

ANALYZING THE NEEDS OF ENGLISH FOR MATHEMATICS TEACHING MATERIALS IN FACILITATING PROJECT-BASED LEARNING: STUDENTS' AND LECTURERS' PERSPECTIVES

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Abstract: Teaching English for Mathematics aims to develop English language skills within mathematical concepts. Currently, learning resources for English for Mathematics using the Project-Based Learning (PjBL) approach are still very limited. Therefore, this study aimed to obtain a comprehensive overview of the needs of students and lecturers for instructional materials in English for Mathematics that are designed to support the implementation of PjBL. This study employed a mixed-methods approach to collect both quantitative and qualitative data. The quantitative data consists of a needs analysis conducted through interviews with two lecturers who teach the course, while the qualitative data was gathered through a needs analysis questionnaire completed by 42 students from three different universities. The interview results revealed that lecturers expect instructional materials that thoroughly cover all stages of PjBL, including school-level mathematics content, problem-solving tasks, the eight teaching skills, interactive media, as well as control cards and assessment rubrics. The student questionnaire results indicated that although 90.7% of respondents were enthusiastic about the course, 41.8% acknowledged facing challenges, including mathematical vocabulary in English, pronunciation of mathematical symbols, and planning and delivering lessons in English. Most students (72.1%) received a video project as their course assessment. This project enhanced their confidence, speaking abilities, and comprehension. Students suggested that the course should be interactive, creative, and focused on improving their English mathematical vocabulary.

Keywords: *English for mathematics, project-based learning, needs analysis*

INTRODUCTION

The accelerated pace of scientific advancement by academics and scientists across the globe has led to an increased demand for proficiency in the English language. The capacity to comprehend English texts facilitates the acquisition of

novel insights and knowledge in specific domains (Chapple, 2015; McKay, 2018), including mathematics education. For those engaged in the teaching of mathematics, a broad knowledge base is an invaluable asset, facilitating students' exploration of the logical and mathematical sciences they are now

acquiring. It is therefore crucial to gain proficiency in English as a gateway to a wealth of knowledge, with the aim of enhancing the quality of learning processes and outcomes.

Additionally, international academic competitions have contributed to the growing necessity for proficiency in the English language (Obaidul Hamid & Nguyen, 2016; Wu et al., 2015). In recent years, Indonesian students have participated in a number of international mathematics olympiads, achieving notable success and winning medals in several categories. In this context, the ability to integrate a comprehensive understanding of mathematical concepts and English language skills is of paramount importance for success in the competition.

The aforementioned explanations represent merely a fraction of the requirements for English language proficiency in mathematics. However, the Indonesian education system offers only a narrow scope of English language learning, focusing on basic proficiency (Panggabean, 2015). There is a paucity of English teaching materials that can be specifically and intensively linked to the field of mathematics, even at the university level, which is oriented towards a single main area of expertise.

English learning for mathematics is also referred to as English for mathematics. This field is part of English for Specific Purposes (ESP), which aims to meet the needs of using English in specific skill contexts (Fitria, 2020; Hyland, 2020). Through English for mathematics, students can develop English language skills through the mathematical concepts they learn.

The integration of mathematical concepts and English language skills within the learning process necessitates the utilization of sophisticated cognitive processes. This is evident when comparing

mathematics and science, as well as English and the humanities. Consequently, the learning of English for mathematics must be designed with learning methods that are aligned with the needs of students, a process currently referred to as "student-centered."

The Ministry of Education, Culture, Research and Technology provides an overview of student-centered methods in the Student-Centered Learning Implementation Guide. Among the various methods mentioned in the guide, project-based learning, also referred to as team-based projects, is one of the methods prioritized in the Higher Education Key Performance Indicator assessment for measuring the achievement of collaborative and participatory classes. This underscores the necessity of ensuring that complex subject matter can be optimally absorbed through increased student participation in the learning process.

Project-based learning is a teaching method that focuses on students as active participants, encouraging them to engage in meaningful tasks to deepen their learning experience (Perry, 2020). In addition, project-based learning is an instructional model that focuses on involving students in project-based tasks, encouraging them to engage in inquiry-driven activities that foster the development of knowledge, skills, and attitudes necessary for evaluation (Hamidah et al., 2020a). In project-based learning, students work together in groups to tackle complex, real-world problems that are connected to the curriculum and often involve multiple subject areas. They are responsible for planning their approach to the problem, choosing the activities they will carry out, and collecting information from diverse sources. Through this process, they synthesize, analyze, and construct new knowledge. Upon completing the project, students present what

they have learned and are evaluated based on their understanding and the effectiveness of their presentation. The teacher acts as a facilitator and mentor, offering guidance and support rather than directing each step of the students' work (Solomon, 2003).

The project-based learning method is distinctive in comparison to other learning methods, especially those ending with a final project. The main contrast between project-based learning and project-ending instruction lies in both the process and the outcomes involved (Hamidah et al., 2020b). In project-based learning, students collaborate in groups under teacher guidance and have the opportunity to make choices throughout the planning and execution of their projects. Moreover, it is centered on the creation of products that address specific challenges through project-based work (Almulla, 2020; Hawari & Noor, 2020). Additionally, the project work in this method is guided by a series of processes, including discussion and collaboration, to ensure the quality of the products produced aligns with the desired outcomes (Crespi et al., 2022; Yuliansyah & Ayu, 2021).

A review of the literature reveals that project-based learning is an effective method for enhancing the quality of students' learning processes and outcomes in a range of subject areas (Issa & Khataibeh, 2021; Ngereja et al., 2020; Ningsih et al., 2020). In the field of mathematics, project-based learning is frequently employed as a principal method for transforming the conventional, uninspiring pattern of mathematical learning (Remijan, 2016; Siswono et al., 2018). The practice of teaching mathematics through written problems on paper must be reimagined in a more creative manner so that the assessment of students' mathematical abilities is not limited to mere numbers on paper, but rather encompasses the capacity for logical

reasoning as the foundation for the development of mathematical concepts.

Several studies have been conducted on the implementation of Project-Based Learning in mathematics education. However, research on the English for Mathematics course remains very limited. One such study is the development of instructional materials by Wijayanti (2018) which resulted in digital English for Mathematics teaching materials incorporating VideoScribe-assisted videos through E-learning. Additionally, Deswita & Niati (2020) conducted a study on the development of instructional materials, beginning with a needs analysis of English for Mathematics textbooks based on collaborative learning for mathematics education students. This study concluded that students require an English for Mathematics textbook based on collaborative learning as a foundation for developing a valid and practical instructional material that can be effectively used in mathematics education courses (Deswita & Niati, 2018). Findings from the research review suggest that no thorough study has been conducted on students' and lecturers' perspectives on the necessity of English for Mathematics teaching materials that support Project-Based Learning. This study can contribute to the development of effective instructional materials in this field.

This research aimed to gain a comprehensive understanding of students' and lecturers' needs for English for mathematics materials designed to facilitate the implementation of project-based learning (PjBL). The research provides a comprehensive overview of the needs of students and lecturers for English for mathematics teaching materials that support the implementation of project-based learning. Consequently, the teaching materials can be

systematically acquired through project-based learning.

METHOD

This research employed a mixed methods approach to obtain both quantitative and qualitative data, thereby ensuring a comprehensive representation of the actual conditions. In particular, this research employs a convergent mixed methods design, which posits that while quantitative and qualitative data are derived from disparate sources, they are nevertheless mutually reinforcing, ultimately leading to a unified conclusion (Creswell & Creswell, 2018). This research design is capable of assisting in the description of the needs of lecturers and students for English for mathematics teaching materials that facilitate project-based learning, which is the purpose of this study.

This research was conducted at three universities in South Kalimantan, which differed in status: a private university, a state university under the Ministry of Religious Affairs, and a state university under the Ministry of Education, Culture, Research and Technology. The diversity of institutional status is anticipated to offer insights into the influence of cultural and learning environment factors. The study's participants included three lecturers and 43 students from the three universities. The lecturers were selected as participants based on their experience teaching English for mathematics, while the students were selected based on their experience learning English for mathematics.

In this study, quantitative data were collected through surveys, which provided descriptive data regarding student perceptions of the need for English for mathematics teaching materials designed to facilitate project-based learning. Additionally, semi-structured interviews and focus group discussions with lecturers were conducted to

collect qualitative data. The results of this data collection were then analyzed to obtain a more comprehensive understanding of the research data.

In the data analysis stage, three stages are carried out in order to analyze data from a convergent mixed methods design. These stages are as follows: 1) describing qualitative data based on relevant themes, 2) analyzing quantitative data using statistical calculations, and 3) integrating the two data sets through a comprehensive data display in order to answer the research questions conclusion (PH. and Chang, 2009).

RESULTS AND DISCUSSION

The objective of this needs analysis is to ascertain the needs of students and lecturers through interviews with lecturers and the administration of needs analysis questionnaires to students enrolled in English for mathematics courses. The interview guideline instrument and the needs analysis questionnaire have been validated by an appropriate panel of experts. It is of great importance to validate the instrument in order to ascertain its feasibility. The needs analysis questionnaire was validated by a mathematics lecturer at Lambung Mangkurat University. The results of the validation process indicate that the instrument is of a satisfactory standard. The comments and suggestions from the validator are as follows: "Improvements are needed to the sentences of the items asked, especially in the content validity and face validity sections." It is significant importance that the sentences utilized within an instrument are clearly comprehensible and do not engender bias. Moreover, the instrument was employed to gather data from mathematics lecturers who teach students in English for mathematics course and from students who have previously undertaken the course.

The needs analysis was conducted with the target lecturers through direct interviews with two mathematics education lecturers who were also responsible for teaching English for mathematics. The first resource person is a lecturer specializing in the teaching of English for mathematics at Lambung Mangkurat University. The second resource person is also a lecturer, this time at Antasari State Islamic University Banjarmasin.

The Results of The Needs Analysis of Lecturers

The interview guideline questions for lecturers can be classified into six main indicators: learning outcomes, teaching materials, learning methods, learning media, assessment and evaluation, and learning resources. Moreover, the six indicators were distilled into a set of 17 questions. The results of the needs analysis conducted with lecturers indicated that students are expected to be able to convey mathematical learning in English, including the ability to understand problems and convey solutions to mathematical problems in English. Nevertheless, English for mathematics course can equip students with the ability to convey their mathematical learning in English. The students' proficiency in mathematics after completing English for mathematics course can be described as satisfactory, though it does not reach the level of expertise.

Moreover, the results of the needs analysis conducted with lecturers regarding the teaching materials indicator revealed that the material utilized in English for mathematics course was primarily an English mathematics textbook. However, the level of mathematical material provided differs between the two sources. The material presented by Resource Person 1 focuses on mathematics at the junior high school level. It

is divided into the following chapters; Chapter 1: Measurement, Estimation, and Using Formulas; Chapter 2: Using Algebraic Equations to Solve Problems; Chapter 3: Word Problems Involving Ratio, Proportion and Percentage; Chapter 4: Word Problems Involving Geometry and Trigonometry; Chapter 5: Word Problems Involving Statistics, Counting, and Probability; Chapter 6: Miscellaneous Problem Drill. In contrast, Resource Person 2's material begins with an overview of elementary-level mathematics and progresses to more advanced topics. This material is divided into groups based on the level of mathematics being covered.

With regard to the learning methods employed, it is established that the teaching method utilized in skill-based English courses at the mathematical level entails the mastery of a minimum of ten vocabulary items at each session. This encompasses not only the acquisition of knowledge regarding the pronunciation and translation of these terms but also the ability to utilize them effectively in context. Moreover, students are required to view English-language learning videos at home and subsequently present the content of the video in class. Other methodologies are presented in the form of games and dialogues. Project assignments are in the form of the production of learning videos, which commence with the compilation of PowerPoint presentations, the subsequent explanation of discussion questions, and the uploading of these videos to YouTube. Thus far, the projects assigned to students have not been based on project-based learning (PjBL). However, the resource person, in this case the lecturer, stated that PjBL is suitable for implementation in learning English for mathematics course because it requires students to apply the knowledge gained as their main task. The most important aspect of implementing PjBL is the burden of PjBL

projects borne by students and careful planning in terms of RPS and all stages. This is in line with the opinion that implementing PjBL requires careful planning, support from educators, adequate facilities and infrastructure so that it leads to successful learning (Nando et al., 2024).

As indicated by the learning media indicator, the materials utilized for instruction encompass English language learning videos, PowerPoint presentations, and quizzes. The video material is sourced from YouTube and includes techniques such as asking questions in simple language and explaining concepts through video, with the aim of facilitating student imitation.

With regard to the assessment and evaluation indicators, it is evident that the evaluation process is conducted orally, both by mid-term test and by final test, with the involvement of Resource Person 1. However, in the case of Resource Person 2, there is a slight discrepancy, whereby the mid-term test is conducted orally and the final test is conducted in writing. The criteria utilized in the assessment process have not yet been explicitly documented; nevertheless, the lecturers provide a range of criteria that are clearly defined and understood by all parties.

In the learning source indicator, it is indicated that Resource Person 1's learning source is a reference book, namely *How to Solve Word Problems in Mathematics* by David S. Wayne published by Mc Graw Hill in 2001. The textbook is comprehensive; however, it includes units that may be unfamiliar to students, such as Lb and pounds. It is therefore incumbent upon the lecturer to provide advance clarification on the interpretation of equations or operations, decimals, fractions, comparisons, and the identification of currencies. It should be noted that not all students have an English background. To illustrate, the sum of 1.5

dollars is read as one point five dollars. Meanwhile, Resource Person 2 employs learning resources in the form of PDF modules from other campuses. The module is presented in a didactic format, providing only the material and questions without any guidance on how to solve the problems. It is anticipated that students will focus on articulating the material and questions in English, rather than on the specifics of the answers. Moreover, it is anticipated that supplementary digital applications will be incorporated into the textbook for English audio. This is due to the fact that students encounter difficulties when attempting to pronounce the appropriate mathematical vocabulary and terminology in English. The recommendation put forth by Resource Person 1 is the necessity for comprehensive instructional materials that encompass eight teaching competencies within the context of microteaching. Resource Person 2 recommended that the learning be conducted digitally with audio, with the objective of integrating pronunciation into the learning process beyond the mere transcription of written material. This is consistent with prior research indicating that audio-visual-based learning can enhance language proficiency through oral engagement and facilitate students' interaction with the presented material, thereby enhancing their comprehension (Baqi et al., 2023)

The Results of The Needs Analysis of Mathematics Education Students

The needs analysis questionnaire was distributed to students via Google Forms through the lecturer, targeting those who had previously taken the English for Mathematics course from three different universities. However, there were 42 respondents participated in the study. The respondents included 12 mathematics education students

from Universitas Muhammadiyah Banjarmasin, 12 mathematics education students from Antasari State Islamic University, and 18 mathematics education students from Lambung Mangkurat University. The proportion of respondents who completed the survey is illustrated in the following diagram.

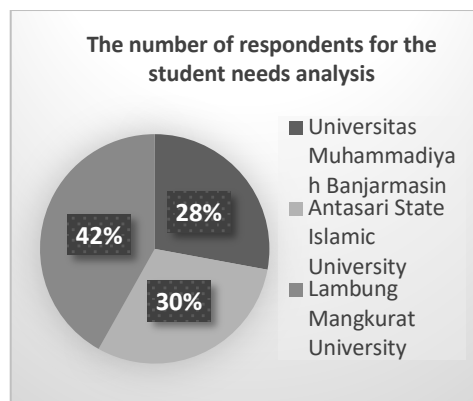


Figure 1. The number of respondents to student needs analysis

A total of 15 questions are posed to students in the needs analysis questionnaire. The results of the analysis of student needs through the aforementioned questionnaire are presented in the following section.

A summary of the responses provided by students to question no. 1 can be found in Figure 2.

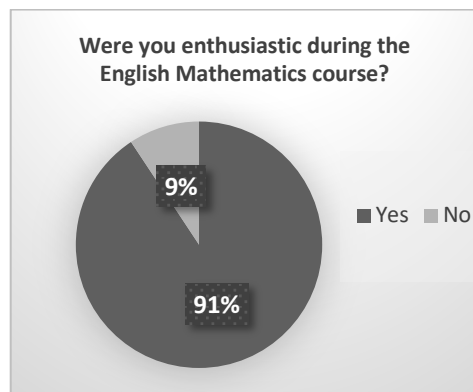


Figure 2. A Summary of Student Answers to Question No. 1

As illustrated in Figure 2, 90.7% of respondents indicated enthusiasm for participating in English for mathematics courses, while 9.3% expressed lack of interest. Moreover, a summary of the responses provided by the students to question number two can be found in Figure 3.

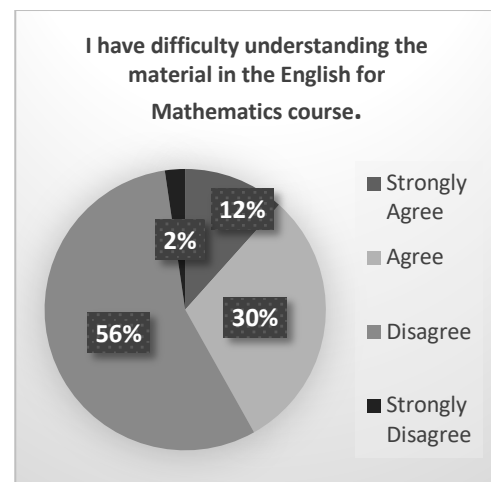


Figure 3. A Summary of Student Answers to Question No. 2

Figure 3 illustrates that 41.8% of respondents either strongly agree or agree that students encounter difficulties in comprehending the material presented in English for mathematics course. In contrast, 58.2% of respondents either disagree or strongly disagree with this assertion.

In question number three, which was posed in the form of an open question, namely, "In your opinion, what material do you find difficult to understand in English for mathematics course?", the students indicated that they encountered difficulties in the following areas: recalling the vocabulary of mathematical terms in English, pronouncing mathematical symbols in English, listening to solving math problems, preparing lesson plans, teaching practices in English, and understanding mathematical material in

English. Moreover, the results of the students' responses to question number four are presented in Figure 4.

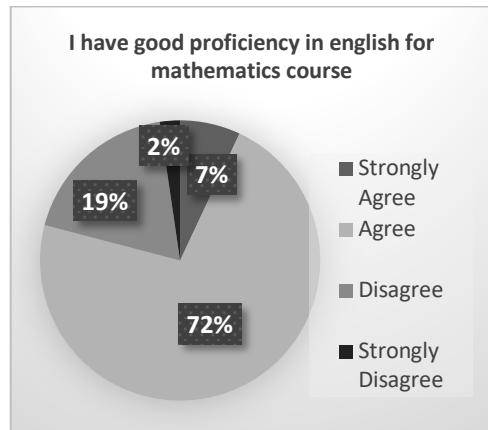


Figure 4. A Summary of Student Answers to Question No. 4

As illustrated in Figure 4, 79.1% of respondents indicate that they either strongly agree or agree that students demonstrate proficiency in English for Mathematics course. In contrast, 20.9% of respondents express disagreement or strong disagreement with this assertion. Moreover, a summary of the responses provided by students to question number five can be found in Figure 5 below.

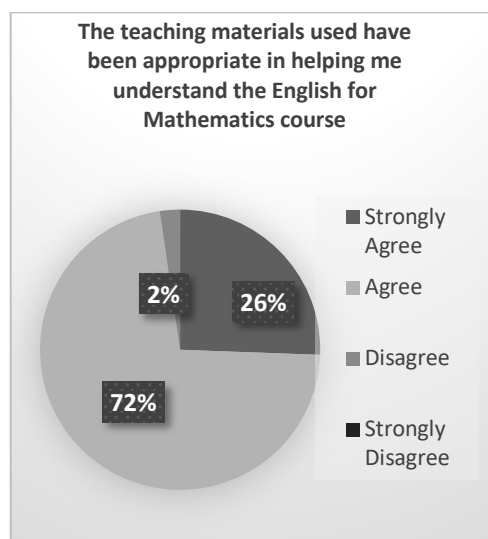


Figure 5. A Summary of Student Answers to Question No. 5

Figure 5 illustrates that 97.7% of respondents indicated that the instructional materials were effective in facilitating comprehension of the contents of English for mathematics course, while 2.3% expressed disagreement or strong disagreement. Further, a summary of the responses to question number six can be found in Figure 6 below.

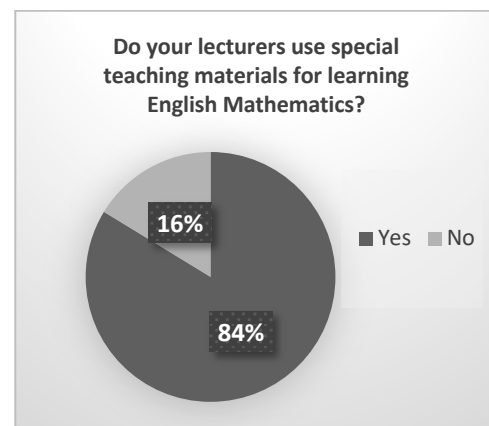


Figure 6. A Summary of Student Answers to Question No. 6

Figure 6 illustrates that 83.7% of respondents affirmed that the lecturer utilized instructional materials in the context of English for mathematics course, whereas 16.3% indicated otherwise. Additionally, Figure 7 depicts the results of student responses to question no. 7.

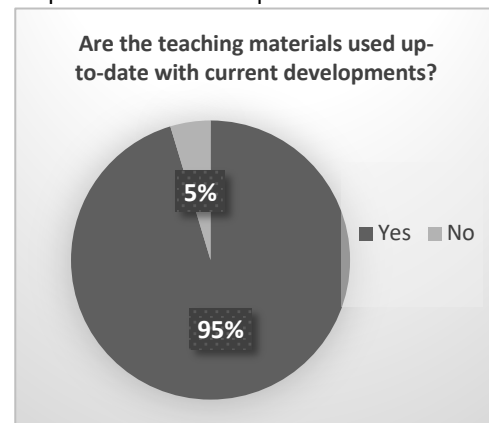


Figure 7. A Summary of Student Answers to Question No. 7

As illustrated in Figure 7, 95.3% of respondents indicated that the instructional materials utilized were aligned with contemporary standards and technological advancements. Conversely, 4.7% of respondents asserted that this was not the case. Moreover, a summary of the responses provided by the students to question no. 8 can be found in Figure 8 below.

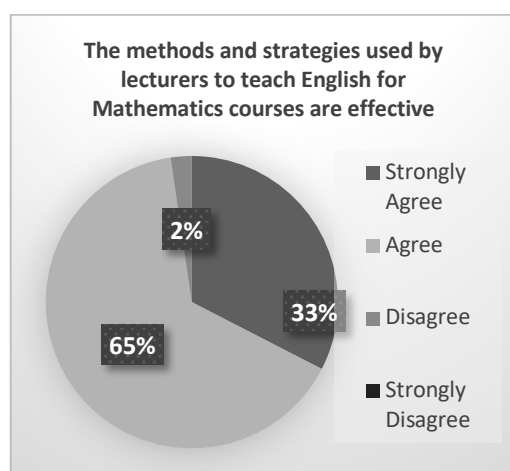


Figure 8. A Summary of Student Answers to Question No. 8

As illustrated in Figure 8, a substantial majority of respondents (97.7%) expressed positive sentiments regarding the efficacy of the pedagogical approaches employed by lecturers in teaching English for mathematics course. Conversely, a minority of respondents (2.3%) conveyed reservations or disagreement.

In question no. 9, which was posed in the form of an open question, namely, "What are the methods and strategies used by lecturers to teach English for mathematics course?," the students provided a variety of responses, including the use of compiled presentations of material, the solving of mathematical problems in English, the creation of interactive videos in English, discussion and question-and-answer sessions followed by the viewing of English

learning videos, the writing of mathematical vocabulary in the video, the practice of English pronunciation in answering mathematical problems, and game-based learning.

In question 10, an open-ended inquiry was posed: "In your opinion, what are the most interesting methods and strategies to be applied in English for mathematics course?" The students indicated that they found discussions, games, quizzes, demonstrations, English practice, watching English learning videos, which were then practiced in front of the class, presentations in English, group discussions, and questions and answers to be the most interesting methods and strategies to be applied in English for mathematics course.

Moreover, a summary of the responses provided by the students to question number 11 can be found in Figure 9 below.

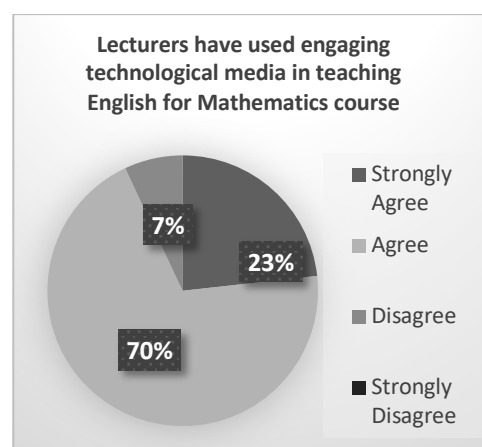


Figure 9. A Summary of Student Answers to Question No. 11

As illustrated in Figure 8, a majority of respondents (93.1%) indicated that they strongly agree or agree with the assertion that lecturers have employed engaging technological media in the instruction of English for mathematics course. Conversely,

a minority of respondents (6.9%) expressed disagreement or strong disagreement with this assertion.

In question 12, which is an open-ended inquiry, respondents were asked to identify the technological media they found most engaging for learning English for mathematics course. Students indicated that they found English language mathematics learning videos, quizzes, game-based learning websites, interactive PowerPoints, Kahoot, and Educaplay to be particularly engaging.

A summary of the responses to question 13 is provided in Figure 10 below.



Figure 10. A Summary of Student Answers to Question No. 13

As illustrated in Figure 10, 72.1% of respondents indicated that they had engaged in project-based work as a course assessment, while 27.9% reported that they had not.

In question 14, which was posed in the form of an open question, students were asked to describe the types of projects they had completed during the course. The students indicated that the projects assigned in English for mathematics course were either individual or group presentations utilizing PowerPoint, delivered directly in class. Additionally, some students presented their

projects through learning videos. Presentations are conducted in the most creative manner possible, utilizing both interactive and animated videos. The application of video production can foster enhanced student self-assurance in English communication abilities and even augment their understanding of video editing (Arif, 2022). Furthermore, if the project is anchored in project-based learning, wherein the learning environment is structured around the constructivist theory that students can achieve a profound comprehension of the subject matter through experiential engagement and the application of their conceptualizations (Krajcik & Blumenfeld, 2006), students will exhibit positive affective benefits and notable advancement in content knowledge and cognitive abilities.

In question 15, an open-ended inquiry is posed: "Please describe your experience with preparing projects, including the advantages and obstacles encountered." It is well documented that students perceive benefits and challenges associated with project-based assignments. The benefits perceived by students include an expansion of their vocabulary in English, encompassing both symbols and mathematical language, as well as the acquisition of accurate pronunciation and the opportunity to hone their public speaking abilities in English. This is consistent with Sumarmo's perspective that when students are provided with encouragement to construct knowledge through their academic assignments, it will foster the development of independent learning skills (Sumarmo, 2004). Moreover, students perceive a positive impact from engaging in independent learning by investigating diverse sources pertaining to the project material to be compiled (Kokotsaki et al., 2014).

At the conclusion of the student needs analysis questionnaire, students proffer comments and suggestions. They tend to gravitate towards learning methods that employ English for mathematics learning media that is interactive, creative, and tailored to the modern era. Moreover, students express a desire to enhance their mathematical and English language learning, with a particular focus on developing their vocabulary and mastering the correct pronunciation of English words. The integration of technology into the classroom setting offers advantages for both educators and students (Ariyanti & Yunus, 2023). The use of interactive English for mathematics learning media provides educators with the opportunity to enhance learning outcomes by developing effective learning techniques. Similarly, it is anticipated that students will be able to more effectively and efficiently assimilate information through the use of interactive English learning media. The ongoing advancement of media technology will facilitate students' access to knowledge in a convenient manner (Annisa et al., 2018).

CONCLUSION

A needs analysis of students and lecturers revealed the necessity for English teaching materials for mathematics that cover the entire PjBL process, from initial planning and data collection to data processing and reporting. These materials should include control cards to monitor student projects and assessment rubrics tailored to each stage of learning. The PjBL-based teaching materials required by students and lecturers should be comprehensive and contain school-level mathematics content. Moreover, the materials need to be equipped with exercises, problem-solving tasks, and eight teaching skills, and should be integrated with interactive learning media to facilitate students' mastery of

English vocabulary and pronunciation, as well as practice in public speaking about mathematics in English. Based on these findings, it is recommended that further research be conducted to develop and validate such teaching materials using a research and development (R&D) approach. By developing teaching materials that align with the needs of students and lecturers based on the components mentioned above, this will facilitate both lecturers and students in understanding the concepts and application of Project-Based Learning (PjBL) in the course of English for Mathematics.

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