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Implementation of Biology Teaching Materials Based on Problem-Based Learning for PPG Students at Manado State University

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ABSTRACT

This research aims to analyze the results of implementing biology learning tools using the problem-based learning (PBL) model for PPG Daljab students at Manado State University. The learning tools used result from a development process that meets the valid, practical, and effective criteria. This research used a qualitative approach, with a sample size of 10 PPG students registered in the biology education study program at Manado State University in 2023/2024. Data was collected through Teaching Module data, Interviews, and Learning Videos. Data analysis uses method triangulation, data presentation, interpretation, data reduction, coding, and categorization to conclude. Based on the examination of research data, PPG Daljab students have succeeded in developing biology learning tools, including CP, ATP, and teaching modules, which are classified as very good. The assessment instrument (THB) is classified as being in the excellent group. Based on these findings, it is recommended that PPG Daljab students improve their skills in formulating biology questions that are relevant to students' daily experiences (practical) and in line with PISA questions.

Keywords: ATP, Biology Learning, PPG Daljab, Problem-Based Learning, Teaching Module

INTRODUCTION

The Professional Teacher Teaching Program (PPG) offers postgraduate teaching after completing a Bachelor's degree. The main aim of implementing PPG is to produce teaching staff who can overcome educational challenges effectively and produce innovative learning approaches (Suryadi, 2019). After thoroughly studying the material, PPG program students are tasked with creating a document that outlines the learning design (Surata et al., 2024). Currently, PPG students undergoing in-service training write learning design documents that only focus on Teaching Modules and evaluation instruments before they start teaching responsibilities (Fauzan & Arifin, 2022). Teaching materials such as learning tools and media are rarely used and are sometimes only borrowed from existing sources. Consequently, there needs to be learning that is more focused on individual students because the choice of methodology and learning model in creating learning materials is currently inappropriate (Rahayu et al., 2019). The impacts include increasing the need for children to engage in physical activity and develop their critical thinking skills. According to the findings of Prasetiyo and Rosy (2021), student-centered learning facilitates the achievement of educational goals and increases students' understanding of topics and critical thinking skills. Another point of view states that student-centered learning requires active engagement and critical thinking to improve student learning outcomes, including their technical and interpersonal skills. Learning is dynamic, creative, and situational (Febrita & Harni, 2020). According to Darwati and Purana (2021), students are dynamic, gain knowledge through practical application, and overcome challenges effectively.

In the PPG curriculum, students engage in a process where they first identify a problem and then plan action strategically. This process aims to produce a learning design document as an alternative solution to the identified difficulties. The analysis is necessary to produce various components, such as teaching materials, LKPD, and learning media (Pawestri & Zulfiati, 2020). This analysis focuses on the curriculum, materials, objectives, and learning models, considering the learning difficulties faced. It also ensures that the necessary facilities are available for implementation and that teachers can implement them (Farhana, 2023).

When creating learning tools, such as LKPD or biology learning media, it is essential to consider the unique characteristics of the biology material and the students. Biology material is characterized by its abstract nature and deductive approach, which can result in teachers providing predetermined theories to students without fully understanding the concepts underlying the subject matter (Sari, 2016). According to Yaumi (2017), learning design principles involve a systematic problem-solving process to improve learning and evaluation. These principles focus on student-centered learning, effective and efficient design to achieve goals, and ensuring alignment between learning objectives and evaluation. Therefore, when designing learning design documents, it is essential to consider students' attributes, which include their development from the natural, partially real, to the conceptual stages. Bruner (Sundari & Fauziati, 2021) suggests that children's cognitive development can be divided into three stages. The first stage is the active stage, where children learn concepts by taking action and connecting them with events around them. The second stage is the iconic stage, where children summarize information by creating mental images. The final stage is the symbolic stage, where children understand and manipulate symbols or explanations. When writing a mathematics learning design paper for middle school, high school, or equivalent, you can consider using problem-based learning (PBL) with a scientific approach as a suitable learning model (Fahlevi, 2022).

The main goal of Problem-Based Learning (PBL) is to introduce students to conducting investigations, encourage collaborative conversations, provide authentic, real-world experiences, and encourage the development of independent learning skills and confidence in their intellectual abilities (Faridatunnisa, 2015). PPG Daljab students should familiarize themselves with this learning model by looking for learning resources outside mathematics textbooks that suit the students' characteristics. Additionally, they should consult newly published journals to access research findings that can be utilized or to gain new insights from the journal's educational resources (Dewi et al., 2024).

Apart from choosing the right learning paradigm, students need to receive literacy learning, 4C thinking (creative, critical, collaborative, and communication), and High Order Thinking Skills (HOTS) using appropriate biological material (Mu'minah, 2021). Selecting educational materials that align with students' daily experiences and encounters can facilitate understanding of biological ideas and, at the same time, foster scientific literacy, critical thinking (4C), and higher-order thinking skills (HOTS). This point of view emphasizes that literacy includes more than just reading and writing. Apart from that, it includes scientific literacy, information technology literacy, and financial literacy (Pramusinta & Faizah, 2022). 4C thinking is a cognitive approach that equips individuals to navigate the increasingly complex challenges of contemporary life and work, enabling them to compete effectively in society (Umayah & Riwanto, 2020; Mangelep et al., 2024).

To design the learning process effectively, combining the PBL learning model, student characteristics, biological knowledge material, technology, student character, and GPA is essential. Learning objectives based on KD should be included in learning design documents, such as Teaching Modules, learning media, Student Worksheets (LKPD), and evaluation instruments. This effort aims to improve literacy, 4C, and higher-order thinking skills (HOTS). Supervisors (DP) and Teachers (GP) accompany PPG Daljab students in developing learning design documents. Through problem identification and action planning activities, the problems and potential solutions formulated are aligned with the Learning Achievement (CP) analysis. Students enrolled in the PPG Daljab program can engage in asynchronous discussions using PPG Learning Management System discussion forums. They can also submit draft learning design documents simultaneously to receive input from Supervisors (DP) and Teachers (GP). Next, the completed learning design documents are uploaded to the Learning Management System (LMS) to undergo evaluation by the Instructor (DP) and the Lead Teacher (GP). This research examines the results of using biology learning resources using the problem-based learning (PBL) model for PPG Daljab students at Manado State University, as explained above.

METHODS

Qualitative research was conducted to analyze the application of a problem-based learning approach. Research participants are postgraduate students registered in the Mathematics Education Study Program at PGRI Madiun University in the 2023/2024 academic year. Eight students chose the Problem-Based Learning (PBL) learning approach and were selected as participants in this investigation. All participants are educators at the junior high or high school level.

Data was collected using the Teaching Module created by the subject to implement PPL cycle 1. Next, in-depth interviews were conducted to obtain complete and detailed information. Interviews were conducted using a semi-structured discussion method. Before continuing, students are asked to present their learning plans. In addition, data was collected through educational videos conducted by students.

The tools used in this research are learning design observation sheets, interview guidelines, and learning video observation guidelines. Teaching Module Observations mainly concentrate on the application of Problem-Based Learning (PBL) in the learning process. Interviews were conducted to explain and provide a comprehensive understanding of the actions and reasons behind each stage of the planned problem-based learning (PBL) activities. Learning observation videos mostly center on applying Problem-Based Learning (PBL) in the educational process.

The triangulation method was used to validate the data. The triangulation process was done by comparing teaching module observation findings, interviews, and learning video observations. The research results obtained from observing learning videos were considered more favorable than those obtained from teaching module observations and interviews. However, including learning design observations and interviews is necessary to ensure the data is comprehensive, extensive, and authentic. Data validation, or triangulation, is used to obtain accurate and reliable data.

Data analysis is carried out on valid data. Previously, the data underwent interpretation, reduction, coding, and categorization to make it easier to draw findings. Data reduction involves excluding data that is not related to the research problem. Coding is used to improve data traceability. Data classification is carried out according to the stages of PBL implementation. Analysis was carried out based on derived categories. Conclusions were obtained based on the analysis findings related to applying the PBL learning paradigm.

RESULTS AND DISCUSSION

To mitigate errors, an analysis of problem-based learning (PBL) in an educational context is needed. Careful attention to this is essential, especially for fellow PPG Daljab students. The following are some problems that usually arise when PBL is applied to biology learning by PPG Daljab students.

1. *During Student Orientation, the focus is on overcoming problems and challenges.*

Usually, the questions given by the teacher are at the most satisfactory standards. The only problem with using it is that the lighter needs to be more transparent. Teachers sometimes need to pay more attention to the importance of these early difficulties. The problems presented at this early stage must be of high quality. The problems used are real problems that exist in the real world. The problem presented should require consideration from many perspectives. Problems provide students with opportunities to gain knowledge in unfamiliar areas of learning. Teachers can discuss with their colleagues to obtain questions that meet these excellent criteria. Teachers can answer questions that meet the Higher Order Thinking Skills (HOTS) criteria. Teachers can consult with MGMP teachers before distributing them to children.

2. *At the stage of coordinating students for learning objectives.*

Participants have been organized in a way that eliminates any form of organization. This occurs due to the arrangement of seating in groups. Students have founded the organization since its inception. Students have founded the organization since its inception. Student groupings need to align with their learning needs. It requires a varied arrangement of students. Heterogeneous organization refers to a system in which individuals with varying intellectual abilities are distributed evenly, preventing the formation of exclusive groups consisting only of knowledgeable individuals and ensuring that individuals with lower intellectual abilities are not isolated from their colleagues. This is done to facilitate cognitive apprenticeship. Cognitive apprenticeship aims to facilitate discussion and enable individuals with higher intelligence to help people with lower intelligence. The group organization must be aligned with the imperative to address and resolve problems. Every student needs to be accountable for their learning process. Therefore, it depends on more than one or a small number of individuals.

3. *At the stage of directing individual and collective questions.*

Students do not conduct independent or collaborative investigations. The reason is that the LKPD offered does not facilitate students in carrying out independent or collaborative inquiry. LKPD should provide an invitation to students to carry out independent and collaborative studies. Investigations can be carried out in widely accepted ways, especially by reading books. Consequently, educators should compose texts that are relevant to the subject matter. This is important because it needs to instruct students to engage in reading explicitly. This learning strategy is used to build a culture of literacy. Investigations may be carried out through coercion or the use of educational resources. Students can utilize the latest software. Students can use teaching aids. Consequently, teachers must know the latest software.

4. *During the explanation and exhibition stages of the project*

Students themselves exhibit their work during class. Teachers may refrain from implementing further advances due to time constraints or concerns about needing more time. Students should process and exhibit their work. However, to achieve these results, participants must be aware and understand because they are tasked with carrying out the development process. More than just presenting the results of their work is required. Interrogating students after their presentations can facilitate the development process. Questions can be presented as quizzes or conversation questions. Questions should enhance and foster understanding related to student assignments.

5. *At the Analyzing and Evaluating Stage of the General Problem Solving Process*

In this step, the teacher's role is to involve students in the learning that has been carried out, regardless of whether the learning is enjoyable. Several educators asked about the challenges the participants had faced so far. The research findings evaluated the mathematics learning design documents CP 1 to CP 3 for PPG Daljab students at Manado State University, using a rubric with a scale ranging from 1 to CP. 5, presented in Table 1.

Table 1. Document Assessment Results for PBL-Based Biology Learning Tools

No.	Students	ATP	Teaching Module	LKPD	Media	Instrument	Total	Average	Score
1	I	5	5	5	4	4	22	4,4	88
2	II	4	4	4	4	4	21	4,2	84
3	III	4	4	4	4	4	21	4,2	84
4	IV	4	4	4	5	4	22	4,4	88
5	V	4	4	5	4	5	23	4,6	92
6	VI	4	4	4	5	4	22	4,4	88
7	VII	4	4	4	5	4	22	4,4	88
8	VIII	5	5	4	5	4	23	4,6	92
9	IX	4	4	4	4	4	20	4	80
10	X	4	4	5	4	4	21	4,2	84
Total		42	47	43	44	41	217	43,4	868
Average		4,2	4,7	4,3	4,4	4,1	21.7	4,34	86,8
Score		84	94	86	88	82	434	86,8	1736

Based on the research data and analysis, the average assessment of biology learning tools for PPG Daljab students at Manado State University is 86.8, including in the very good category.

PPG Daljab students demonstrated a high level of proficiency in creating Teaching Modules by obtaining an average score of 94 in the very good category. This aligns with the Teaching Module document that PPG Daljab students created. There is a match between CP (Learning Outcomes) and ATP (Learning Goal Flow). Learning resources that refer to relevant research findings are available. Apart from that, there is a description of teaching and learning activities that align with the Problem-Based Learning (PBL) stage and evaluations that align with learning objectives. Preparing the ATP element Teaching Module includes adjusting learning objectives with CP, selecting appropriate learning materials, utilizing learning media, using appropriate approaches, models, and methodologies, conducting evaluations, and allocating time based on the desired objectives (Sugi, 2019). The findings of this research strengthen the findings of Dharmayana and Alexon (2019) regarding workshops on preparing and developing learning tools at the Pre-Service PPG Study Program, FKIP, Bengkulu University. The overall assessment of the workshop was considered satisfactory, with an average score of 3.88, indicating a good level of quality.

Apart from that, when creating learning materials, the highest average score achieved was 86.8, so it was included in the "very good" category. It is vital to create learning aids that adhere to the principles of relevance, consistency, and sufficiency (Nana, 2019). The learning material created by PPG Daljab students consists of ATP components and learning objectives aligned with CP. The substance of the material is in line with the learning objectives, and the information presented adheres to the idea of sufficiency, meaning that it is enough to help students achieve the learning objectives. The findings of Zulfitri et al. (2019) confirm previous research, which showed that teacher proficiency in selecting and controlling educational resources was 91.66.

Furthermore, when preparing the LKPD, they obtained an average score of 86 and were included in the "very good" group. The LKPD (Student Worksheet) created by PPG Daljab students is equipped with ATP (Learning Objective Flow) features and learning objectives that are aligned with CP

(Learning Outcomes). The assignments are tailored to the student's specific environment and aligned with the chosen learning approach, encouraging the development of problem-solving, critical thinking, and advanced cognitive skills. The findings of this research strengthen the research findings of Astuti et al. (2018) regarding the progress of PBL-based LKPD with valid, practical, and effective results (Astuti., 2018), as well as Elfina & Syilvia (2020) regarding critical thinking training, and Yustianingsih et al. (2017) about improving problem-solving skills.

Moreover, when creating educational materials, the average score achieved is 88, which indicates high quality. The learning materials developed by PPG Daljab students consist of ATP elements and learning objectives aligned with CP. The information offered is tailored to students' specific situations to facilitate their understanding of the studied concepts. The content aligns with Problem-Based Learning (PBL) principles, which aim to foster students' learning independence, enjoyment, and enthusiasm and hone their communication and reasoning skills. This research reinforces Caesarani's (2018) research findings regarding the efficacy of interactive multimedia in encouraging independent learning and fostering enjoyment and enthusiasm among students. Apart from that, these results align with research conducted by Sartika (2017), which states that interactive learning media can be an alternative approach to increasing conceptual understanding and developing communication and reasoning skills.

Next, an average score of 82 was obtained in the "good" category at the instrument preparation stage. The evaluation tools PPG Daljab students developed to align with learning objectives. However, there needs to be improvements in the training of students on higher-order thinking Skills (HOTS) questions. The findings of this research confirm the findings of previous research (Susanto & Retnawati, 2016) regarding the efficacy of using problem-based learning (PBL) tools to improve students' higher-order thinking skills (HOTS), with a success rate exceeding 75%. The results of developing creative skills assessment tools can be categorized into validity and practicality. Additionally, there are apparent gaps in the creative abilities of students who utilize them.

CONCLUSION

Based on research data analysis, PPG Daljab students have successfully developed biology learning tools such as CP, ATP, and Teaching Modules with a very high level of proficiency. The assessment instrument (THB) is also classified in the "good" category. Based on these findings, it is recommended that PPG Daljab students improve their ability to produce biology questions that are relevant to students' daily experiences (practical) and in line with PISA questions.

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