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Development of Problem-Based Tools to Improve Thinking Abilities in In-Service PPG Program Students

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ABSTRACT

This research aims to develop problem-based learning tools that empower students' thinking abilities in the In-service Teacher Professional Education Program at Unima. The learning tools developed consist of modules and LKPD for the Biology Learning Tool Development course. The development model used is the ADDIE development model consisting of four stages, namely 1) analysis, 2) design, 3) development, 4) implementation, and 5) evaluation. The results of the research are the feasibility of the learning tools which are seen based on the aspects of validity, practicality, and effectiveness of the learning tools. Next, to see the effectiveness of problem-based learning tools on thinking ability using One Group Pretest-Posttest Design which was implemented on 29 PPG Daljab Category 1 students, class 3 of 2023. The results of the research show that the learning tools are very valid with an assessment score interval between 3.5-4 and reliability between 95%-98%. The learning implementation is categorized as very good with an assessment score interval between 3.6-4 with an average reliability of 97%, the average readability level of the device based on the Gunning Fox index is 11 with medium criteria, the readability percentage of the learning device based on the readability sheet of the learning device is 97% and students provide a positive response to learning tools was 98%. The increase in students' cognitive learning outcomes can be seen from the average N-gain value for all students, namely 0.68 with medium criteria, classical completeness of 100%, and indicator completeness with an interval of 2.5-3.5. Based on the results of this research, it can be concluded that problem-based

learning tools in the biology teaching tool development course are suitable for use to improve the thinking skills of students in the PPG Daljab Program at Unima.

Keywords: learning tools, problem-based, thinking skills

INTRODUCTION

Development in the 21st century has become an era of transformation in various areas of life, including in the world of education. Several skills are mentioned to prepare students to be able to compete and adapt in the 21st-century era. Yu Shu, et al (2020) stated that one of the abilities needed is the ability to think. The ability to think is the core of human cognitive processes that allow us to analyze, conclude, and solve problems. Thinking abilities cover various aspects ranging from critical to creative thinking, as well as the ability to solve problems effectively (Rengkuan et al, 2023). Critical thinking involves in-depth evaluation of information, identifying assumptions, and making judgments based on existing evidence. Meanwhile, it was reported by Chen, et al (2022) that creative thinking involves the ability to think of new and unconventional solutions, as well as seeing problems from different points of view. Apart from that, Rengkuan, et al (2022) stated that thinking skills also include the ability to analyze situations quickly, make the right decisions, and anticipate the consequences of actions taken. By developing the ability to think comprehensively, individuals can become more flexible in facing challenges, more innovative in creating solutions, and more effective in achieving their goals in their personal and professional lives.

The explanation above illustrates that the ability to think is very much needed in human life, especially students, in facing a better life. Thinking abilities can be formed through learning models that empower or facilitate these abilities. One learning model that empowers thinking skills is the problem-based learning model. The problem-based learning model is a student-centered learning model, where students are faced with a relevant problem and actively become problem solvers in the learning process. In problem-based learning, students are given real situations or problems with the learning content being studied. They are then expected to use the knowledge and skills they have learned to analyze, formulate solutions, and seek answers to the problem. This model allows students to develop a deeper understanding of the learning material because they must apply the concepts they learn in contexts that are meaningful to them. In addition, problem-based learning also promotes critical thinking, problem-solving, collaboration, and communication skills, because students often work in teams to solve problems. By introducing real-life situations into the classroom, problem-based learning not only increases students' motivation but also prepares them to face real-world challenges. Problem-based learning models can be developed in learning tools.

Based on the results of the analysis of several learning device products, namely teaching modules and student worksheets (LKPD), it is known that biology learning has not empowered high-level thinking abilities. This can be seen in learning objectives, learning processes, and learning evaluation. Apart from that, no feature contains reflection and learning monitoring sections. Even though these two components are important in the formation of independent learners. Students who are skilled at planning, monitoring, and evaluating each learning activity will produce students who are more

independent and confident in learning. Therefore, this research aims to develop problem-based learning tools that empower students' thinking abilities.

METHODS

This research is research that adapts the ADDIE development model consisting of four stages, namely 1) analysis, 2) design, 3) development, 4) implementation, and 5) evaluation. Diagrammatically, the ADDIE development model can be illustrated in Figure 1.

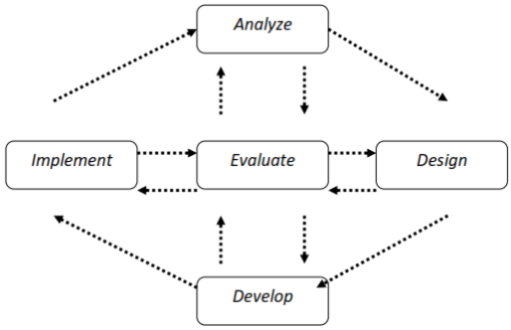


Figure 1. Stages of the ADDIE Model

In the first stage, namely analysis, the definition of what students will learn is carried out. The second stage is design, what is done is to make a design. The design involves determining learning objectives, preparing tests, and determining a problem-based learning model. Followed by the third stage, namely development. At this stage, the design becomes a reality so that the fact that a learning model needs to be developed emerges. One important step at this stage is a trial before it is implemented in a class (limited class trial/small class). In the implementation phase, the research subjects were PPG Daljab Category 1 students, batch 3 of 2023/2024 with a research sample of 29 students.

The learning tools developed include teaching modules and LKPD with student learning journals and learning outcome assessment sheets. The learning tool or first draft that was developed was then validated by 3 experts. The development stage continues with revising the learning tools according to expert input. The revised first draft resulted in a revised second draft and continued with limited testing on 10 students to determine the validity, reliability, sensitivity, practicality, and effectiveness of the learning tools.

The next stage is the implementation stage of learning tools in class A Biology PPG Daljab Category 1. The research design used is a group Pretest-Posttest Design which is described as follows:

Pre-test	Experiment	Post-Test
O1	⟶ X ⟶	O2

Information:
O1: Initial test, aims to determine the level of student mastery of learning material and students' thinking abilities before being given treatment.
O2: Final test, aims to determine the level of student mastery of learning material and students' thinking abilities after being given treatment.
X: Learning treatment by applying the PBL model

The activities carried out at this implementation stage are sequential starting from the initial test, 96 lecture activities, and then continuing with the final test. The purpose of this implementation phase is to obtain data that will be analyzed descriptively to answer research questions and to develop final learning tools. The research variables measured in this research are the validity of learning tools or the correctness of the content of learning tools, the readability of learning tools, the implementation of learning, increasing students' high-order thinking abilities, and student responses.
Validation of learning device components was analyzed using qualitative descriptive analysis, namely by averaging the scores obtained from the two validators. Learning devices are said to be valid and can be used if the results of the device validation analysis are > 2.6 (adapted from Ratuman and Laurens, 2006). The readability of learning devices can be calculated using the Gunning Fox index formula, as follows:

$$\text{The readability} = 0{,}4\ \left(\frac{Words}{Sentences}\right) + 100\ \left(\frac{difficult\ word}{Words}\right) \qquad (1)$$

The readability level of the device is in the medium criteria if the readability level of the device is in the interval 7-11. The readability of the learning tools was also analyzed descriptively quantitatively by asking students to provide corrections regarding the readability of the Modules and LKPD on the instrument sheet. Devices are categorized as interesting and understandable if the percentage given by students is more than 60%. The implementation of the teaching module is analyzed by calculating the percentage and average score given by observers regarding the implementation of the learning. The completeness of student learning outcomes is seen from the ability to think at a high level which is analyzed using normality gain tests, completeness indicators, individual completeness, and classical completeness. Students can be said to have experienced an increase in learning outcomes if the N-Gain value obtained is between 0.3-0.7, while students are said to have completed individually if the student gets a score of 2.67. This score is based on the KKM value set by the Republic of Indonesia Minister of Education and Culture Regulation No. 104 of 2014.

RESULTS AND DISCUSSION

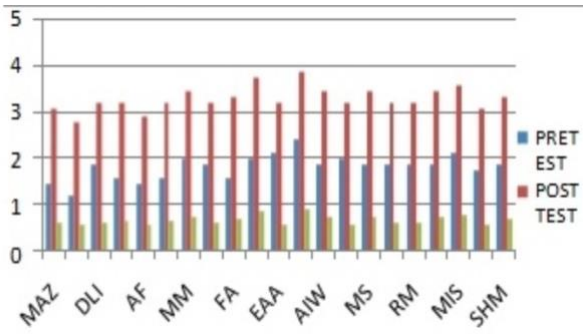
This research aims to develop problem-based learning tools that are suitable for use in the learning of PPG Daljab Category 1 biology students, class 3 of 2023. The tools developed are teaching modules, LKPD which are equipped with learning journals and learning outcome assessment sheets.

The learning tool developed is a PBL model where the problem raised is environmental pollution by observing colors and smells. LKPD is designed to overcome environmental problems by recycling plastic waste into paving blocks which has entrepreneurial potential.

The validated learning tools consist of teaching modules, LKPD, and Learning Outcome Assessment Sheets. Based on the results of expert assessments, the problem-based learning tools developed include teaching modules, LKPD, and learning outcome assessment sheets which were declared valid in the very valid category with an assessment score interval of between 3.5 to 4 with reliability between 95% and 98%. This states that the learning tools developed have met valid and reliable standards as a guide for lecturers in teaching material about environmental balance and changes and to improve students' cognitive learning outcomes. Suwardi (2007) states that planning is an important step to achieve learning success. If the learning plan is prepared well, the learning objectives can be achieved effectively and efficiently. The learning tools developed have also been adapted to the Republic of Indonesia Minister of Education and Culture Regulation No. 81 A regarding the format for preparing lesson plans and other learning tools which include: School identity, subjects and classes/semester, main material, time allocation, KI, KD and indicators of competency achievement, learning objectives, learning materials, approaches, models and learning methods, media, tools and learning resources, steps for learning activities and assessments so that when validation of learning tools is carried out, this aspect gets the highest score with very valid criteria.

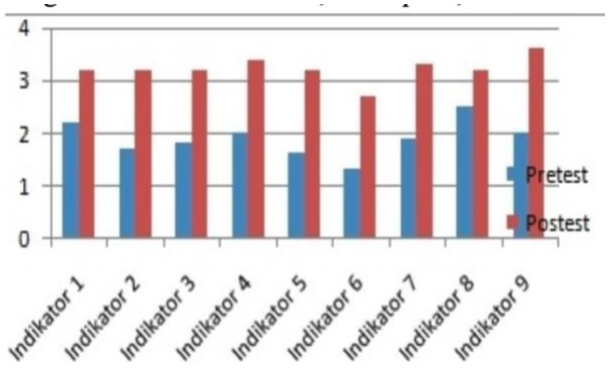
Implementation of the Learning Implementation Plan is used by observers to determine and assess the implementation of self-regulated learning-based biology learning steps that are adapted to the RPP. The implementation of the problem-based RPP tool was observed using an implementation sheet of the RPP tool which was observed by two observers based on aspects of teaching and learning activities consisting of preliminary, core, and closing activities, as well as time management and class atmosphere. Based on the results of data analysis, it is known that the RPP has been implemented 100%. The average interval score for each learning aspect is between 3.6-4 in the very good category. The implementation of the RPP is declared trustworthy or reliable based on the results of a reliability calculation of 97%. This states that the module developed is very good and can be used as a reference or guide for teachers in delivering environmental pollution material.

Analysis of students' high-level thinking abilities is determined based on the increase in student learning outcomes after the learning process is carried out (Rengkuan, et al. 2023). Learning outcomes are learning indicator achievement scores obtained by students from learning outcomes tests using HOTS-based questions. Assessment of student learning outcomes is measured using activity sheets (LK) which consist of exploring alternative solutions, determining solutions, making action plans, and making evaluation plans with an assessment rubric for each LK. The analysis of the completeness of student learning outcomes is seen based on the increase in learning outcomes obtained by students from the LK which is shown in Graph 1. Based on Graph 1, information is obtained that all students did not complete the pretest with a score range of 1.20-2.40, but after the learning was carried out based on The problem with the cycle that has been developed by PPG is that there is an increase in learning outcomes where all students complete the score range from 2.5-3.8. N-gain analysis for each student also shows an increase in learning outcomes. Based on the results of the N-gain analysis, it is known that the average N-gain score is 0.68 with medium criteria, with the student N-gain interval between 0.57 to 0.92 with the medium to high category.



Graph 1. N-gain analysis

An increase in student learning outcomes indicates an increase in student knowledge regarding the material that has been taught using problem-based learning. These results are supported by Lukitasari, et al (2019) who stated that the problem-based learning model can empower critical thinking and metacognitive abilities. In line with this opinion, Yulianti (2019) stated that the Problem-Based Learning Model can empower critical thinking and metacognitive abilities. Hasanah et al (2019) added that Problem-Based Learning can develop critical thinking abilities and entrepreneurial skills. Beames and P. Higgins (2016) also reported that differences in student learning outcomes could be influenced by differences in students' cognitive abilities. Based on the analysis of learning completion indicators in Graph 2, it is known that all learning indicators were incomplete during the pretest with a value range of 1.3-2.5, and after learning was carried out it was discovered that there was an increase in the learning indicator completion score where all indicators were completed with a value range of 2 .7-3.6. This illustrates that students have completed and mastered all the learning indicators that must be achieved in learning competencies. Based on the sensitivity analysis of learning outcome items, it is known that all question items on the learning outcome assessment sheet are declared sensitive with a score interval between 0.30 to 0.60.



Graph 2. Sensitifitas Soal pretest & postest

If the learning indicator achieves completeness, the student is declared to have achieved the competency that must be achieved in the material. So it can be concluded that after the problem-based learning process, students can complete the learning indicators or achieve the basic competencies that must be achieved in the material. This is in accordance with Minister of Education and Culture Regulation 104 concerning the assessment of learning outcomes which states that the assessment of learning outcomes by educators uses criteria as a reference, which is an assessment of students' progress compared to the competency achievement criteria set with an average score for knowledge competency completeness of at least 2.7. Sensitivity analysis of knowledge items shows that all questions are declared sensitive so they can measure learning effects. Overall, the item sensitivity interval score is between 0.3 to 0.6. An item is declared sensitive if the sensitivity value is more than or equal to 0.3 (Arikunto, 2012). According to Grounland (1985), the effective sensitivity index is between 0 and 1, and a larger positive value indicates that the item has greater sensitivity to learning effects. Items that have a sensitivity > 0.30 can be said to be sensitive to learning.

Based on the results of the research that has been carried out, the following things were found:

1) Problem-based learning tools developed include lesson plans, teaching modules, LKPD, learning outcome assessment sheets and metacognitive skills questionnaires. Based on the validation results, the device is said to be valid in the very valid category with an assessment score interval between 3.5 to 4 with reliability between 95% and 98%.
2) The readability level of learning tools based on Gunning Fox Index calculations is at level 11 with medium criteria. Meanwhile, the percentage of readability of learning tools based on the readability sheet for learning tools is 97%, which indicates that learning tools are interesting and easy for students to understand.
3) Tools Problem-based learning tools are practical tools to use. This can be seen from the results of the learning implementation analysis that all learning activities in the learning implementation plan were carried out 100% with a score interval of 3.5-4.0 with a very good category in every aspect of learning with an average reliability of 97%.
4) Tools Problem-based learning tools can improve cognitive learning outcomes (C4-C6) and students' metacognitive skills. The increase in student cognitive learning outcomes can be seen from the completeness of all learning indicators with a score range of 2.5 to 3.5 and the average N-gain value for all students is 0.68 with medium criteria, classical completeness is 100%.
5) Problem-based learning tools received a positive response from students as seen from the results of the student response questionnaire analysis, namely 98%.

CONCLUSION

Problem-based learning tools are suitable for use in lectures and can improve students' critical thinking and metacognitive abilities. Problem-based learning tools that have been successfully developed can be an alternative learning tool in the PPG Program by taking into account students' initial abilities.

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