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# THE EFFECTIVENESS OF ENGLISH TEACHING MATERIALS BASED ON CONTENT AND LANGUAGE-INTEGRATED LEARNING (CLIL) TO INCREASE THE TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) OF PROSPECTIVE BIOLOGY TEACHERS

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**Abstract:** This study aims to examine the use of English in the Biology handbook through a learning approach based on Content Language Integrated Learning (CLIL) to increase the Technological Pedagogical Content Knowledge (TPACK) for prospective teacher students in the Biology Education Study Program at the University of Mataram. This research was conducted using a quasi-experimental approach with multiple group pre-test and post-test patterns. The test subjects and units of analysis were all second-semester students taking English for Biology courses at the FKIP Biology Education Study Program in the 2021/2022 academic year consisting of 6 classes, namely A, B, C, D, E, and F. TPACK data were analyzed using the N-gain. The N-gain test is used to measure the difference between the post-test and the pre-test. Based on the results of data analysis, it is known that there is an increase in students' TPACK ability to get N-gain values of 91%, 56%, 67%, 64%, 66%, and 61% for classes A, B, C, D, E, and F. The average value of N-gain for TPACK of biology education students is 68, which is quite effective. Therefore, it can be concluded that the English handbook through a CLIL-based learning approach contributes quite effectively to increasing the TPACK of prospective Biology teacher students.

**Keywords:** *Teaching Materials, CLIL, TPACK, Students.*

## INTRODUCTION

Technology cannot be separated from life today. Learning has shifted from traditional knowledge to learning based on technological developments. Therefore, as the spearhead of education, teachers are required to have competence in many fields. Teachers should update students' learning processes by utilizing all the capabilities and potential of technology.

The opposite shows that the ability of teachers to design competency development plans is a serious challenge faced by the world of education in Indonesia in a global context, especially in the aspect of Technological Pedagogical Content Knowledge (TPACK). TPACK is knowledge about integrating technology and pedagogy in developing content in education. The integration between technology and science is expected to bring change to the world of education [1]. This approach is also expected to provide new directions for educators on applying technology in learning so that learning activities can run effectively and efficiently. Reflecting on this, the education system in Indonesia needs to prepare human resources who have knowledge and skills in using technology to improve the quality of professionalism and competence of teaching staff [2].

Professional teaching staff must have adequate TPACK competence due to the realm of competence, especially pedagogic competence and professional competence. Preparing professional teachers should start when they are still prospective teacher students [3]. Future teacher students must be equipped with teaching methods, use information and computer technology (ICT), strengthen mastery of scientific content, and learn how students think and learn [4].

Students and teachers need to learn in a complex way so that they are not only mastered in theory but also as a whole. Complex learning includes integrating knowledge, skills, and attitudes; coordinating various skills in a quality manner; and applying the knowledge they know in everyday life [5]. In the teaching process, more than teachers are needed to transfer knowledge but must also integrate all the competencies they have. In university, student teacher candidates learn a lot about theory in education to prepare them to become teachers.

Based on the description above, it is necessary to research whether using CLIL-based English Textbooks can increase the TPACK of prospective teacher students in the Biology Education Study Program, FKIP University of Mataram.

## RESEARCH METHOD

This study was designed to examine the utilization of products resulting from the development of previous research, namely the English for Biology handbook, to improve the TPACK of prospective Biology teacher students at the Faculty of Teacher Training and Education, University of Mataram. The research was conducted using a quasi-experimental approach with multiple group pretest-posttest patterns [6]. The test subjects and units of analysis were all second (even) semester

students, with a total of 180 students taking English for Biology courses at the FKIP Biology Education Study Program in the 2021/2022 academic year. There are approximately 176 students who actively participate in lectures from the beginning to the end of the semester and become the sample units in analyzing this research data.

The research data was collected using a rubric developed by the research team to assess individual students' learning video projects. Data collection was carried out using the pre-test and post-test techniques. The first TPACK data was analyzed from videos (Video 1) made by students individually in the fourth week of the first month of lectures. The first video score is taken as the pre-test score. Furthermore, the post-test scores were taken from Video 2, which is in the 10th week as the second student's project score. Data on increasing student acquisition for the TPACK variable or data on the type of instrument were analyzed by calculating the normalized gain as proposed by Hake [7 as follows:

$$g = \frac{Spost - Spre}{Smax - Spre} x100\%$$

Description:

| | | |
|---|---|---|
| G | = | N-gain |
| Spost | = | Post-test score |
| Spre | = | Pre-test score |
| Smax | = | The maximum score of questions |

The results of the calculation of the N-gain test are then categorized in the criteria in Table 2.1.

Table 1. N-gain Assessment Criteria

| Percentage | Criteria |
|---|---|
| <40 | Not Effective |
| 40 – 55 | Less Effective |
| 56 – 75 | Quite Effective |
| >76 | Effective |

## RESULT AND DISCUSSION

CLIL is an important and useful approach for students to develop communication skills [8]. Meanwhile, Technological Pedagogical Content Knowledge (TPACK) is an intellectual model that supports prospective teachers and educators to conduct learning research in their field, develop professionalism on an ongoing basis, and utilize relevant technology in the learning they teach [9].

The English for Biology textbook used as a learning resource and tested for the effectiveness of its implementation in this study consists of 6 chapters. Each chapter is equipped with competencies and learning objectives, two or more sections, review sections, supporting video links, and information about assignments that students must do. The description of the material in each section is adapted from various Biology learning sources with English presentations. The availability of teaching materials like this is implemented with the CLIL approach and is assumed to increase student learning activities and increase the TPACK of prospective teacher students [10].

English for Biology teaching materials has been developed by Pérez & Malagón[11-12], which suggests steps that include: 1) choosing the suitable topic material and determining the field of study material and relevant English material, 2) identifying and selecting the right learning resources such as types of textbooks, audio, video, and the like, 3) organizing and adapting the material, 4) deciding on the types of learning activities and elaborating activities, 5) developing tools for evaluating English proficiency and mastery of subject matter, as well as other instruments needed.

Obtaining the average score of the Pre-Test, Post-Test and N-gain can be seen in Table 3.1.

Table 2. TPACK Capability Data

| Aspects | Research Classes | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | | B | | C | | D | | E | | F | |
| | Pre-Test | Post-Test | Pre-Test | Post-Test | Pre-Test | Post-Test | Pre-Test | Post-Test | Pre-Test | Post-Test | Pre-Test | Post-Test |
| N | 24 | 24 | 18 | 18 | 19 | 19 | 13 | 13 | 12 | 12 | 13 | 13 |
| $\bar{X}$ | 3 | 87 | 49 | 78 | 14 | 72 | 5 | 66 | 5 | 68 | 3 | 63 |
| SD | 0.78 | 0.55 | 0.85 | 0,85 | 0.88 | 0.88 | 0.90 | 0.90 | 1.46 | 1.46 | 0.95 | 0.95 |
| <g> | 91% | | 56% | | 67% | | 64% | | 66% | | 61% | |

Description: N = number of students, $\bar{X}$ = Average, SD = Standard Deviation, <g> = N-gain

Normalized gain data analysis was carried out to see differences in the increase in TPACK abilities before and after using the CLIL-based English teaching materials (Heras, Lasagabaster, 2015)13. The table above shows an increase in students' TPACK abilities with effective and quite effective improvement categories. Of the five classes, one class is in the effective category, and the other five are in the quite effective category. The N-gain value for class A is 91 with the effective

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category. The N-gain values for classes B, C, D, E, and F are 56, 67, 64, 66, and 61, with the quite effective category. It shows that using CLIL-based English teaching materials effectively improves the TPACK abilities of Biology Education students with an average N-gain of 68. The average N-gain score for biology education students' TPACK mastery can be seen in Figures 1.

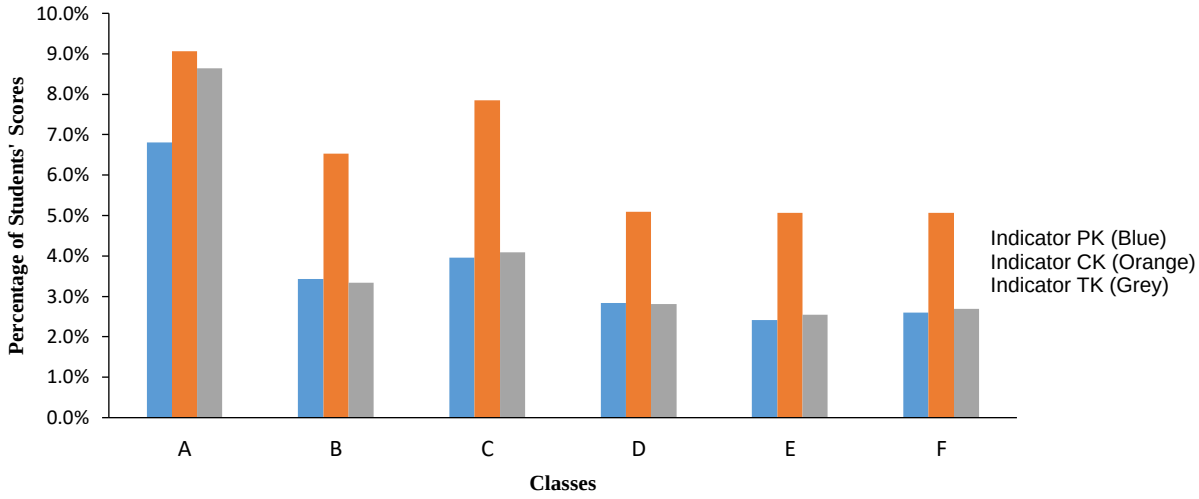


Figure 1. The average value of the indicators for TPACK

The concept in TPACK emphasizes the relationship between subject matter, technology, and pedagogy. The interaction between the three components has the power and appeal to foster active learning and focus on students. It can be interpreted as a form of teacher-centered to student-centered learning. TPACK emphasizes the relationship between technology, curriculum content, and pedagogical approaches that interact with each other to produce Information and Communication Technology (ICT) -based learning. In the TPACK scheme using the English for Biology textbook, there is a relationship between the constituent components, which overlap between Content (C), Pedagogy (P), and Technology (T) which influence the learning context. The components focused on in this study are Pedagogical Knowledge (PK), Content Knowledge (CK), Technological Knowledge (TK), and Technological Pedagogical Content Knowledge (TAPCK) [14-17].

The Technological Knowledge (TK) indicator includes students' ability to adapt and learn the latest technology. These abilities need to be owned by prospective teacher students due to the developments and changes in technology that continue to develop. It shows from the data that class A has 6,8% of Technological knowledge and class E has the lowest Technological knowledge at 2,4% over six classes. In this study, students' Technological knowledge was seen from students learning videos every week.

Pedagogical Knowledge (PK) indicator is a teaching process involving methods including classroom management knowledge, giving judgment, developing a plan for learning, and student learning processes. The data shows that class A has the highest score percentage of Pedagogical Knowledge, which is 9,1%, followed by class C at 7,8%, class B at 6,5%, and class D, E, and F at 5,1%. Therefore, the prospective Biology teachers' motivation through the material in the English for Biology handbook develops from students' critical thinking about the concept of biology.

Content Knowledge (CK) is knowledge of the subjects to be studied. A teacher is expected to master this ability in the teaching and learning process. Content knowledge is also important because this ability determines the distinctive way of thinking about scientific disciplines in each of its studies. Data analysis results for the six classes obtained the highest results in class A, 8.6%, and the lowest in class E, 2.5%. It shows that the Content Knowledge of Biology teacher candidates increases after studying English in the Biology handbook for one semester.

The result of increasing the highest indicator in the six classes is the Pedagogical Knowledge (PK) indicator, namely the ability to master pedagogical material with an average of 6.4%. The average for the Technological Knowledge (TK) indicator is 3.7%, and for Content Knowledge (CK), it is 4.0%. This result indicates that the implementation of CLIL-based English for Biology learning is effectively used to improve TPACK abilities, especially in improving the pedagogical abilities of Biology Education students.

Technology-based learning approaches develop TPACK competencies of future

mathematics teachers and transform knowledge in integrating technology into teaching practice mathematics after training in technology-based learning [18-22]. The results of Muhtadi's research show that the technology-based learning approach can effectively improve teachers' math TPACK competencies.

## CONCLUSION

This study was expected to provide new directions for educators on how to apply technology to run teaching and learning activities effectively and efficiently. Reflecting on this, the result of increasing the highest indicator in the six classes is the Pedagogical Knowledge (PK) indicator, which is the student's ability to master pedagogical material with an average of 6.4%. The average for the Technological Knowledge (TK) indicator is 3.7%, and for Content Knowledge (CK), it is 4.0%. Therefore, using English for Biology Textbooks as teaching materials through a learning approach based on Content Language Integrated Learning (CLIL) contributes quite effectively to increasing Technological Pedagogical Content Knowledge (TPACK). Especially in the Pedagogical Knowledge (PK) for prospective teacher students at the Biology Education Study Program, FKIP University of Mataram.

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