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Enhancing the Quality of Learning Through Training in PBL and TPACK-Based Teaching Module

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Abstract: The goal of the PKM activity is to enhance the quality of learning through intensive training in the creation of teaching modules that integrate the concepts of PBL with the application of TPACK. This reflects the urgency of the teacher's role in adapting the learning approach to the current developments and preparing students to face future challenges. Focusing on the improvement of learning quality provides insights into the importance of integrating PBL and TPACK in innovative and relevant modern learning. The implementation method involves knowledge transfer and the Community Development Model through synchronous and asynchronous online activities. The partners in this activity are students of the PPG Daljab Biology Class of 2023 from the Mandalika University of Education. The activity is carried out for a total of 3 meetings. The results of the activity show that the partners' participation is very active, and there is a significant impact of the training on the partners' understanding of the PBL model and the TPACK approach, as well as their integration into teaching modules.

Keywords: *PBL, TPACK, Teching Module*

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INTRODUCTION

The ongoing evolution of education, understanding of innovative teaching methodologies, and technological advancements have become crucial aspects. The current primary focus is on efforts to strengthen the quality of learning, with two key elements receiving special attention: Problem-Based Learning (PBL) and Technological Pedagogical Content Knowledge (TPACK). These approaches, rooted in research and pedagogical frameworks, capture attention due to their potential to revolutionize the world of education.

Education in the modern era demands a paradigm shift in teaching methods to equip students with relevant skills for future challenges. Recognition of Problem-Based Learning (PBL) as an approach capable of developing analytical, collaborative, and problem-solving skills in students has already been acknowledged (Mirawati et al., 2017; Suaedin et al., 2014).

However, the success of PBL in delivering quality learning greatly depends on the use of technology, conceptual understanding, and the pedagogical approach of teachers in designing and implementing learning modules.

TPACK (Technological Pedagogical Content Knowledge) serves as a framework that integrates technological, pedagogical, and content knowledge as the foundation for technology-based learning development. In the context of teaching PBL, the integration of TPACK becomes crucial as it involves using technology as a tool to pedagogically deliver content to students.

The importance of enhancing the quality of learning through PBL module training with a TPACK approach is increasingly evident, considering the challenges of dynamic curriculum needs, student diversity, and rapid technological advancements. Teachers, as key actors in the learning process, need adequate training to design PBL modules that not only focus on content but also intelligently integrate technology and employ appropriate pedagogical approaches.

Strengthening the quality of learning through training on Problem-Based Learning (PBL) and Technological Pedagogical Content Knowledge (TPACK) teaching modules is a crucial aspect in education development. TPACK is a framework that illustrates the knowledge teachers need to integrate technology in designing, implementing, and evaluating learning (Mishra & Koehler, 2006). A study by Loseñara & Jugar (2023) emphasizes the importance of enhancing teachers' TPACK through tailored Professional Teacher Development (PPG) to strengthen biology education and maximize learning. Additionally, Setiawan et al. (2022) provide a brief overview of TPACK, highlighting its significance in effective teaching. Imelda (2019) underscores the need for appropriate modules to implement the PBL model aimed at improving students' mathematical communication skills, supported by Dakabesi & Luoise (2019), who propose the use of PBL-based modules to enhance Higher Order Thinking Skills (HOTS) in subjects like linear equations.

Research by Septriani et al. (2018) indicates the effectiveness of the PBL model in improving students' understanding, motivation, and critical thinking skills. Similarly, Prasetyo Wati et al. (2022) emphasize that PBL aims to develop students' self-directed learning, inquiry, and problem-solving skills. The further relevance of TPACK is emphasized by Hmelo-Silver (2004), discussing the importance of TPACK in supporting distance learning for optimal educational outcomes. Moreover, Khan & Amin (2021) investigate student learning outcomes through PBL, highlighting the effectiveness of this approach. Additionally, Mariette (2022) discusses how PBL challenges traditional assessment approaches, indicating its potential to revolutionize education.

The synthesis of these references underscores the importance of PBL and TPACK in enhancing the quality of learning. PBL models not only improve students' critical thinking and problem-solving skills but also foster independent learning, while TPACK plays a crucial role in integrating technology for effective teaching and learning processes.

Enhancing the quality of learning through PBL module training with a TPACK approach becomes essential considering the challenges posed by dynamic curriculum needs, student diversity, and rapid technological

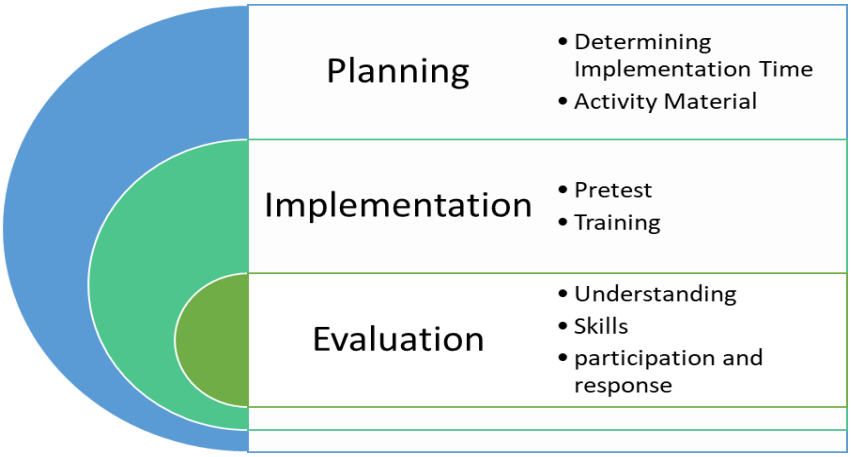
developments. Teachers, as the main actors in the learning process, need adequate training to design PBL modules that not only focus on content but also intelligently integrate technology and employ the right pedagogical approach.

The initial study results show that the second cohort of Biology PPG students has an understanding of Problem-Based Learning (PBL) and Technological Pedagogical Content Knowledge (TPACK). However, it is regrettable that students have not reached a sufficient level of proficiency in effectively integrating both concepts in the process of developing learning modules. This condition serves as the basis for community service.

Based on this study, the goal of this community service is to strengthen the quality of learning through training on PBL-based teaching modules with a TPACK approach. This effort aims to enhance teachers' competence in integrating technology, pedagogy, and content to make learning more relevant, interactive, and effective in preparing students for future demands.

METHOD

This Community Service Activity (PKM) is carried out using the knowledge transfer method and the Community Development Model, which is an approach that involves partners directly as both objects and subjects in the implementation of PKM (Asy'ari et al., 2022). The activities are conducted through both synchronous and asynchronous online methods. The partners in the PKM activity are students of the 2nd Batch of Biology Daljab PPG at the Mandalika University of Education, totaling 29 individuals. The PKM process is divided into three stages: Planning, Implementation, and Evaluation. The stages are presented in a flowchart as follows.



Picture 1. Implementation Diagram of Community Service Program (PKM)

1. Planning activities include determining the schedule, location, and resource needs for the implementation of the Community Service Program (PKM).
2. Implementation. This activity includes: a) conducting pre-tests before the training to measure the participants' understanding of the training material to be presented, b) delivering training materials covering the concepts of Problem-Based Learning (PBL), Technological Pedagogical

Content Knowledge (TPACK), and how to develop teaching modules based on both, c) Developing Teaching Modules.

3. Evaluation. Training evaluation has several main objectives to assess the effectiveness, success, response, and impact of the training program. This evaluation helps ensure that training and the development of teaching modules are not just one-time activities but can contribute significantly to the long-term improvement of learning quality. The effectiveness of the activity is evaluated using understanding instruments and observation sheets for skills in creating teaching modules, while responses are evaluated using questionnaire instruments. The data obtained are analyzed using SPSS.

The general goal of Community Service is to improve the quality of learning through training in teaching modules based on Problem-Based Learning (PBL) and Technological Pedagogical Content Knowledge (TPACK) to support the development of students' problem-solving skills and effective technology utilization. The success indicators of this activity are:

1. Increased Participation of PPG Students. The percentage of teachers actively participating in training on PBL and TPACK-based teaching modules.
2. Improved understanding and skills of teachers in developing PBL and TPACK-based Teaching Modules.

By achieving these success indicators, it is expected that this community service activity can have a positive impact on strengthening the quality of learning, promoting innovation in teaching approaches, and improving student learning outcomes.

RESULTS AND DISCUSSION

The Community Service activity, in general, is declared successful based on indicators such as active participation of PPG students in training activities and an improvement in the understanding and skills of PPG students in developing PBL-based Teaching Modules and TPACK. The detailed results are outlined as follows:

A. Partner participation during the activity.

Partner participation is evaluated using a questionnaire instrument consisting of 10 indicators. The results of the analysis are presented in table 1 below.

Table 1. Average value of partner participation during training activities

No	Training Participant Activity Indicators	Average Value	Category
1	Participation in Discussions	85	Very Active
2	Attendance in Training Sessions	100	Very Active
3	Engagement in Practical Activities	90	Very Active
4	Submission of Questions and Request for Clarifications	80	Very Active
5	Utilization of Additional Learning Resources	95	Very Active
6	Online Activities Outside Training Sessions	90	Very Active

No	Training Participant Activity Indicators	Average Value	Category
7	Participation in Structured Assignments	90	Very Active
8	Willingness to Share Experiences	100	Very Active
9	Engagement in Participant Collaboration	90	Very Active
10	Self-Evaluation and Reflection	95	Very Active

The training participants demonstrated a high level of engagement throughout the program, as reflected in the consistently high average scores on each indicator. During discussions, participants not only actively participated but also provided valuable contributions, effectively supporting group interactions. Full attendance in every training session reflects a strong commitment to the learning activities. Additionally, participants showed significant involvement in practical activities, such as designing teaching modules and learning simulations, demonstrating a solid understanding and application of concepts.

Although the scores for asking questions and requesting explanations were slightly below average, participants still exhibited curiosity and a desire to deepen their understanding of concepts. The utilization of additional learning resources achieved high scores, indicating participants' initiative to expand their understanding beyond the main training materials. Online activities outside of the training sessions were also quite high, signaling sustained participation in the virtual environment.

Participants successfully completed structured tasks, showcasing their understanding and application of concepts in real-world contexts. Their willingness to share personal experiences contributed valuable insights to collective understanding. Engagement in collaborative activities and active self-evaluation indicates participants' awareness of their personal development throughout the training.

Overall, this excellent level of engagement instills confidence that training participants can effectively apply PBL and TPACK concepts in their learning contexts, positively impacting the quality of education.

B. Increased understanding of PBL and TPACK-based Teaching Modules

Improvement in understanding of PBL (Problem-Based Learning) and TPACK (Technological Pedagogical Content Knowledge) based Teaching Modules can be measured by comparing the average pretest and post-test scores, as well as observing changes in the standard deviation. Prior to the training, participants had an average pretest score of 51.3448 with a standard deviation of 6.44912. This indicates that the initial understanding levels of the participants had significant variability.

After undergoing the training, there was a significant increase in participants' understanding, as evidenced by the post-test average score reaching 81.9310. Such an increase reflects the positive impact of the training on participants' understanding of PBL and TPACK-based Teaching Modules. Moreover, the increased standard deviation, now at 8.63932, indicates that after the training, there is a wider variation in participants' understanding of the material. This may be attributed to the influence of diverse backgrounds or participants' initial levels of understanding.

This significant improvement in understanding can be interpreted as a success of the training in positively impacting participants' knowledge enhancement regarding the concepts of PBL and TPACK. The increase in standard deviation also suggests that the training successfully targeted participants with diverse levels of understanding, resulting in a more even comprehension among them. Thus, these results provide an overview that PBL and TPACK-based Teaching Module training is effective in enhancing participants' understanding by addressing various levels of comprehension and backgrounds. In summary, the analysis results are presented in Table 2 below:

Table 2. Pretest and posttest analysis results

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	51.3448	29	6.44912	1.19757
	Posttest	81.9310	29	8.63932	1.60428

The strengthening of learning quality can be achieved through training modules based on Problem-Based Learning (PBL) and Technological Pedagogical Content Knowledge (TPACK). PBL, with a focus on problem-solving, enables students to develop critical and analytical skills. TPACK, the combination of content knowledge, pedagogy, and technology, ensures that teachers can effectively integrate technology into teaching.

The combination of PBL and TPACK provides significant benefits, enhancing student engagement and motivating them towards deeper understanding (Koehler & Mishra, 2005). The integration of PBL and TPACK is particularly effective in increasing student activities and improving students' understanding of the taught content. The creation of PBL and TPACK-based teaching modules involves designing authentic problems and utilizing appropriate technology. Teachers need to be empowered through training to design and implement optimal learning experiences.

An evaluation system involving formative and summative assessments is used to measure the success of learning. Feedback from students and teachers assists in continuous improvement of teaching modules and learning strategies. PBL and TPACK also empower students to learn independently and develop initiative, creating a contextual and relevant learning environment in the era of information technology.

Table 3. Paired Samples Test -Training Impact Analysis

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest-Postest	-30.58621	10.53402	1.95612	-34.59313	-26.57928	-15.636	28	.000

After the training, there was a significant change in the measured variables, with an average difference of about -30.59 and a standard deviation of approximately 10.53. The standard error of the mean for the average difference is around 1.96. The 95% confidence interval for the difference between the Before Training and After Training conditions is between -34.59 and -26.58. A large t-value (-15.636) with 28 degrees of freedom indicates very

low statistical significance (Sig. = 0.000), implying that the difference between the Before Training and After Training conditions is highly statistically significant. These results indicate a significant impact of the training on partners' understanding levels of the PBL Model and TPACK approach, as well as their integration into teaching modules.

In-depth analysis results reveal a significant positive impact of the training on the measured variables, particularly on partners' understanding levels of the PBL Model and TPACK approach, and their integration into open modules. The observed average difference of -30.59 signifies a substantial improvement from the pre-training condition. A standard deviation of 10.53 reflects the variability in partners' responses to the training, indicating diversity in the enhancement of understanding.

Furthermore, the standard error of the mean for the average difference at around 1.96 indicates the precision of this difference, providing confidence that the observed improvement is reliable. The 95% confidence interval for the difference between conditions before and after training, ranging from -34.59 to -26.58, is shown with 95% confidence, suggesting that the actual difference between the two conditions on average falls within this range.

Moreover, the large t-value (-15.636) with 28 degrees of freedom indicates very low statistical significance (Sig. = 0.000). This value implies that the difference between the Before Training and After Training conditions is highly statistically significant. In other words, the analysis results suggest that the change in partners' understanding levels after training did not occur by chance but as a result of the training intervention.

With these findings, it can be concluded that PBL and TPACK-based teaching module training effectively enhances partners' understanding of the PBL Model and TPACK approach, along with their ability to integrate them into teaching modules. These results have a positive impact on the quality of learning, providing a strong foundation for further desires and developments related to strengthening skills and understanding in the context of PBL and TPACK-based learning.

CONCLUSION

The Community Service Activity has successfully demonstrated its effectiveness through the active participation of PPG students in training and the enhancement of their understanding and skills in developing PBL and TPACK-based Teaching Modules. Evaluation of partner participation, using a questionnaire with 10 indicators, indicated very high average scores, reaching the category of highly active involvement. This was observed in aspects such as participation in discussions, attendance in training sessions, and engagement in practical activities. Furthermore, the analysis of pretest and post-test results revealed a significant improvement in understanding, with the average post-test score reaching 81.9310 compared to the pretest score of 51.3448. With an increased standard deviation of 8.63932, this outcome suggests that the training successfully targeted participants with diverse levels of understanding, resulting in a more uniform comprehension among them. The Paired Samples Test analysis validated the positive impact of the training with high statistical significance (Sig. = 0.000). Cumulatively, these findings indicate that the Community Service Activity has made a substantial

positive contribution to improving the quality of learning by reinforcing understanding and skills in developing PBL and TPACK-based Teaching Modules.

RECOMMENDATIONS

Based on the conclusions drawn from the Community Engagement activity, it is recommended to strengthen the involvement of partners in the planning of training to ensure greater relevance and more effective implementation. Regular monitoring and evaluation are also crucial to identify areas for improvement and ensure the continuous enhancement of the quality of learning. The empowerment of PPG students can be enhanced through increased access to additional learning resources. Furthermore, it is recommended to conduct further research to measure the long-term impact of this training on the improvement of learning quality in the field. By implementing these recommendations, it is anticipated that the Community Engagement activity will continue to deliver positive and sustainable impacts for both partners and PPG students

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