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Teachers' Reflections on Teaching Mathematics in English: A Consideration for Developing ESP Course

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ABSTRACT

This research aimed to identify the Reflections done by mathematics teachers when delivering material when teaching mathematics in international schools. The study was conducted at Permata Bangsa Elementary school that follows the Cambridge Curriculum and involved mathematics teachers from this school. This study used a Qualitative Method. Data were collected through interviews to obtain in-depth insights, and an interactive analysis method was used. The research found that they use the Team teaching method to improve their English fluency by studying from reference books and other print and online sources and working with their fellow teachers. Mathematics teachers actively aim to increase their knowledge related to mathematics through continuous learning, using special applications, book references, and YouTube online materials, attend webinars, explore educational websites, collaborate with colleagues, and leverage technology and online resources.The findings of the study provide valuable insights for designing ESP courses for mathematics teachers and help teachers prepare their English competence better.

INTRODUCTION

English has been more widely used in Indonesian education these days, not only as a subject but also as a medium of instruction for other content subjects such as mathematicsand science. It can be easily seen from the increasing number of international schools in Indonesia. In 2020, there are 509 international schools managed by both local and foreign institutions with 98.625 active students (Kementerian Pendidikan dan Kebudayaan, 2020). International schools adopt certain curriculum provided by foreign institutions. The content subjects are delivered in English as the international language. This condition results in the increasing demand for subject teachers who have good English proficiency in providing the expected learning experience.

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One of the dilemmas faced by English-medium schools in Indonesia is experienced by mathematics teachers. Teaching mathematics in English has a certain level of difficulties, such as dealing with the specific mathematical terms and expressions of learning activities that are different between Indonesian and English. Mathematics, often considered a universal language, primarily relies on numerical operations that transcend linguistic boundaries. However, the challenge arises when teachers are tasked with not only comprehending mathematical operations but also effectively conveying and explaining these concepts in English to their students(Kinnear, 2020).Further complexity arises from the fact that mathematical terminology can carry different meanings or concepts in contrast to everyday language usage or various contexts. For instance, the term 'root' in mathematics, such as in 'square root,' diverges from its usage in science, where it pertains to 'roots' and 'stems' (Ghasemi & Mozaheb, 2020).

Ideally, learning activity might run well if the students have mastered a certain level of language proficiency (Adoniou & Qing, 2014). However, in the Indonesian context, in which English is considered a foreign language, classrooms usually contain students at various levels of English proficiency that might burdenboth the learning and communication processes. The lack of English skills results in difficulties in classroom communication (Freeman, 2012). This little communication in mathematics classrooms is evident that the medium language inhibits communication (Waswa, 2020). Therefore, mathematics teachers have an additional task to deliver all students' learning materials and ensure that the communication runs well. Teachers also sometimes face difficulty dealing with themselves, such as feeling unconfident with their English proficiency due to lack of knowledge or inadequate training in pre-service education (Othman & Saat, 2009).

This condition is found in one public school in Medan, which has run two curriculum, namely Merdeka curriculum and Cambridge curriculum, since 2020. There are three subjects adopting the Cambridge curriculum: mathematics, science, and English as a second language. The students in this school attend mathematics classes delivered in English. Two aspects come into the concern. First, the mathematics teachers should adapt to the new curriculum, which should be delivered in English. The foundation provides training through several methods to improve the teachers' English skills, such as workshops, micro-teaching, and speaking clubs.

Second, there are many students with various levels of English proficiency. Some of thestudents who graduated from elementary school managed by the same foundation found no problems in mathematics class since they have taken the same curriculum at the previous level. However, those coming from other schools do not have adequate background in English. It makes the learning process slower since the teachers need to deliver the materials in a way all students can understand the concept.

Issues dealing with how and to what extent English proficiency for mathematics teachers should be developed emerged. Having a good understanding of mathematical concepts doesn't seem enough. They need pedagogical skills to help the students learn effectively. In the condition that English becomes the medium, their English competence does become another concern.

The purpose of this study is to gather empirical data from Elementary school mathematics teachers regarding their experiences presenting instruction and learning materials in English. study aims at investigating the English competence needed by mathematics teachers to deliver learning materials in English effectively. There are three focuses in this study, namely 1) the difficulties faced by mathematics teachers in delivering

learning materials in English, 2) the strategies carried out by the teachers to cope with the difficulties, and 3) the implication of the teachers' reflection for ESP design. The results of this study will be beneficial in several ways. For the English department or other departments concernedwith it, it gives insight for designing ESP courses for mathematics. This study reflects the real teaching experiences in the classroom. Therefore, mathematics teachers or prospective mathematics teachers can prepare their English competence better.

Difficulties in Teaching Mathematics in English

Mathematics is one of the content subjects delivered in English. There are several challenges in teaching mathematics in English seen from both teachers' and students' points of view. One of the common problems is the students' and the teachers' readiness to join the class. It can be caused by two main factors, namely the students' low levels of English proficiency and the teachers' less capacity to present an effective teaching and learning process. The teachers' less capacity might affect classroom management. In addition, speaking skill is considered the hardest skill to develop, whereas this skill plays an important role in classroom communication (Poedjiastutie, 2017). This language-related issue also influences the students' performance.

Several strategies are employed to bring mathematical concepts easier to be understood by the students. Teachers may implement narrative or procedural contexts related to real-life applications such as sport, recipes, entertainment, transport, and technology to introduce mathematical word problems (Halladay & Neumann, 2012). Mathematics teachers also need to ensure vocabulary for new topic areas is introduced to the students. Vocabulary is key in reading comprehension, including in mathematics. As the students went through years of schooling, they would find that mathematics vocabulary became more idiosyncratic, and the concepts became more abstract.

Another strategy to cope with the challenge in teaching mathematics in English is by implementing various learning activities appropriate to the students' condition. Even though the English terms and language expressions are different in mathematics, effective pedagogical strategies in English classrooms can also be implemented in mathematics classrooms (Halladay & Neumann, 2012). Those strategies are, for example, reading aloud, authentic materials, teacher's silence, question and answer exercises, peer correction, and translation of literary passages (Malasari et al., 2021).

English Specific Purpose

ESP, a distinct branch within the realm of English language instruction, is primarily designed to enhance students' proficiency in a specific linguistic domain. Its primary aim is to empower learners with the ability to effectively communicate in English, tailored to their specific needs. ESP, as a pedagogical approach, typically encompasses a thorough needs analysis that identifies the language requirements specific to the students' field of study or workplace. A fundamental aspect of communication competence within ESP also involves understanding the discourse practices that characterize the language's use, an essential skill for learners operating in their respective domains (Ahmed, 2014).

Through needs analysis, educators ascertain the dimensions of language that warrant study within the framework of ESP. This analysis addresses critical questions such as the extent of language proficiency required by students and the underlying reasons for their language study. Neglecting these considerations can potentially pose challenges to educators' roles, as it may lead to dissatisfaction among students and institutions

(Poedjiastutie & Oliver, 2017) A comprehensive examination of the need analysis for both pre-service and in-service teachers in Europe identified several crucial requirements.

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These encompass the improvement of their understanding of theoretical and methodological aspects, broadening their range of teaching resources, enhancing their linguistic and intercultural competence, and promoting continuous professional development. The study emphasizes the importance of teacher readiness in ensuring the effectiveness of English-medium learning processes, ultimately highlighting the responsibility of educational institutions to facilitate such preparedness.

METHOD

This study employs a qualitative research methodology, which involved conducting interviews with five mathematics teachers from the Permata Bangsa Elementary school, who specialize in teaching Cambridge Curriculm. Data collection took place in November 2023, followed by an in-depth analysis of the collected data using an interactive approach aligned with the research objectives, ultimately leading to the formulation of conclusions.

The participants consisted of four female mathematics teachers working at Permata Bangsa Elementary school, where they taught mathematics using the Cambridge curriculum. Their age range falls between 25 and 30 years. These individuals are all native speakers of Indonesian, with none of them having resided in English-speaking countries for more than six months. Furthermore, they have not participated in any intensive English courses lasting at least one month. The foundation provides weekly English language programs, and pedagogy training sessions are conducted every semester. While their prior teaching experiences varied, it's noteworthy that all participants have been teaching mathematics in Cambridge classes since 2020.

The data collection method was an interview. In this study, the data was acquired through interviews conducted with four mathematics teachers at Permata Bangsa Elementary school. The interview instrument consisted of some questions to elicit information about the research topic.

The researchers reached out to five mathematics teachers from Permata Bangsa Elementary school providing them with a clear explanation of the research's scope and procedures. All of them willingly agreed to participate as participants in the study. Subsequently, an online interview was conducted, and the responses obtained were subjected to analysis using interactive analysis methods.

This approach involves a sequence of four key steps: data collection, data reduction, data presentation, and drawing conclusions. The initial phase involves gathering data through interviews. Subsequently, the data is condensed to extract essential elements and emphasize significant details, with the goal of identifying overarching themes and patterns that enhance data clarity and facilitate researchers in gathering and discovering insights. This process constitutes data reduction. Following this, the data is presented in a concise format, comprising a summary of information, thus allowing for the potential derivation of conclusions. The final stage is drawing conclusions, which occurs once all the data has been fully collected and analyzed.

RESULTS AND DISCUSSION

English for Specific Purposes (ESP), especially for mathematics teachers, is one of the essential factors that contribute to the success of the learning process, especially those who teach in an international school or bilingual school, which always increase in number year by year. Being a teacher means that he needs to deliver or explain the learning materials to help the students understand the concept.This section presents the results of the data analysis

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concerning the Reflections done by teachers for teaching mathematics in English. Furthermore, the implications of these findingy s are discussed in the context of developing English for Specific Purposes (ESP) courses tailored for mathematics teachers.

Here are the Questions and answers of Interviews of this research

1. *"What are the main difficulties mathematics teachers face in teaching mathematics in English?"*

Respondent A

"Because Mathematics is a subject that requires precise and concise language, teaching mathematical concepts, definitions, and theorems in a non-native language can be a challenge for me, who is not native. I have difficulty articulating complex ideas accurately in English and occasionally mix them with Indonesian."

Respondent B

"Mathematics has a unique vocabulary and terminology that can be confusing. Understanding and explaining these terms can take more work for me. I feel worried if my students don't understand my explanation or if I cannot present the materials well. So *I study and read references to have a strong understanding of mathematics terminology in English in order to teach the subject effectively."*

Respondent C

"I felt not confident because of my language, *sometimes I need help understanding complex ideas and communicating them effectively in English."*

Respondent D

Sometimes difficulties also come from students who don't understand English instructions so students who don't understand the will take the wrong steps in working on the questions.

Vocabulary turns into an important factor because several specific terms in mathematics are different from daily usage. Some terms are totally new for several students who had not attended content subject delivered in English. The teachers should have learned vocabularies that they are about to use, including their word classes and form variations. Students' understanding of word families and word classes helps them understand the relation between the word concepts and the mathematical task they require. For example, 'multiple' is an adjective; 'the multiples of 10' is a noun; 'multiply' is a verb; 'multiplication' is a noun (Adoniou & Qing, 2014).

The level of difficulties may differ based on several factors, such as the teachers' and students' levels of English proficiency, the teachers' pedagogical competence, school facilities, etc. However .This study only focused on the teachers' point of view in delivering learning materials in English. This finding section presents the results of data analysis dealing with the teachers' difficulties and strategies in teaching mathematics in the English language, as well as their strategies to cope with it. Furthermore, the implications of the findings are presented as a consideration in developing ESP courses for mathematics teachers. Teachers' Difficulties in Teaching Mathematics in English As can be derived from the responses, all teachers were not confident when teaching mathematics in English because they were uncertain about their English proficiency. Meanwhile for the mastery of the materials was all fine.

2. *"Does the use of English influence how you design and deliver mathematics course material?"*

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Respondent A

Sometimes, I design the materials and learning activities by myself. I design the materials with games, I take the materials from some websites, such as onlinemathlearning.com. For quizzes or evaluation, I use live worksheets from Pinterest APPs and quizziz."

Respondent B

Language proficiency and understanding of mathematical terminology are essential. Designing the material makes it more exciting and easy for students to understand. The role of ICT and professional program development helped me improve my linguistic skills to design and deliver mathematics lesson material effectively.

Respondent C

I design bilingual course materials, combining English and student material; I also pay attention to the needs of my students so that it is easier to deliver the material on target.

Based on inerview above can conclude English language proficiency plays a significant role in shaping the design and delivery of mathematics course materials, especially in contexts where English is not the first language. Here are a few ways in which it may influence the process:

The first is Language clarity: Mathematics requires precise language and terminology. When designing course materials, educators need to ensure that the English used is clear, concise, and easily understandable by students. This includes using appropriate mathematical language and avoiding ambiguous or confusing phrases. The Second is Language support: For students who are not fluen English, providing additional language support is crucial. This may involve providing explanations in simpler terms, offering translations or glossaries for technical terms, and using visual aids to aid understanding.

The Third is Cultural adaptation: Different cultures may have different approaches to teaching and learning mathematics. Educators must consider cultural nuances when designing course materials in English and adapt the content accordingly. This may include incorporating examples and problems relatable to students' cultural backgrounds. The fourth Bilingualism: In some contexts, educators may need to design bilingual course materials, combining English and the student's . This can help bridge the language gap and support students' understanding of mathematical concepts. The last Teacher training: For educators teaching mathematics in English as a second language context, their language proficiency and understanding of mathematical terminology become crucial. Professional development programs can help teachers enhance their linguistic skills to design and deliver mathematics course materials effectively.

In summary, using English in designing and delivering mathematics course materials can significantly impact language clarity, cultural adaptation, language support, and teacher training. It is essential to accommodate the needs of students who are non-native English speakers and ensure that they have access to adequate learning materials. However, some studies suggest that English may be a medium of instruction in mathematics courses and that students' English background may impact their performance in mathematics courses. Additionally, some studies examine the course design and materials selection processes in the context of English for Academic Purposes, which may be relevant to designing and delivering mathematics course material in English-speaking contexts. Overall, more research is needed

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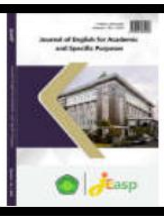

to determine the extent to which the use of English influences the design and delivery of mathematics course material.

3. *"Do difficulties in teaching mathematics in English impact students' understanding of the subject matter?"*

Respondent A

I *t*hink no*t impact my students. Caused These language aspects significantly impact my teaching. But If I struggle with vocabulary or pronunciation, it can lead to misunderstandings. Grammar proficiency is crucial for clarity, and speaking fluency is essential for engaging students and fostering a positive learning environment."*

Respondent B
"For some students who are not fluent in English, they need help understanding content, following instructions, or asking questions."
Respondent C
"Yes, difficulties in teaching mathematics in English can potentially impact students' understanding of the subject matter. "
Respondent D
"Yes, difficulties in teaching mathematics in English can potentially impact students' understanding of the subject matter."

Based on inerview above can conclude difficulties in teaching mathematics in English can potentially impact students' understanding of the subject matter. Here are a few reasons why this may occur:

The first is Language barrier: For students who are not fluent in English, the language can be a barrier to understanding mathematical concepts. Suppose the language used in the classroom or course materials must be entirely comprehensible to the students. In that case, they may need help grasping the content, following instructions, or asking questions for clarification.

The Second is Misinterpretation of terminology: Mathematics relies on precise terminology, and even small nuances in language can lead to misinterpretation. If students are familiar with the specific mathematical terminology used in English, it can help their ability to understand and apply concepts correctly.

The Third is Difficulty in expression and communication: In a classroom where English is not the student's first language, they might need help expressing their thoughts and ideas clearly in English. This can limit their ability to ask questions, participate in discussions, or seek help from the teacher, ultimately affecting their understanding of the subject matter.

The fourth is Cognitive overload: Learning mathematics requires cognitive effort and mental processing. When students have to simultaneously understand the mathematical concepts in English and translate them into their native language for better comprehension, it can create cognitive overload and hinder their ability to absorb and retain the content effectively.

The last is Cultural differences: The cultural context in which students learn mathematics may influence their understanding of the subject matter. When mathematics course materials are designed primarily in English without considering cultural references or examples that resonate with the student's background, it can lead to a lack of connection and lower engagement levels, negatively impacting their understanding.

However, it is essential to note that with proper support, such as bilingual explanations, visual aids, and language assistance, the impact of teaching mathematics in

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English can be mitigated. Additionally, teachers' awareness of language barriers and their efforts to accommodate students' diverse linguistic needs can significantly improve students' understanding of mathematics.

4. How do mathematics teachers overcome language barriers when teaching mathematics concepts in English?"

Respondent A

"I actively aim to increase my knowledge related to mathematics through continuous learning and using special applications, book references, and YouTube online materials. I also integrate new words into my lesson plans to strengthen understanding. I prepare myself and make sure that I have mastered the materials before I am going to teach. I learn about the specific mathematical terms in the topic and try to pronounce them correctly "

Respondent B

"I attend webinars and explore educational websites to enhance my language skills. Additionally, I collaborate with my friend's team teaching and follow online forums to share resources and ideas for instructional materials."

Respondent C

"I prepare the media such as PowerPoint, note stylus pen. I also learn the materials, the sentences I might use to explain the materials, and practice speaking if the time is enough. And I concerned used the Cambridge reference book"

To overcome these difficulties, mathematics teachers can engage in professional development programs, attend workshops or seminars focused on mathematics education in an English-speaking context, and continuously improve their English language skills. Collaboration with other mathematics teachers and seeking support from colleagues who are fluent in English can also be beneficial. Lastly, leveraging technology and online resources can provide additional support in clarifying concepts and improving language proficiency. Line with the previous study (Kadirolova, 2020; Keshtiarast & Salehi, 2020) It is noted that The use of ICT tools is suggested in the ESP curriculum to support textbooks.

CONCLUSION

A study was conducted to gather empirical data from elementary school mathematics teachers regarding their experiences in presenting instruction and learning materials in English. The findings of this study are expected to provide valuable insights for designing ESP courses for mathematics teachers and help teachers prepare their English competence better. Teaching mathematics in English presents several challenges for both teachers and students. Teachers need help in articulating complex ideas accurately, understanding and explaining mathematical terminology, and feeling confident in their language proficiency. Students, on the other hand, may need help with understanding content, following instructions, or asking questions due to language barriers. To address these challenges, teachers employ various strategies such as using real-life applications, ensuring vocabulary introduction, and implementing learning activities appropriate to students' conditions.

English for Specific Purposes (ESP) is crucial for mathematics teachers in international or bilingual schools. The use of English significantly impacts the design and delivery of mathematics course materials, influencing language clarity, cultural adaptation, language support, and teacher training. Difficulties in teaching mathematics in English can impact students' understanding of the subject matter, leading to language barriers, misinterpretation of terminology, difficulty in expression and communication, cognitive overload, and cultural differences. However, with proper support and awareness of language barriers, the impact of teaching mathematics in English can be mitigated.

To overcome language barriers when teaching mathematics concepts in English, mathematics teachers actively aim to increase their knowledge related to mathematics through continuous learning, using special applications, book references, and YouTube online materials, attend webinars, explore educational websites, collaborate with colleagues, and leverage technology and online resources. Professional development programs, workshops, seminars, and collaboration with other teachers are also beneficial in improving English language skills and clarifying concepts. In conclusion, teaching mathematics in English presents various challenges for both teachers and students, but with the right strategies and support, these challenges can be overcome. The findings of the study provide valuable insights for designing ESP courses for mathematics teachers and help teachers prepare their English competence better.

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