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Problem Based Learning to Improve Students' Problem Solving Skills on Environmental Change Material

Cicilia Angelina Priska [1], Yokhebed [2*],

[1] SMAN 3 Bengkayang, JL.Bambang Ismoyo, Bengkayang, Kalimantan Barat, Indonesia
[2] Biology Education, Faculty of Teacher Training and Education, Universitas Tanjungpura, Pontianak, Indonesia

[1] cicilia.angelina88@gmail.com; [2] Yokhebed@fkip.untan.ac.id*
* Corresponding Author

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ABSTRACT

This research aims to determine the application of problem-based learning to improve problem-solving skills in environmental change material. The type of research used is classroom action, which consists of 2 cycles. Each cycle consists of planning, action, observation, and reflection. The subjects in this research were 30 students in class X MIPA 1 SMA Negeri 3 Bengkayang. The research instrument used was a problem-solving skills observation sheet. The results showed that problem-solving skills increased from quite skilled to skilled. The percentage of each indicator of problem-solving skills has increased. Increase indicators identifying information gaps and the need for action by 18.97%, processing information to understand problems and making decisions by 19.83%, reaching solutions by 23.27%, and communicating decisions by 18.98%. Thus, problem-based learning can improve problem-solving skills.

KEYWORDS

Problem-based learning;
Problem solving skills;
Environmental changes.

1. Introduction

21st-century education directs learning to various skills needed in the 21st century, one of which is problem-solving skills (Redhana 2019). As a consequence of these demands, namely adjustments to the learning process that implement problem-based learning strategies (Zubaidah 2016).

Problem-solving skills are an essential skill in work and everyday life. Problem-solving skills are critical to use to deal with complex problems (Nurpatri et al. 2022). Problem-solving skills can be obtained through learning steps that direct students to think and find solutions to problems (Sari et al. 2021). In the problem-solving framework, there are four main steps, namely (1) identifying information gaps and action needs, (2) processing information when information and knowledge related to the problem are stored, interpreted, and used to understand the problem and make decisions (3) reach an established solution, and (4) communicating decisions (Rausch and Wuttke 2016).

Biology learning at the high school level, problem-solving skills are one of the core competency skills. The problem-solving process is carried out when students construct knowledge. In biology subjects, especially in basic competency 3.11, Analyzing data on environmental changes, their causes and impacts on life (Kurikulum 2013), students can analyze environmental changes, their causes and impacts through authentic problems as a starting point for learning. Contextual and authentic learning stimulates students to solve problems (D. Ali, Nurhanurawati, and Noer 2022). However, based on the results of observations in class X at SMAN 3 Bengkayang in biology learning, students tend to need help solving complex problems in the learning process. Teachers have implemented direct learning, when teachers present complex problems, students tend to provide solutions from only one point of view. Based on the initial observations, only 9 out of 30 students (30%) could provide solutions from more than one point of view to the environmental problems provided by the teacher. This is because teachers' learning model needs to

accommodate the need for complex problem-solving through planning, implementation and evaluation in the learning process.

Problem-based learning model is one of the learning processes that can be carried out to practice problem-solving skills. This is based on previous research reporting that problem-based learning impacts problem-solving skills. (Siregar and Khairuna 2022; Syafii and Yasin 2013; Asyhari and Sifa'i 2021). Activities carried out by students in problem-solving learning include the process of collecting data, creating hypotheses, and providing solutions so that problem-solving skills can be developed and trained. The problem-based learning (PBL) model aims to 1) build a broad and flexible knowledge base; 2) develop practical problem-solving skills; 3) develop independent learning skills and lifelong learning; 4) help students become effective collaborators; and 5) help students become intrinsically motivated to learn (Hmelo-silver 2004).

Learning using PBL is a cycle that starts with a problem scenario. Menurut Hmelo-Silver and Eberbach (2012) PBL learning cycle begins with presenting a problem. At this stage, students are presented with a problem scenario. Students are directed to formulate and analyze problems by identifying relevant facts from the problem presented. Once students understand the problem, students generate hypotheses about possible solutions. After that, students identify a lack of knowledge, also known as a learning problem, where students find information to solve the problem (self-directed learning). Next, students apply knowledge and evaluate hypotheses based on their acquired knowledge. Students then apply their knowledge and evaluate their hypotheses based on their learning. After solving the problem, students reflect on the knowledge gained.

Based on the results of previous research, problem-based learning was reported to be effective in improving problem-solving skills in biology learning on addictive substance material (Yulistiawati, Mamin, and Ramlawati 2019), growth and development (Bahri, Putriana, and Idris 2018), excretion (Kurniawan, Suganda, and Widiantie 2018). This research reviews the application of the problem-based learning model to environmental change material. Knowing the impact of problem-based learning on environmental change material on problem-solving skills is very important. This is because environmental change material is authentic material that is very close to everyday life and requires solutions to the environmental problems faced. In this way, it is hoped that students as part of the community can provide solutions to environmental problems (Zubaidah 2017). This research determine the improvement of problem solving skills through problem-based learning especially in environmental change material.

2. Method

The type of this research is classroom action research. Classroom action research was carried out in 2 cycles, each cycle consisting of planning, action, observation and reflection stages (Kemmis, McTaggart, and Nixon 2014). The research subjects consisted of 30 students from the class. The students consisted of 13 men and 17 women. The instrument used consists of a problem-solving skills observation sheet with indicators referring to Rausch and Wuttke (2016) namely (1) identifying information gaps and action needs, (2) processing information when information and knowledge related to the problem are stored, interpreted, and used to understand the problem and make decisions (3) reach an established solution, and (4) communicating decisions. When teachers use a problem-based learning model, observers observe the learning process and problem-solving skills. Observers score one if poor, two if sufficient, three if good, and four if very good. Next, the percentage of achievement of each indicator of problem-solving skills is calculated. The percentage results for each indicator are interpreted based on Table 1. The success indicators in the research are that each indicator has at least reached the skilled category.

Table 1. Problem solving skills score criteria

Score	*Criteria*
81-100	Very skilled
61-80	Skilled
41-60	Quite skilled
21-40	Less skilled
0-20	Very unskilled

Source: Sahertian and Hidayati (2022)

3. Results and Discussion

3.1. Result

Problem-solving is an essential skill for students to have because it can help them succeed in life. (Sahertian and Hidayati 2022). The results of observing students' problem-solving skills can be seen in Table 2.

Table 2. Observation results of problem-solving skills

Indicator	*Percentage of achievement of Cycle 1*	*Criteria*	*Percentage of achievement of Cycle 2*	*Criteria*	*Difference*
identify information gaps and action needs	57,75 %	Quite skilled	76,72 %	Skilled	18,97%
process information to understand problems and make decisions	58,62 %	Quite skilled	78,45 %	Skilled	19,83%
reach a solution	47,41 %	Quite skilled	70,68 %	Skilled	23,27%
communicate decisions	43,10 %	Quite skilled	62,06 %	Skilled	18,96%

Table 2 shows that students' average problem-solving skills have increased from the moderately skilled to the skilled category. The highest indicator increase in the indicator reaches the solution.

3.2. Discussion

Based on the results of data analysis, information was obtained that students' problem-solving skills had increased for each indicator. The highest increase in the indicator reaches the solution. Students can provide solutions to environmental problems provided through Student Worksheets. This is in line with the results of Valdez (2019) research that problem-solving abilities relatively increased after learning using PBL. In the first syntax of the problem-based learning model, namely presenting a problem, the teacher presents the problem using videos and discourse about gold mining without permits in the environment around the students. In the second syntax, namely identifying facts, students observe phenomena in the video and understand the discourse.

Next, in the third syntax, namely making hypotheses related to observed phenomena and facts, students put forward a hypothesis that will be proven. Through the hypothesis that has been prepared, students then identify the concepts needed to answer the problem formulation (fourth syntax). The next step is observation and literature review activities through independent learning activities through teacher guidance (fifth syntax). In the sixth syntax, students use the knowledge gained to answer problems, put forward solutions and decide on the best solution according to the students.

Problem-based learning provides context and facilitates students' involvement in problem-solving. The context of problem-solving in the form of the problem of unlicensed gold mining (PETI) is a problem close to students' daily lives. The PETI problem is a local issue that has become a global issue that is widely discussed today. The PETI problem is an authentic problem presented in learning. Authentic problems so that students can be interested in getting involved in finding solutions related to the problems they face (Suwarnisi, Sariyasa, and Suparta 2022).

Problem-based learning raises metacognitive abilities, which influence problem-solving abilities (Iskandar 2014). During the problem-solving process, a person will manage his thoughts by utilizing the

knowledge he already has, controlling and reflecting on his thinking processes and results and finding strategies that help in solving problems (Huda, Agustin, and Khikmiyah 2021).

The problem-solving process is carried out by identifying concepts that students previously knew and then continuing by looking for unknown information that will be used to solve the problem. Next, students ask questions that help solve problems. Students then provide possible proposed solutions to solve the problem. After that, students evaluate the solutions and decide which solutions can be implemented.

The research results prove that problem-based learning helps students solve complex problems in the form of PETI problems, which require problem-solving from various scientific disciplines. This can be seen from the results of the LKPD, and students provide solutions from various points of view, namely from the perspective of ecology (environmental damage/pollution), health (health impacts or risks), economics (profits and losses) and law. This follows previous research, which reports that multidisciplinary problem-based learning can help support collaborative competence and involve students from various backgrounds working on multidisciplinary projects (Rajabzadeh, Mehrtash, and Srinivasan 2022). Wang (2017) also reported that multidisciplinary PBL, by adopting real-life problems and related social problems, is effective for increasing students' knowledge and motivation and for engaging students in deeper thinking, such as creative thinking, problem-solving, and critical thinking.

Problem-based learning also prioritizes collaboration between group members. Problem-solving in scaffolding team-based groups, specifically the process of concept development, interdependence among team members, and group self-organization (Dondlinger and McLeod 2015). This encourages students to develop skills that can be useful for the future and practical life in a team environment (S. S. Ali 2019). The implementation of PBL in teaching environmental change materials usually involves several key stages. First, students are exposed to a complex environmental scenario or problem. They then work in groups to identify what they know, what they need to know, and how they can obtain the necessary information. This process helps develop students' metacognitive skills, which is an important component of problem solving (Chiang and Lee, 2016). In terms of developing problem-solving skills, PBL has been shown to be very effective. Studies by Yew and Goh (2016) show that students who learn through PBL show significant improvements in their ability to identify problems, analyze information and develop effective solutions. This is particularly relevant in the context of environmental change, where solutions often require interdisciplinary and innovative thinking.

4. Conclusion

Based on the research results, it was concluded that problem-based learning improves problem-solving skills for all indicators from the moderately skilled to skilled category. The highest increase in problem-solving skills is the indicator of reaching a solution. The problem-based learning model can be used as an alternative model that can improve problem solving skills in biology learning.

This study has limitations including that the study may be limited to a certain number of students or classes, which may limit the generalizability of the results. If the study was conducted over a short period of time, this could limit understanding of the long-term effects of PBL. In addition, the study focused on a particular geographical or socio-economic context, which may limit the applicability of the results to other contexts. Factors such as teachers' teaching styles, students' backgrounds or school resources may not be fully controlled, which could affect the results.

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