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ORIGINAL

The Implementation of Problem-Based Learning with Multimedia for Improving Scientific Process Skills

La aplicación del aprendizaje basado en problemas con multimedia para mejorar las destrezas del proceso científico

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ABSTRACT

Introduction: learning problems in the subject of energy and its changes where there are still students who have difficulty understanding it and lack of science process skills. Learning with a scientific process is needed to solve problems and produce a product in the form of a concept. One of them is by implementing the Problem Based Learning learning model. This research aims to determine the improvement in science process skills students in Indonesian elementary school in the 2023/2024 academic year. Participants were a classroom teacher and 23 students, consisting of 13 male and 10 female students.
Method: the data used are qualitative and quantitative data. This study uses a classroom action research method. Data collection techniques use observation and interviews. Data validity uses triangulation of sources and techniques. This study was conducted in three cycles with five meetings. Qualitative and quantitative data were collected through observation and interviews. Data analysis was carried out using three stages consisting of data reduction, data presentation, and drawing conclusions.
Results: the results showed an increase in science process skills in the natural and social science subject among students when the Problem Based Learning model with multimedia was implemented. The average percentage of science process skill indicators in cycle I was 71,52 %, cycle II = 82,89 %, and cycle III = 89,79 %.
Conclusions: it can be concluded that the application of the Problem Based Learning model with multimedia can improve 4th-grade students' scientific processing skills skills in the natural and social science subject in the 2023/2024 academic year.

Keywords: Problem Based Learning; Science Process Skills; Elementary School.

RESUMEN

Introducción: los problemas de aprendizaje en el tema de la energía y sus cambios donde todavía hay estudiantes que tienen dificultades para entenderlo y la falta de habilidades de proceso de la ciencia. El aprendizaje con un proceso científico es necesario para resolver problemas y elaborar un producto en forma de concepto. Una de ellas es implementando el modelo de aprendizaje de Aprendizaje Basado en Problemas. Esta investigación tiene como objetivo determinar la mejora en las habilidades de proceso científico de los estudiantes de la escuela primaria de Indonesia en el año académico 2023/2024. Los participantes fueron un

profesor de aula y 23 estudiantes, de los cuales 13 eran hombres y 10 mujeres.
Método: los datos utilizados son cualitativos y cuantitativos. Este estudio utiliza un método de investigación-acción en el aula. Las técnicas de recogida de datos utilizan la observación y las entrevistas. La validez de los datos se basa en la triangulación de fuentes y técnicas. Este estudio se llevó a cabo en tres ciclos con cinco reuniones. Se recogieron datos cualitativos y cuantitativos mediante la observación y las entrevistas. El análisis de los datos se llevó a cabo en tres etapas: reducción de datos, presentación de datos y extracción de conclusiones.
Resultados: los resultados mostraron un incremento en las habilidades del proceso científico en la asignatura de ciencias naturales y sociales entre los estudiantes cuando se implementó el modelo de Aprendizaje Basado en Problemas con multimedia. El porcentaje medio de indicadores de destrezas de procesos científicos en el ciclo I fue del 71,52 %, en el ciclo II = 82,89 %, y en el ciclo III = 89,79 %.
Conclusiones: se puede concluir que la aplicación del modelo de Aprendizaje Basado en Problemas con multimedia puede mejorar las habilidades de procesamiento científico de los estudiantes de 4º de primaria en la asignatura de ciencias naturales y sociales en el curso 2023/2024.

Palabras clave: Aprendizaje Basado En Problemas; Habilidades de Proceso Científico; Escuela Primaria.

INTRODUCTION

Education is a process aimed at enhancing human resources' quality to discover new things that can develop attitudes, skills, and intellect.[1] The quality of education is influenced by the curriculum. The curriculum is the heart of education and possesses a dynamic nature, meaning it constantly undergoes changes and developments to keep pace with the times.[2]

The current curriculum implemented in Indonesia is the Curriculum Merdeka. One of the subjects in the Merdeka curriculum is Natural and Social Sciences. Natural and Social Sciences (IPAS) is a learning approach that integrates subjects such as science and social studies.[3] IPAS learning can provide direct experiences to students. The active participation of teachers and students is crucial to achieving the desired learning objectives.[4] Therefore, the researchers were interested in the IPAS subject, leading to interviews and observations conducted on fourth-grade teachers and students at SD Negeri 1 Karangsari in the academic year 2023/2024.

Based on the interviews and observations of fourth-grade teachers and students at SD Negeri 1 Karangsari in the academic year 2023/2024, it was found that the science process skills of the students in IPAS were categorized as low. This is evidenced by students' behaviors such as low activity levels and lack of confidence in expressing opinions, as well as learning activities that have not fully developed science process skills. Observations of science process skills were based on several indicators, including observation, hypothesis formulation, experimentation, conclusion drawing, and communication. Many students were unable to formulate experiments correctly and lacked the ability to conduct experiments independently. Additionally, teachers have not fully utilized technology and have not sufficiently engaged students in IPAS learning activities.

Based on the results of observations and interviews, several issues have been identified that necessitate improvement and innovation in teaching with the aim of enhancing students' science process skills. These skills need to be cultivated so that students become adept at processing information related to everyday phenomena. Teachers are encouraged to provide ample opportunities for students to learn problem-solving.[5] One of the reasons why students' science process skills are not optimal is due to teachers' lack of variety in instructional models.[6,7] Efforts to enhance science process skills include implementing engaging, stimulating, enjoyable, and scientifically rigorous instructional models to prevent monotony. One suitable instructional model for this purpose is Problem Based Learning (PBL). This aligns with [8] assertion that PBL is effective for developing and improving Science Process Skills (SPS) by actively involving students in their learning.

According to Fitriani[9], PBL involves students in problem-solving tasks to develop their problem-solving abilities, thereby enhancing both process skills and learning outcomes. PBL is particularly effective when supported by multimedia, as suggested by research such as that of [10], which indicates that multimedia-enhanced PBL increases student and teacher engagement, thereby improving process skills and learning outcomes.

Based on the above discussion, the researchers are interested in conducting classroom action research titled "The Implementation of Problem-Based Learning with Multimedia for Improving Scientific Process skills in Natural and Social Science Subject among 4th-grade students in the 2023-2024 Academic Year." This classroom action research aims to determine the improvement in science process skills students in Indonesian elementary school in the 2023/2024 academic year.

METHOD

The research employed the Classroom Action Research (CAR) method, defined by [11] as a type of research

investigating cause and effect through actions. It consisted of three cycles: cycles 1 and 2 comprised 2 sessions each, while cycle 3 had 1 session.The population in this study were all teachers and fourth grade students in Kebumen District. The sample in this study was selected using a simple random sampling technique. The study involved 23 fourth-grade teachers and students at SD Negeri 1 Karangsari in Indonesia, Consisting of 13 male and 10 female students Each cycle encompassed four stages: (1) planning, (2) implementation, (3) observation, and (4) reflection.[12] The researchers conducted teaching and observations within the classroom setting.

Data collection included both qualitative and quantitative data. The variables in this article consist of two variables, namely the independent variable, namely the Problem Based Learning model, while the dependent variable is science process skills. Quantitative data focused on the percentage of science process skill indicators in the Natural and Social Sciences subject on energy and its changes (IPAS). Qualitative data encompassed the implementation of IPAS learning using PBL with multimedia and the science process skills of fourth-grade students at SD Negeri 1 Karangsari. Quantitative data is then interpreted in the form of qualitative data with the following provisions.

Table 1. Data Measurement Scale

Percentage gain	Description
0-34 %	Very less
35-69 %	less
70-75 %	Enough
75-84 %	Good
85-100 %	Very good

Data sources included teachers and fourth-grade students, with data gathered through non-test techniques such as observation instruments and interviews. Data validity was ensured through source triangulation and technique triangulation. Data analysis utilized qualitative descriptive and comparative descriptive techniques, following the stages of data reduction, data display, and conclusion drawing as outlined by Miles and Huberman.[13,14]

RESULTS AND DISCUSSION

Implementation of PBL with Multimedia

This research utilized the PBL model with multimedia. The steps for implementing PBL with multimedia included: (1) Problem orientation with multimedia assistance, (2) Organizing students with multimedia assistance, (3) Guiding and directing students to conduct investigations, (4) Developing and presenting discussion results, (5) Analyzing and evaluating with multimedia assistance. These steps were adapted from the study by Novelni and Sukma (2021). The research was conducted over three cycles consisting of five sessions.

In the first step, problem orientation with multimedia, the teacher presented a problem related to the lesson using multimedia tools such as educational videos, images, or text readings. The teacher then posed provocative questions related to the lesson. This stage aimed to explore the students' prior knowledge.

The second step involved organizing students to learn with multimedia assistance. The teacher presented questions and then divided the students into groups, providing instructions for conducting the discussions. According to Rosidah[15], in the student organization stage, the teacher assists with tasks and discussion topics to solve a problem.

The third step was guiding and directing students to conduct investigations. In this step, the teacher guided and directed students in discussions and experiments related to the IPAS material being studied. The investigation activities aimed to solve the problems presented by the teacher, encouraging active student participation in learning. Rosidah[15] explained that during this stage, the teacher monitored student engagement during discussions and experiments, as well as the skills demonstrated during these activities.

The fourth step involved developing and presenting discussion results. Students were allowed to compile their discussion results into reports and draw conclusions based on their investigations. Students then presented their discussion results. According to Sofyan et al.[16], this stage allowed students to compile reports and present their discussion outcomes.

The fifth step was analyzing and evaluating with multimedia. This final step in the PBL model with multimedia involved the teacher guiding students to reflect and complete evaluation questions using Quizziz paper mode. This step aimed to assess students' understanding of the problem-solving process and the material learned.[15]

The above description outlines the implementation of the PBL model with multimedia. This approach demonstrated improvements in each cycle, as observed by the observer in the fourth-grade teachers and students at SD Negeri 1 Karangsari for the 2023/2024 academic year. The following are the observation results and assessments from cycle I to cycle III.

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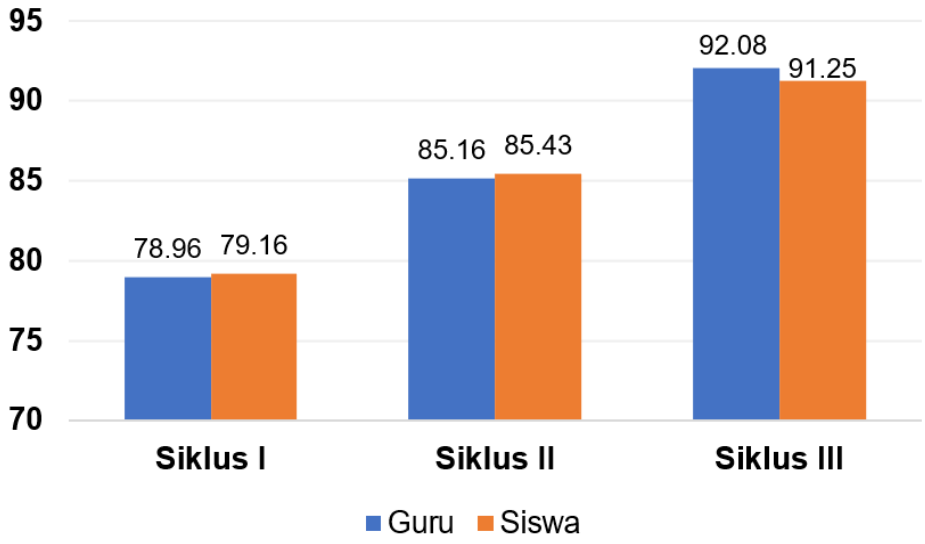

Figure 1. Observation Results of the Implementation of the PBL Model with Multimedia

Based on figure 1, it can be seen that the learning process in cycles I, II, and III consistently showed improvement. The increase in observation results for teachers from cycle I to cycle II was 6,2 %, and from cycle II to cycle III, it was 6,92 %. For students, the increase from cycle I to cycle II was 6,27 %, and from cycle II to cycle III, it was 5,82 %. By the third cycle, both teachers and students had reached the target performance indicator of 85 %. In cycle I, the percentage of observation results for the implementation of the PBL Model with Multimedia fell into the "fair" category. In cycle II, it was categorized as "good," and in cycle III, it was categorized as "very good."

Each step of the learning process through the PBL model with multimedia also showed varying degrees of improvement. Table 1 below presents a comparison of the implementation results of the PBL model with multimedia for teachers and students across cycles I, II, and III.

Table 2. Comparison of Results Across Cycles for Implementing the PBL Model with Multimedia for Teachers and Students

Step 1	Cycle I		Cycle II		Cycle III		Mean	
	T	S	T	S	T	S	T	S
Problem orientation with multimedia	81,25	82,29	89,16	84,37	93,75	93,75	88,05	86,80
Organizing students to learn using multimedia	82,29	80,20	83,95	84,26	93,75	93,75	86,66	86,07
Guiding and directing students to conduct investigation	76,04	76,04	83,95	84,26	91,67	87,50	83,89	82,60
Developing and presenting discussion results	79,16	79,16	87,5	90,62	93,75	93,75	86,80	87,84
Conducting analysis and evaluation using multimedia	76,04	78,12	81,25	82,91	87,50	87,50	81,60	82,84
Mean	78,96	79,16	85,16	85,29	92,08	91,25	85,40	85,23

Description: T = Teacher; S = Students.

Table 2 demonstrates that learning through the PBL model with multimedia showed improvement in each cycle. In Cycle I, the third and fifth steps had the lowest percentages. The teacher encountered difficulties in guiding group discussions due to the large number of students, with some students chatting or playing by themselves. During group formation, the classroom was noisy because some students disliked their assigned group members. Additionally, students lacked confidence when presenting discussion results in front of the class and were not well-acquainted with completing evaluations using the Quizziz paper mode. Consequently, Cycle I did not meet the research performance indicator of 85 %. Given the shortcomings in Cycle I, the researchers proceeded to Cycle II. Each learning step using the PBL model with multimedia improved for both teachers and students. By Cycle II, the learning process had notably improved. Students were more orderly during group formation, though a few remained dissatisfied with their group assignments. The average observation results for both teachers and students met the research performance indicators. However, some steps still fell short of the desired performance benchmarks. In Cycle III, the teacher successfully implemented the PBL model with multimedia. The challenges encountered in previous cycles were effectively addressed. Students became more understanding and orderly during group formation, confident and bold in presenting discussion results, and proficient in completing the Quizziz paper mode evaluations.

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Enhancement of Science Process Skills in IPAS for Fourth Grade

Science process skills, encompassing physical and mental capabilities, help students develop information from activities that uncover scientific concepts, principles, or theories. These skills enhance curiosity, independence, problem-solving abilities, and active participation in learning. The skills were measured using observation sheets with indicators including: (1) Observing, (2) Designing experiments, (3) Conducting experiments, (4) Concluding, (5) Communicating results.

Implementing the PBL model with multimedia significantly improved the science process skills of fourth-grade students in the IPAS subject. The improvement of science process skills among fourth-grade students in the IPAS subject is illustrated in figure 2.

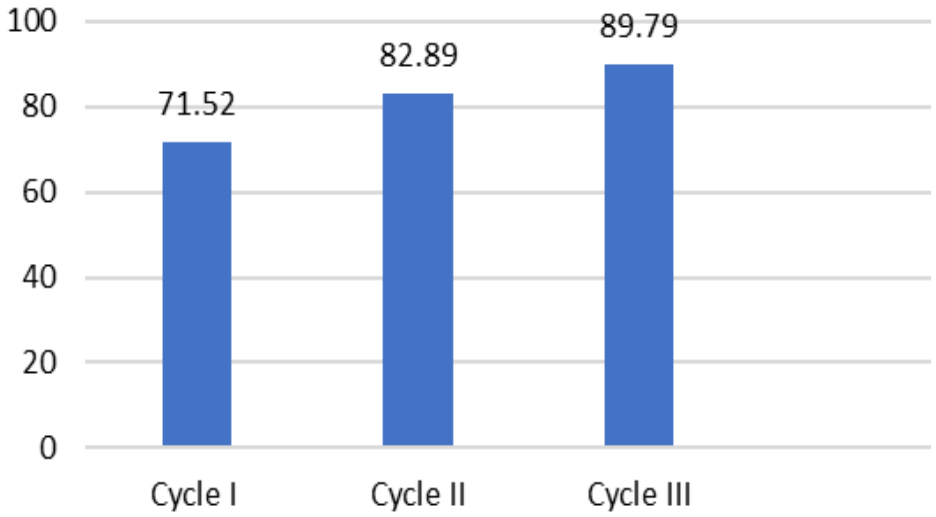

Figure 2. Science process skill improvement

Based on figure 2, the average science process skills in Cycle I were 71,52 %, in Cycle II were 82,89 %, and in Cycle III were 82,79 %. The average observation results of science process skills in Cycle I and II were categorized as good, while in Cycle III they were categorized as very good. This finding is in accordance with previous research which stated that there were differences in scores and tended to increase after using PBL with higher scores compared to the traditional model.[17] PBL syntax is very useful for providing challenges for students through questions and answers and solving real problems in an authentic and meaningful way.[18] The following is a comparison of the observation of science process skills in the IPAS subject for fourth-grade students at SD Negeri 1 Karangsari.

Table 3. Comparison of Science Process Skills across cycles based on the observation

Aspects	Cycle I	Cycle II	Cycle III
Observing	Students often joked with friends, resulting in a lack of focus during observation	Students were more trained to focus on observing objects during experiments	Students enjoyed observing objects, focusing in detail, and using their eyes
Planning experiments	Students were unable to formulate hypotheses or preliminary guesses	Students were able to formulate hypotheses	Students were able to plan experiments based on observations and hypotheses
Conducting Experiments	Students did not follow experiment instructions fully (some steps were not executed)	Students followed LKPD instructions but some were less meticulous	Students conducted experiments carefully and with focus
Drawing Conclusions	Students did not make logical and clear conclusions	Students wrote clear conclusions based on observations	Students drew conclusions based on observations
Communicating	Most students lacked confidence in presenting discussion results	Most students were brave enough to present discussion results	Students confidently presented discussion results and were willing to ask questions or respond

Based on table 3, it shows that each indicator of science process skills improved with each cycle. This is evidenced by the development of students in the indicators of observing, planning experiments, drawing

conclusions, and communicating. Observations also indicated that teachers effectively directed students to observe objects in detail and create well-structured experiment plans. Additionally, teachers motivated and encouraged students not to be shy when presenting their discussion results.

This demonstrates that the PBL model with multimedia can enhance science process skills. This research aligns with the study by another research, which found that the application of the PBL model can improve students' thinking, analysis, and science process skills.[19] This research is also relevant to previous findings that discuss process skills.[20,21,22] The learning model used by the teacher successfully measured students' science process skills. This PBL learning model has a positive relationship with students' science process skills and analytical thinking in learning. This is further supported by Duda et al.[23], who explained that the PBL model involves authentic problems to develop problem-solving abilities, thereby enhancing both process skills and learning outcomes for students. PBL strongly encourages students through explorations that occur in their daily lives so that they get more learning experiences. PBL also encourages students to identify problems, design and conduct experiments, and find solutions based on the scientific knowledge they have learned.[24]

The implementation of PBL with multimedia makes students more active and interested in learning. This is consistent with Lestaringsih's[25] assertion that PBL has several advantages, such as helping students understand material more easily by solving problems, and enhancing student performance so they become more engaged in learning. Furthermore, multimedia offers the advantage of presenting concepts attractively by combining various formats such as images, animations, and appealing sounds, thereby reducing boredom among students[26] Other research results also show successful and enjoyable learning activities marked by increased student performance after the PBL model was implemented. Students became more knowledgeable about the material even though they had no previous experience.[27] The effectiveness of the PBL model in the classroom is none other than because pedagogically, this model places students as the center of learning and allows students to develop other desired learning attributes.[28,29] The application of PBL also improves communication and group collaboration among students. The nature of constructivist learning is very binding in this model so that it encourages reflective thinking in students. Therefore, the application of PBL with multimedia proves to be an effective model for enhancing students' science process skills in the Natural and Social Sciences subject.

CONCLUSIONS

The conclusion of this study is that the science process skills of fourth grade students of SD Negeri 1 Karangsari can be improved through the implementation of multimedia-assisted PBL with significant improvement in each cycle with a very good category from cycle I to cycle III. The application of the model begins with problem orientation using multimedia, organizing students with the help of multimedia, guiding and directing students in conducting investigations, developing and presenting discussion results, and ending with analyzing and evaluating with multimedia.

This research serves as a consideration for teachers to create engaging learning environments that prevent student boredom and enhance student understanding during lessons. Furthermore, it can serve as a reference for implementing more innovative and meaningful teaching practices that ultimately improve the quality of education.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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