematics in this case came first as understanding concepts of Calculus is the basic idea of the course. English as the communication language took part as it is also the material of learning. So the combination of learning Calculus in English give a big overview that in the future students will have two skills which are the concepts of Calculus and English. While Bahasa, will assist both lecturer and students to deliberately discuss the course. In addition the use of Bahasa also help the students to eliminate the difficulty related to the concept which might demanding as well adjust to the second language that we use in the classroom.

Teaching and Learning Strategy in Bilingual Mathematics Classroom

According to participants, there are two strategies that teachers used in the bilingual classroom. These two strategies were used gradually along the course to maintain students' attention to Calculus content. The gradual changing of learning strategies during the course was allowing the students to gradually adjust to Calculus content. In order to do that, these are the techniques that teacher usually used in the classroom:

Strategy	Techniques
Teacher centered	Reading – explaining – discussion – practice
	Reading – discussion – explanation – practice
Student centered	Discussion – practice – explanation – practice
	Reading – presentation (by the students) – discussion – practice

Table 1. Teaching strategy in Calculus bilingual Classroom

The teaching strategies were allowing students to learn step by step technique of learning Calculus by using English. The students were introduced to learn mathematics from the text book. Than later on lecturer is expecting students to gradually improve their language utilization as well as their understanding of concepts in Calculus. Thus, learning Calculus in bilingual classroom suggested to have two benefits. The first one is understanding the content of calculus itself. The second one is about learning English in specific content (Naude, Engelbrecht, harding, & Rogan, 2004). These two benefits hopefully develop their skill in terms of conducting mathematics classroom bilingually. However, according to Jarmon in Barbara and Boylan (2011) redesigning course may still need to do since both the students and the lecturer perceive bilingual classroom is not an easy task.

Moreover, according to Barbara and Boylan (2011) successful teaching usually involved multiple ways of teaching. Different competencies shall be delivered in different way to show to the learners that they hold different concepts and skills. For the students in MESP, any course is part of their professional development (Bonham & Boylan, 2011). Therefore, the activity within bilingual Calculus classroom is as maximum as an example of their classroom practice in the future.

Mathematics Teacher Preparation through Second Language

Mathematics Education Study Program (MESP) is designed to provide prospective teachers of mathematics for their professional career as mathematics teachers. The program was set two basic skills for the novel teachers. The content as the first part of the competency while teaching and learning skill as pedagogy competency. Bilingual, initially is included in the second part of the preparation program.

All students involved in the program understand that they are expected to have sufficient skill to conduct bilingual mathematics classroom. Consequently, they should be able to adapt their course demanding activity which is using English as a mean of academic communication. From the participant responds, they acknowledge that understanding mathematical concepts should come first before the other aspect of the learning (Novotna & Hofmannova, 2000). After that they seems to adjust the second language use in the learning process (Pavesi, Bertocchi, Hofmannova, & Kazianka, 2001). Even the percentage of the utilization may still low in some extent, their effort can help them to gradually improve their English as academic communication.

By the strategies that had been used in the class, students acquire three important messages. Calculus content is the first aspect that students gain from the course. After that, the students learn to use English in learning specific content knowledge (Pavesi, Bertocchi, Hofmannova, & Kazianka, 2001). And finally they could have a brief picture of conducting bilingual mathematics classroom (Novotna & Hofmannova, 2000).

CONCLUSION

This article is only a part of a big project that we have in our faculty in MESP State University of Jakarta. This piloting study shows that although learning mathematics in bilingual Calculus classroom still demanding, participants can gain positive aspects from the implementation.

In conclusion, this article addresses three important issues as being questioned at the beginning. The first one, the lecturer use teacher centered strategy and students centered strategy within the Calculus course. Table 1 illustrated that each strategy use two techniques. Those techniques were implemented to engage the students within the new environment of bilingual classroom activity. Gradually along the course lecturer was asking them to use basic technique of learning that had been demonstrated by the lecturer.

The second one, students understand that the bilingual activity is important for them. They realized that this way of teaching give a big overview about conducting teaching and learning activity within bilingual classroom in the future. Out of globalization issue, the students perceived this way of learning for their own belonging as prospective teachers of mathematics.

Finally, the participants said that the use of two languages is quite difficult for them. The participants were experience some difficulties in adjusting themselves within the bilingual classroom. However, through the strategies that had been implemented, students gradually managed themselves to adapt the demanding environment.

There still limited article available within the discussion of bilingualism in mathematics education as well as the implementation of CLIL in education. Therefore, this article hopefully could add the knowledge of those themes and suggest another or advance study regarding this issue. Although the implementation of bilingual in our public schools was banned, this practice is used in numbers of private schools. As these schools are parts of educational system, I suggest this issue is reasonably crucial to be discussed.

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