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The Implementation of a Problem Based Learning Model Assisted by Kahoot Media within a Lesson Study Framework to Enhance Learning Outcomes in Basic Science Concepts among Prospective Elementary School Teachers

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ABSTRACT

Prospective elementary school teachers often encounter difficulties in understanding the Basic Science Concepts course, particularly on topics such as Motion, Force, and Simple Machines. These challenges are influenced by students' diverse academic backgrounds, which affect their initial conceptual understanding. This study aims to enhance students' learning outcomes through the implementation of the Problem Based Learning (PBL) model assisted by Kahoot media within a Lesson Study framework. The research employed a Classroom Action Research (CAR) design consisting of four stages: planning, implementation, observation, and reflection. The participants were students from class C24D (22 students) and class C24E (23 students) of the Primary School Teacher Education (PGSD) Study Program, Campus V, Universitas Negeri Makassar. Data were collected through observation of learning activities and learning outcome tests. The findings revealed a steady improvement in students' achievement, with the average score increasing from 62 (57.78% mastery) in the pre-cycle to 69 (64.44% mastery) in the first cycle, and reaching 86 (84.44% mastery) in the second cycle. Furthermore, student participation, collaboration, problem-solving ability, and engagement through Kahoot also increased, while lecturer performance was rated as very good. Therefore, the implementation of the PBL model assisted by Kahoot media effectively improved students' understanding and learning outcomes in Basic Science Concepts.

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1. INTRODUCTION

The Basic Science Concepts course is a compulsory subject in the undergraduate Primary School Teacher Education (PGSD) Study Program. It is offered in the second semester and serves as a crucial foundation in shaping the competencies of prospective elementary school teachers to understand and teach fundamental science concepts effectively. The primary goal of this course is to enable students to analyze, explain, and apply basic science concepts taught in elementary schools, including the topics of Motion, Force,

and Simple Machines [1]. Therefore, mastery of these basic concepts becomes an essential benchmark for future teachers in developing meaningful science learning at the elementary level. In this context, it is important to ensure that learning not only transfers knowledge but also builds the pedagogical and conceptual understanding that will later be applied in elementary classrooms.

However, in practice, students often experience difficulties in understanding the material in the Basic Science Concepts course, especially on the topics of Motion, Force, and Simple Machines. Based on the pretest results conducted among students of classes C24D and C24E in the PGSD Study Program, Campus V, Universitas Negeri Makassar, it was found that the average learning outcome score was only 62, with a mastery level of 57.78%, which is below the Minimum Mastery Criteria (KKM) of 75. These low results are influenced by the diverse educational backgrounds of students. Some students come from science (IPA) majors, while others come from social studies, language, or vocational schools with different concentrations. This diversity affects students' initial abilities and cognitive readiness to understand scientific concepts that are abstract and require scientific thinking skills. Such conditions highlight the need for a learning model that can bridge students' different starting points and provide active, contextual, and digital-based learning experiences.

In addition to differences in academic background, students' limited understanding is also affected by the lack of variety in learning models used in lectures. Learning activities that tend to be one-way make students less actively involved in the process of knowledge construction. Students often receive information passively without sufficient opportunities to explore concepts through hands-on experiences or problem-based discussions. As a result, their conceptual understanding of science materials—particularly topics such as Motion, Force, and Simple Machines—becomes less comprehensive. Therefore, learning models that combine constructivist and collaborative approaches, supported by interactive technology, are needed to stimulate engagement and deepen conceptual understanding.

One learning model that is relevant to overcome this problem is Problem-Based Learning (PBL). This model emphasizes the presentation of contextual problems as a basis for students to search, analyze, and find solutions through scientific reasoning. PBL can improve critical thinking skills and conceptual understanding because students learn through the exploration of real-world problems related to the learning material [2]. In the context of the Basic Science Concepts course, the implementation of PBL allows students to relate the concepts of Motion, Force, and Simple Machines to phenomena that occur in daily life, making the learning process more meaningful and applicable. Furthermore, PBL aligns with the needs of teacher education in preparing future educators who are capable of applying inquiry-based and student-centered teaching practices.

To make the implementation of PBL more engaging and interactive, it is necessary to use digital learning media that can increase students' motivation. One medium that can be used is Kahoot, an interactive game-based quiz platform that encourages active student participation through healthy competition and instant feedback. The use of Kahoot in learning can enhance students' focus, engagement, and learning outcomes by creating a fun and stimulating classroom environment [3]. The integration of PBL with Kahoot supports digital pedagogy, enabling students to experience technology-enhanced learning aligned with 21st-century skills—especially collaboration, creativity, and critical thinking [4]. Thus, PBL combined with Kahoot can bridge the gap between conceptual mastery and digital literacy expected from future teachers.

To ensure the quality and sustainability of the learning improvement process, the Lesson Study approach is introduced as a professional development framework that focuses on reflective and collaborative teaching improvement. Lesson Study emphasizes systematic planning, implementation, and reflection of lessons among lecturers and peers to improve teaching quality. This approach is relevant to digital-based learning because it provides a structured mechanism to evaluate the integration of PBL and Kahoot, ensuring that learning innovations are evidence-based and continuously refined [5]. Through Lesson Study, lecturers collaboratively design PBL-based digital lessons, observe students' learning engagement, and reflect on outcomes to enhance both pedagogical practice and digital fluency [6].

Based on the rationale above, this classroom action research aims to improve students' understanding of concepts, learning engagement, and motivation through the implementation of the Problem-Based Learning model assisted by Kahoot media within a Lesson Study framework among PGSD students at Campus V, Universitas Negeri Makassar. The integration of PBL, Kahoot, and Lesson Study forms a coherent pedagogical strategy that addresses the gap between traditional instruction and digital, reflective learning practices. This research is expected to contribute pedagogically by providing a model for digital-integrated reflective learning that enhances the professional competencies of future teachers, particularly in designing, implementing, and evaluating technology-supported learning innovations. Therefore, this study not only responds to existing learning challenges but also contributes to the advancement of teacher education through a sustainable and evidence-based digital pedagogy framework.

In line with these objectives, the present study explores how the implementation of the Problem-Based Learning model assisted by Kahoot can improve students' learning outcomes in the Basic Science Concepts

course, and how the Lesson Study approach supports the enhancement of teaching quality and student engagement during the learning process. Through these inquiries, the study seeks to provide a comprehensive understanding of the interaction between problem-based learning design, digital media integration, and collaborative reflection. Accordingly, the research hypothesis posits that the application of the PBL model assisted by Kahoot within the Lesson Study framework can significantly increase students' learning outcomes, engagement, and motivation compared to conventional learning methods. This formulation explicitly connects the identified learning gaps with the proposed pedagogical solution and highlights the potential contribution of this research to the advancement of digital and reflective pedagogy in teacher education.

2. RESEARCH METHOD

This study employed a Classroom Action Research (CAR) design integrated with the Lesson Study approach. The purpose was to improve students' learning outcomes through the application of the Problem-Based Learning (PBL) model assisted by Kahoot media. The research was conducted during the even semester of the 2024/2025 academic year at the PGSD Study Program, Campus V, Universitas Negeri Makassar, involving 45 second-semester students from classes C24D and C24E.

The research focused on the Basic Science Concepts course, particularly on the topics of Motion, Force, and Simple Machines. The instruments used were a student activity observation sheet, a lecturer observation sheet, and a learning outcome test. The study consisted of two cycles, each following four stages: Plan, Do, Observe, and Reflect. In the planning stage, the learning design was prepared collaboratively by the model lecturer and observer team, integrating PBL with Kahoot media. In the implementation stage, the model lecturer conducted learning according to the plan. During the observation stage, observers recorded student activities and learning implementation. The reflection stage involved discussions between the lecturer and observers to evaluate results and make improvements for the next cycle.

Two cycles were carried out to ensure improvement and refinement of learning. Reflection in Cycle I identified weaknesses in participation and use of Kahoot, which were corrected in Cycle II by improving group management and time allocation. The study was considered successful when at least 80% of students achieved mastery learning and showed higher engagement. Within the Lesson Study framework, the model lecturer acted as the main practitioner, while observers documented student engagement and provided feedback for reflection. All participants were informed about the study's purpose and procedures, and their participation was voluntary with prior consent.

Data were analyzed qualitatively and quantitatively. Qualitative data described learning activities and lecturer performance, while quantitative data compared students' pretest and posttest scores to determine improvement in learning outcomes.

3. RESULTS AND DISCUSSION

Problem Based Learning (PBL) Model

Problem Based Learning (PBL) is an instructional model that places contextual problems as the starting point of the learning process to encourage students to think critically, solve problems, and construct new knowledge. PBL is a student-centered learning approach that uses real-world problems as a means to develop higher-order thinking skills [7]. In addition, PBL helps students gain a deeper understanding of concepts through open and collaborative inquiry processes [8].

In both elementary and higher education settings, PBL serves as a medium for students to build scientific understanding through active engagement in finding solutions to real-life problems relevant to their field of study. PBL encourages learners not only to master subject content but also to develop metacognitive abilities, communication skills, and teamwork competence [9].

Characteristics of Problem Based Learning

Several key characteristics define Problem Based Learning (PBL), namely: (1) problems serve as the main focus of learning, being relevant to real-life situations and challenging students' critical thinking; (2) learning is student-centered, where the lecturer acts as a facilitator rather than the primary source of information; (3) collaborative learning, which requires students to work together in small groups; (4) continuous reflection on the learning process, aimed at improving thinking strategies and problem-solving approaches; and (5) integration of interdisciplinary knowledge, as the problems encountered are often complex and multidimensional [10].

With these characteristics, PBL becomes an effective approach for developing students' critical thinking skills and conceptual understanding, particularly in scientific courses such as Basic Concepts of Science.

Steps or Syntax of Problem-Based Learning (PBL)

The main steps in problem-based learning include:

1. Orienting students to the problem, in which the lecturer presents a contextual problem that is both challenging and relevant to real-life situations.
2. Organizing students for learning, where students are divided into groups to discuss and formulate initial hypotheses.
3. Guiding individual and group investigations, during which the lecturer facilitates students in seeking information and collecting relevant data.
4. Developing and presenting the results, where students present the outcomes of their investigations in the form of reports, discussions, or digital media.
5. Analyzing and evaluating the problem-solving process, in which students reflect on their work and the thinking processes they have undertaken [11].

This model provides a meaningful learning experience that requires students to actively engage, think critically, and collaborate in solving scientific problems.

Advantages and Disadvantages of Problem-Based Learning (PBL)

The advantages of PBL include: (1) enhancing critical and creative thinking skills, (2) fostering independence and responsibility in learning, (3) strengthening communication and collaboration skills, and (4) cultivating a scientific attitude and learning motivation.

However, PBL also has several drawbacks, such as requiring a relatively long duration of time, demanding lecturer readiness in designing contextual problems, and needing supporting facilities such as interactive learning media to make the process more effective [12].

Kahoot Media

Kahoot is a game-based learning platform that allows lecturers or teachers to create interactive quizzes accessible online through computers, tablets, or smartphones. It is a web-based learning application that combines elements of gameplay, competition, and instant feedback to enhance students' motivation and engagement in the learning process [13].

Kahoot functions not only as an evaluation tool but also as a medium that promotes collaboration and interactive discussion among students [14]. Through engaging visuals, dynamic background music, and a competitive point system, Kahoot creates an enjoyable learning atmosphere while improving focus and material retention.

In the context of science learning, Kahoot can be utilized to test conceptual understanding, train quick thinking, and identify students' misconceptions on topics such as motion, force, and simple machines.

Characteristics of Kahoot

Kahoot possesses several key characteristics that make it effective as a learning aid, including:

a. Interactive and participatory, as students can respond directly to questions using their digital devices;
b. Game-based (gamified), which fosters a sense of competition and intrinsic motivation;
c. Provides real-time feedback, allowing students to immediately recognize and correct their mistakes;
d. Supports collaborative learning, since students often discuss or work together when answering questions, and it can be integrated with various learning models such as Problem-Based Learning, Discovery Learning, or Project-Based Learning [15].

The Role of Kahoot in Enhancing Learning Outcomes

Kahoot plays an essential role in improving learning outcomes by integrating **c**ognitive, affective, and psychomotor aspects in a balanced manner. The gamification elements in Kahoot increase students' intrinsic motivation to learn, which positively affects their academic achievement. Furthermore, Kahoot enables real-time formative evaluation, allowing lecturers to assess students' understanding and provide immediate feedback [16].

Research indicates that using Kahoot in problem-based learning enhances students' critical thinking activity and strengthens their ability to analyze scientific concepts [17]. This aligns with the findings of Nisa et al. (2025), who reported that students showed a 15–20% improvement in academic performance after using Kahoot compared to conventional methods [16].

Therefore, integrating Kahoot into the Problem-Based Learning model is an effective strategy, as it supports every stage of learning—from problem investigation and group discussion to interactive and enjoyable evaluation.

Learning Outcomes

Learning outcomes refer to the behavioral changes that occur in an individual after undergoing the learning process, encompassing the cognitive, affective, and psychomotor domains. They represent the competencies students acquire after experiencing learning activities, reflected through their mastery of

knowledge, skills, and attitudes [18]. Learning outcomes also indicate the degree to which students have achieved the predetermined learning objectives [19].
In the context of higher education, learning outcomes are not only measured by students' ability to recall or comprehend concepts but also by their capacity to think critically, creatively, and collaboratively in solving real-world problems.

Learning outcomes serve as indicators of the effectiveness of the learning process and form the basis for academic decision-making [20]. In Problem-Based Learning, learning outcomes also encompass students' ability to integrate concepts, construct scientific arguments, and apply knowledge to solve problems. Thus, learning outcomes can be understood as the outcome of interaction among students, lecturers, and the learning environment facilitated through specific instructional strategies.

Students' Learning Outcomes on the Topics of Motion, Force, and Simple Machines

Students' learning outcomes were analyzed based on their pretest, posttest cycle I, and posttest cycle II scores. The data indicate an improvement in students' understanding and mastery of basic science concepts after the implementation of the Problem-Based Learning (PBL) model supported by Kahoot media.

Table 1. Summary of Students' Learning Outcomes

Stage	Mean	Median	Standard Deviation	Number of Students Achieving Mastery	Mastery Percentage (%)
Pretest	74,13	76	10,41	26	57,78
Cycle I	77,20	77	6,97	29	64,44
Cycle II	81,71	82	7,21	38	84,44

Based on the data analysis in Table 1, there was a clear improvement in students' learning outcomes from the pre-cycle to cycle II. During the pre-cycle phase, the average score was 74.13 with a mastery level of 57.78%, indicating that most students had not yet mastered the fundamental science concepts, particularly those related to Motion, Force, and Simple Machines. This finding suggests that students still faced difficulties in understanding the relationship between force and motion concepts and physical phenomena commonly encountered in daily life.

After implementing the intervention in cycle I, the students' average score increased to 77.20, with a mastery level of 64.44%. This improvement demonstrates that the application of the Problem-Based Learning (PBL) model began to produce a positive impact on students' engagement in learning activities. Students became more active in group discussions, more confident in expressing opinions, and showed improved critical thinking skills when analyzing problems. The use of Kahoot as an evaluation tool also enhanced students' motivation and enthusiasm, as they were able to learn while playing an interactive quiz.

A more significant improvement was observed in cycle II, where the average score reached 81.71, and the overall mastery level increased to 84.44%, surpassing the Minimum Mastery Criteria (MMC) of 80%. This result indicates that problem-based learning supported by Kahoot successfully encouraged students to better comprehend and apply concepts in problem-solving contexts. Structured group activities and reflective discussions from Lesson Study further refined the instructional process in cycle II, particularly through the improvement of guiding questions and enhanced lecturer feedback.

These findings are consistent with Arends (2012), who states that Problem-Based Learning effectively enhances critical thinking and conceptual understanding because it requires learners to identify problems, gather data, and find solutions independently. Furthermore, the integration of interactive digital media such as Kahoot increases learning engagement and provides enjoyable formative assessment opportunities [21].

Thus, it can be concluded that the implementation of PBL supported by Kahoot is effective in improving the learning outcomes of prospective elementary school teachers, both in terms of conceptual understanding and scientific thinking skills.

Implementation of Lesson Study (Plan–Do–See)

Lesson Study (LS) was conducted in three main stages Plan, Do, and See, which were carried out collaboratively between the model lecturer and the observers with the aim of improving the quality of learning in each cycle.

Table 2. Implementation of Lesson Study in Each Cycle

Lesson Study Stage	Observed Aspects	Cycle I	Cycle II	Category
Plan (Planning)	Preparation of lesson plans (RPS), problem formulation, and PBL design	83%	92%	Very Good
Do (Implementation)	Student engagement, Kahoot application, lecturer facilitation	80%	90%	Very Good
See (Reflection)	Team discussion, identification of challenges, and action improvement	85%	93%	Very Good
Overall Average	-	82,7%	91,7%	Very Good

The implementation of Lesson Study in this research demonstrated positive results and supported the successful application of the Problem-Based Learning (PBL) model assisted by Kahoot. Based on the observations presented in Table 2, the implementation level of Lesson Study improved from 82.7% in cycle I to 91.7% in cycle II, both of which fall into the "very good" category.

During the Plan (Planning) stage, the model lecturer and research team collaboratively designed a problem-based learning scenario, taking into account the key stages of PBL. This included identifying contextual problems, forming student groups, and developing Kahoot quiz items. This planning stage served as a crucial foundation for effective learning implementation, as a well-structured lesson design determines the direction and quality of students' learning activities.

The Do (Implementation) stage showed an improvement in the quality of classroom interaction. Students became more active in discussions and collaborated more effectively to solve problems. The use of Kahoot made the learning process more dynamic and engaging, fostering a collaborative learning environment. The lecturer acted as a facilitator rather than the sole source of information, aligning with the student-centered learning principle of the Merdeka Curriculum.

In the See (Reflection) stage, the teaching team and observers discussed the outcomes of the learning implementation to evaluate the challenges and strengths encountered during the process. Reflections from cycle I led to several improvements implemented in cycle II, including clearer instructional guidance, more challenging quiz items, and an increased proportion of Kahoot-based formative assessments. Through this collective reflection process, the quality of learning improved continuously.

These findings support the view that Lesson Study is effective in enhancing educators' professionalism and learning quality through a systematic cycle of reflection and improvement [22]. In other words, Lesson Study not only refines the lecturer's instructional practice but also directly contributes to increased student engagement and learning outcomes.

4. CONCLUSION

Based on the results of the classroom action research conducted over two cycles, the following conclusions can be drawn: The implementation of the Problem-Based Learning (PBL) model supported by Kahoot media significantly improved students' learning outcomes on the topics of Motion, Force, and Simple Machines. The students' average scores increased from 74.13 in the pre-cycle to 77.20 in cycle I, and further to 81.71 in cycle II, with the classical mastery level rising from 57.78% to 84.44%. This demonstrates that problem-based learning effectively encourages students to think critically, develop a deeper conceptual understanding, and engage actively in the learning process. The implementation of Lesson Study through the Plan–Do–See stages was carried out successfully and showed an improvement in instructional quality. The implementation percentage increased from 82.7% in cycle I to 91.7% in cycle II, both categorized as "very good." Collaborative planning, student-centered execution, and systematic reflection were the key factors contributing to the improvement of learning quality. The combination of the PBL model, interactive digital media (Kahoot), and the Lesson Study approach proved effective in creating an active and enjoyable learning atmosphere, fostering collaboration between lecturers and students to enhance both the learning process and outcomes. This synergy not only improved students' understanding of scientific concepts but also nurtured their scientific thinking skills and confidence in solving contextual problems.

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