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Improving Science and Social Studies Learning Outcomes Through Project-Based Learning Model Based on Simple Experiments

[1]*Aqila Widyastuti., [1]Abd Rahman Azhari., [1]Roso Sugiyanto., [1]Ichyatul Afrom

[1]Universitas Palangka Raya, Central Borneo, Indonesia.

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ABSTRACT

Aim: This study aims to improve science and social studies learning outcomes of third-grade students at SDN 2 Panarung through the implementation of a simple experiment-based Project-Based Learning (PjBL) model that accommodates kinesthetic and hyperactive learning characteristics. *Method:* The research was conducted using Classroom Action Research with the Kemmis and McTaggart model in two cycles involving 23 third-grade students. Data were collected through learning outcome tests, observations, and documentation, then analyzed descriptively using gain scores and narrative qualitative analysis. *Result and Discussions:* The findings indicate a significant improvement in student learning outcomes across cycles. The average score increased from 32.17 in the pre-cycle to 56.09 in Cycle I and 87.83 in Cycle II. The N-Gain analysis showed a moderate improvement in Cycle I (0.35) and a high improvement in Cycle II (0.84). Learning mastery also improved from 0% in the pre-cycle to 47.8% in Cycle I and reached 100% in Cycle II. The improvement in Cycle II was supported by the use of simpler and more concrete experiments that aligned with students' developmental levels and learning styles. *Conclusion,* The implementation of simple experiment-based PjBL proved effective in enhancing learning outcomes, encouraging active participation, and increasing students' understanding and motivation. This learning model is recommended for use in classrooms with similar student characteristics.

Keywords: Project-Based Learning, Simple Experiment, Science, Learning Outcomes.

Corresponding Author:
Aqila Widyastuti
Teacher Professional Education
Universitas Palangka Raya,
Yos Sudarso Street, Palangka Raya, Central Kalimantan, 73111
Email: aqillawidyastuti06@gmail.com

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INTRODUCTION

Trianto (2010:17) states that learning is a complex aspect of human activity that cannot be fully explained. In simple terms, learning can be understood as the product of continuous interaction between development and life experiences. In its more complex meaning, learning is a conscious effort by a teacher to facilitate student learning by guiding their interaction with various learning resources to achieve the intended educational goals.(Kartinah et al., 2014)

Primary education is a crucial foundation in shaping children's character, critical thinking skills, and cognitive abilities. One of the key subjects at this level is Natural and Social Sciences (IPAS), which aims to equip students with scientific and social knowledge that is contextual and applicable in daily life. Unfortunately, the IPAS learning process still faces various challenges, one of which is the limitation of teaching approaches that align with students' learning styles.

In reality, science learning in elementary schools often falls short of expectations. Most teachers and students rely solely on textbooks and rarely conduct experiments. As a result, students are forced to learn science without practical experience, limiting their skill development and making the learning process less effective. Several factors contribute to this issue: (1) Teachers rely only on textbooks; (2) Although the school has a science lab, it is used for storing equipment instead of conducting experiments; (3) The available materials are outdated and lack innovation; (4) Teachers struggle to conduct experiments due to limited guidance; and (5) There is no environmental-based practical science guide. This study aims to explore how simple experiments can improve students' science process skills (Ibrahim et al., 2019).(Farikhatun Nikmah et al., 2023)

At SDN 2 Panarung, particularly in grade III, the IPAS learning process has not yet shown optimal results. Based on initial observations, most students exhibit hyperactive characteristics and predominantly kinesthetic learning styles, which require physical activity and direct experience in learning. However, conventional methods such as lecturing remain the primary approach used, resulting in low student engagement and focus during lessons. This is evident from the pre-cycle learning outcomes showing an average score of only 32.17.

In response to these issues, innovation in teaching strategies that are more interactive and contextual is necessary. One learning model considered effective for this condition is Project-Based Learning (PjBL). This model emphasizes active student involvement through real projects or tasks that integrate knowledge and skills to solve problems. When PjBL is combined with simple experiments, students have the opportunity to directly experience the learning process through enjoyable and relevant experiments.

Offering project-based learning can seem like an extraordinary endeavor, so much so that it can be difficult to know where to start. Although adopting this educational modality comes with various challenges, two points are generally agreed upon in the literature about strategies for implementing project-based learning – namely, teaching is fundamentally different and increasingly complex when the teacher designs a project that is to serve as the pedagogical axis of their class, and when student learning is to be evaluated through the final project. Because of this, the advice offered by leading researchers in the field is to support the teacher in designing a feasible and effective project. (Yang, 2020)

Several studies indicate that experimental approaches in science learning can significantly improve conceptual understanding. Simple practical activities, such as making ice cream by hand or observing changes in states of matter, can link theory with real practice and encourage students to think critically and collaborate in groups. Thus, implementing a simple experiment-based PjBL model becomes a strategic alternative to improve the IPAS learning outcomes of third-grade students, especially at SDN 2 Panarung.

One of the topics in science lessons is changes in states of matter. The state of matter refers to the physical form of a substance, which can change through physical or chemical processes. Changes in states of matter include melting, freezing, and evaporation. Melting occurs when a solid, such as ice, changes into a liquid state due to heating or the addition of heat. This process, known as melting, involves heat absorption triggering the transition from solid to liquid. Freezing is the opposite, where a liquid turns into a solid. During freezing, heat is released at low temperatures, contrary to melting where heat is absorbed. Evaporation refers to the change from liquid to gas, which can occur due to heating, both in the environment and within the human body. For example, when water boils, evaporation takes place.(Putri et al., 2024) And an attempt is made to answer the following research question: How does the simple experiment-based Project-Based Learning (PjBL) model affect the science and social studies learning outcomes of third-grade students at SDN 2 Panarung?

Learning outcomes represent students' ability to understand and master the subject matter. In Natural and Social Sciences (IPAS), learning outcomes are not only measured by test scores but also through scientific thinking skills and the ability to apply concepts in real life (Sumantri, 2001). Learning engagement refers to the active participation of students in the ongoing learning process, where they interact with both their peers and the teacher (Endang Sri Wahyuningsih, 2020: 48).(Susilowati, 2023)

Learning outcomes refer to observable and measurable changes in a person's behavior, including knowledge, attitudes, and skills. These changes indicate improvement and development—from not knowing to knowing (Hamalik, 2007:30).

According to Sudjana (2009:22), learning outcomes are the abilities students acquire after undergoing learning experiences, reflected in changes within the cognitive, affective, and psychomotor domains as a result of the learning process.(Nuzula et al., 2022)

The Project-Based Learning (PjBL) model is an instructional approach that places students at the center of the learning process through completing projects related to real-world contexts. This model requires students to work in groups, design and complete projects, and present their results, thereby developing various 21st-century skills such as communication, collaboration, creativity, and problem-solving (Cahyati & Prastiwi, 2024).

PjBL has six main characteristics, including: triggering students' curiosity to generate questions, making students active in projects, focusing on students' goals and achievements, promoting cooperation among team members, creating artifacts relevant to the current era, and utilizing advanced technology. (Hidayat et al., 2024)

Teachers are given the opportunity to oversee classroom learning through project-based work. The goal of the project is to provide students with challenging tasks that encourage them to think critically, solve problems, make decisions, conduct investigations, and work independently while also pursuing their interests in learning.

Students are encouraged to reflect on what they have learned by working on real-world projects. Through project-based learning, they also have the chance to explore the connection between theory and practice. As if in real-life situations, students are able to apply their skills and create authentic products.(Cahyati & Sriwijayanti, 2024)

PjBL has a significant and beneficial positive effect on students' academic achievement, including language skills, critical thinking, and knowledge acquisition (Du & Han, 2016). In PjBL, students are assigned complex and relatively challenging projects that are complete and realistic, while still receiving sufficient support to enable them to complete the tasks (Berhitu et al., 2020). The PjBL model engages students in learning activities based on a scientific approach, such as asking questions, conducting observations, research, experiments, reasoning, and interacting with others in order to gather information or data (Wayan & Mahendra, 2017). (Trisnawati et al., 2024) According to Sari (2018), project-based learning is "a learning approach that directly involves students in creating a project." (Sumampow et al., 2023)

Science learning in elementary school emphasizes direct observation of the natural environment. Students observe plants, animals, and natural phenomena around them to build observational and inferential skills. This approach fosters critical and creative thinking by encouraging students to ask questions, plan experiments, collect data, and draw conclusions. Additionally, collaborative group activities help students improve social and problem-solving skills. Overall, interactive and exploratory science lessons aim to develop students' interest and foundational understanding of science for future learning.(Ansya, 2023).

Changes in the States of Matter

Matter is classified into three types based on its state: liquids, solids, and gases. Liquids are made up of loosely packed molecules, allowing them to flow, take the shape of their container, and move freely in all directions; examples include syrup and cooking oil. Solids consist of tightly packed molecules with a fixed shape and volume that are difficult to change, such as rocks, chairs, and tables. Gases have very loosely packed molecules and do not have a fixed volume but occupy space and exert pressure; examples are air, oxygen, and water vapor. Matter can change from one state to another through processes such as melting, sublimation, condensation, freezing, and evaporation. These changes may be permanent (chemical changes) or temporary (physical changes). Factors like temperature, pressure, mixing with water, and exposure to air influence these changes.(Sari et al., 2021)

The term "experiment method" consists of two words with distinct meanings. According to Badudu (2002), a method is a systematic way used to carry out a task to achieve desired goals; it is a systematic work process to facilitate the implementation of activities to reach a specific objective. Meanwhile, an experiment is a systematically planned trial conducted to prove the validity of a theory. Rusyan in Sagala and Saiful (2009) states that the concept of an experiment is often confused with laboratory work, although both share similar principles, their connotations differ. An experiment is a trial aimed at testing a specific question or hypothesis. Experiments can be conducted inside or outside the laboratory. The experimental process implies learning by doing, which makes it suitable to be incorporated as a learning method. According to Abimanyu, Soli (2008), the experimental method in learning is a way of presenting material that allows students to conduct trials to test questions or hypotheses being studied.(Masriani et al., 2014)

Simple experiments are very suitable for use in elementary schools because they utilize easily available tools and materials and follow safe procedures. Through experiments, students learn by directly observing natural phenomena, which aligns well with kinesthetic learning styles. This approach also helps students understand abstract concepts in a more concrete manner (Masriani et al., 2020; Tanjung, 2023).

In teaching, there are procedures or steps that can be carried out in the classroom, including:

1. The teacher explains the purpose of the experiment to the students.
2. The teacher describes the tools and materials to be used in the experiment and prepares student worksheets (LKS).
3. Students need to pay attention to what actions must be taken and what should be recorded during the experiment. In the implementation stage, students observe the object being studied, conduct a simple experiment, then analyze and draw conclusions from the results.
4. The teacher should supervise and provide assistance to students who experience difficulties during the experiment.
5. In the closing stage, students submit their experiment reports, and the results are presented in front of the class.(Adolph, 2016).

METHOD

In formal education, the most commonly developed research by teachers in schools is Classroom Action Research (CAR) because the subjects of the research are the students (Susilowati, 2018). This type of research is experimental Classroom Action Research, which is conducted by attempting to apply various techniques or strategies effectively and efficiently in teaching and learning activities (Mardinugroho, 2021). Through Classroom Action Research, the researcher can study students by observing their interactions during the learning process (Hariatin, 2022).(Muh Ali et al., 2023)

This study is a Classroom Action Research (CAR) using the Kemmis & McTaggart model, which consists of four stages: planning, action implementation, observation, and reflection. The research was conducted in the third grade at SDN 2 Panarung during the even semester of the 2024/2025 academic year.

The research subjects were 23 students, the majority of whom exhibited hyperactive characteristics and kinesthetic learning styles. Data were collected using learning outcome tests, student activity observation sheets, and documentation of learning activities.

Quantitative data, in the form of learning outcome scores, were analyzed using descriptive statistics to determine the improvement in learning outcomes in each cycle. Meanwhile, qualitative data, derived from observations, were analyzed narratively to assess the level of student engagement and participation in the learning process.

RESULTS AND DISCUSSION

At The Pre-Cycle Stage, Learning Was Conducted Conventionally Using The Lecture Method. As A Result, Students Were Less Actively Engaged And Tend To Be Unfocused. The Class Average Score Was Only 32.17. Observations Showed That Students Were More Interested In Moving Around Than Listening To The Teacher's Explanation.

Cycle I – Simple Experiment "Melting And Freezing" (Making Stirred Ice Cream)

a. Planning

   Learning Was Designed Using A Project-Based Learning Approach With An Experiment On Melting And Freezing Through Making Stirred Ice Cream. Materials, Student Worksheets, And Learning Aids Were Prepared.

b. Implementation

Students Conducted An Experiment Making Ice Cream By Using Ice, Salt, And Milk To Observe The Freezing Process.

c. Evaluation Results

After The Activity, Students Took A Post-Test To Measure Conceptual Understanding.

- Pre-Test Average Score: 32.17
- Post-Test Average Score Cycle I: 56.09
- Average N-Gain: 0.35 (Moderate Category)
- Number Of Students Passing (≥75): 11 Out Of 23 Students (47.8%)

d. Reflection

Reflection is the activity of reviewing and evaluating each cycle in order to make improvements in the next one. Based on the data analysis above, although the results are generally positive, there are still some shortcomings during the learning process—some students still had difficulty understanding the material, resulting in incorrect answers on the assessment. (Nurhalizha, 2017). The Experiment In Cycle I Was Still Considered Quite Difficult Due To Complex Procedures. Many Students Experienced Confusion, So The Understanding Of The Concepts Of Melting And Freezing Was Not Yet Optimal. Improvements Are Needed With Simpler And More Observable Experiments.

Cycle II – Simple Experiment "Sublimation And Crystallization" (Camphor)

a. Planning

The Plan Was Improved By Choosing The Sublimation And Crystallization Experiment Using Camphor. This Experiment Was Simpler And Did Not Require Complex Tools.

b. Implementation

Students Observed The Change Of Camphor From Solid To Gas (Sublimation) And From Gas Back To Solid (Crystallization).

c. Evaluation Results

After The Activity, A Post-Test Was Conducted To Measure The Increase In Conceptual Understanding.

- Post-Test Average Score Cycle II: 87.83
- Average N-Gain: 0.84 (High Category)
- Number Of Students Passing (≥75): 23 Out Of 23 Students (100%)

d. Reflection

The Experiment In Cycle II Was Proven More Effective. Students Found It Easier To Understand The Concept Of Changes In States Of Matter Because The Process Was Simple And Directly Observable. Learning Outcomes Improved Significantly.

Table I. Results of Cycle I and Cycle II

Aspect Analyzed	**Pre-Test**	**Post-Test Cycle I**	**Post-Test Cycle II**
Average Score	32.17	56.09	87.83
Average Gain (Score Increase)	–	23.91	55.65
Average N-Gain	–	0.35 (moderate)	0.84 (high)
Learning Mastery (≥ KKM 75)	0%	± 47,8%	± 100%
Improvement Category	–	Moderate Improvement	Significant Improvement
Experiment Effectiveness	–	Less Optimal (due to complex procedure)	Optimal (simple experiment, easy to observe)

Discussion

1. Description of Research Results

This study aimed to improve the Natural and Social Sciences (IPAS) learning outcomes of third-grade students through the implementation of a Project-Based Learning (PjBL) model based on simple experiments. The experiments were conducted in two cycles. In Cycle I, the melting and freezing experiment was carried out through making stirred ice cream. Meanwhile, in Cycle II, the experiment was simplified to observing the sublimation and crystallization processes using camphor.

Table II. Summary of Average Learning Outcome Scores and Mastery

Stage	**Average Score**	**N-Gain**	**Mastery Percentage**
Pre-Test	32.17	–	0%
Post-Test Cycle I	56.09	0.35	47.8%
Post-Test Cycle II	87.83	0.84	100%

The results showed a significant improvement in Cycle II, both in terms of average scores, N-Gain, and the number of students meeting the Minimum Mastery Criteria (≥75).

2. Interpretation of Results

The implementation of Project-Based Learning (PjBL) combined with an experimental approach provided students the opportunity to learn through direct experience. In Cycle I, the ice cream making experiment was indeed engaging but was less suitable for the cognitive development level of third-grade students. The complex procedure and the lack of supporting visual media resulted in less than optimal student understanding. This was reflected in the post-test average score, which was still below the optimal mastery standard, with only 11 out of 23 students (47.8%) achieving the Minimum Mastery Criteria.

Improvements in Cycle II, through a simpler and more concrete experiment using camphor, successfully increased the effectiveness of learning. The sublimation and crystallization processes could be directly observed and understood more intuitively by students. The average score increased drastically to 87.83, with a mastery rate reaching 100%, and an N-Gain of 0.84, categorized as high. This indicates that simple, relevant, and directly observable experiments are more effective in supporting science learning at the elementary school level.

3. Discussion With Previous Studies

The findings of this study support and reinforce the conclusions of Cahyati & Prastiwi (2024), who stated that integrating the Project-Based Learning model with an experimental approach significantly improves learning outcomes, critical thinking skills, and student motivation. Similarly, the study by Masriani et al. (2020) at SDN Lenju showed that the experimental method on the topic of changes in states of matter increased student engagement and learning outcomes progressively across cycles.

Furthermore, research by Tanjung (2023) at MIS NU Kampung Mudik also found that the experimental method significantly improved students' understanding of science concepts from cycle to cycle. This study provides evidence that the experimental method, especially when adapted to the conditions and characteristics of students, is highly effective in science learning.

One view is that project-based learning can significantly improve student learning outcomes, including academic achievement, motivation, and higher-order thinking skills. Karpudewan et al. (2016) explored the feasibility of improving energy literacy among secondary school students using a project-based instructional approach. The quantitative results of the study showed that students exposed to a PjBL curriculum had better performance on energyrelated knowledge, attitudes, behaviors, and beliefs. (Zhang & Ma, 2023).

CONCLUSION

Based on the results of the Classroom Action Research conducted in Cycle 1 and Cycle 2, it can be concluded that the implementation of the Project-Based Learning model based on simple experiments has proven effective in improving the learning outcomes of Natural and Social Sciences (IPAS) for third-grade students at SDN 2 Panarung. This learning model is highly suitable for students with hyperactive and kinesthetic learning characteristics, as it provides opportunities for active learning through enjoyable and meaningful hands-on activities.

The implementation of this model not only enhances students' conceptual understanding of IPAS but also significantly fosters their interest and motivation to learn. The learning process involving simple experiments allows students to observe, try, and directly experience the lesson material, thereby increasing their engagement and absorption of the content taught.

Therefore, it is recommended that teachers more frequently integrate the Project-Based Learning model based on simple experiments in IPAS learning as well as in other relevant subjects. This is expected to help address challenges in learning, especially for students with Kinesthetic learning styles and other special needs.

Furthermore, the school is expected to provide support by supplying adequate facilities and infrastructure, such as simple experimental tools that are safe, easy to operate, and comply with student safety standards. Such support is crucial to ensure the smooth and successful implementation of this learning model, enabling it to achieve the intended educational objectives optimally.

Thus, the application of the Project-Based Learning model based on simple experiments can serve as an effective and innovative alternative learning strategy to improve the quality of education at the elementary school level, particularly in IPAS learning.

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