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Implementation of Problem-Based Learning Model to Enhance Critical Thinking Skills on Force Material in Fourth Grade Elementary School.

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Abstract

Learning about force material in natural science can be challenging for elementary school-age children due to its abstract nature. This poses a problem in the learning process, as force is essentially a concept that exists only in the human mind. The purpose of this study was to investigate the impact of the Problem-Based Learning (PBL) model on enhancing critical thinking skills in fourth-grade elementary school students, specifically in the context of force material. The study employed a quantitative experimental method (quasi-experimental) and involved a total sample of 50 students from SDN Tipar Bogor. The independent variable in this study was the utilization of the Problem-Based Learning model, while the dependent variables were the students' critical thinking ability and mastery of the minimum competency in force material. In this study, the data collection techniques were tests and observation. The results of the study revealed a significant difference in the average critical thinking ability of the experimental class, which was found to be 85.06. This indicates that the students in the experimental class successfully met the specified target, surpassing the minimum completeness criterion of 70. Based on the findings, it can be concluded that the implementation of the Problem-Based Learning (PBL) model significantly improved students' critical thinking skills in the context of force material. The control class achieved an average score of 75.08, meeting the minimum mastery criterion of 70. This indicates that the PBL model was effective in enhancing students' critical thinking abilities. The N-Gain results demonstrated a substantial increase of 0.75 in the experimental class, which falls under the high gain category. The obtained results can serve as a valuable reference for implementing the Problem-Based Learning (PBL) model in science education, particularly in teaching force material to elementary school students. The study suggests using the Problem-Based Learning (PBL) model for teaching force material to elementary school students. It effectively enhances critical thinking skills and is recommended for science education in elementary schools.

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INTRODUCTION

Science learning involves exploring nature and is not limited to memorizing theories, formulas, laws, and principles from textbooks. It prioritizes providing students with direct experiences to develop their competencies, making the learning process more meaningful (Kristiawan et.al. 2022). Students become more active in testing hypotheses and theories, while the teacher serves as a facilitator and motivator, guiding students during their learning process (Sekti et.al, 2023). The scope of science study materials for elementary schools includes topics such as forces, which encompass gravitational forces, frictional forces, and magnetism. These concepts are essential for understanding how objects move and interact with each other. By introducing these topics early on, students can develop a strong foundation in scientific principles

Force is defined as a push or pull that can cause an object to move. There are different types of forces that we can understand. For example, the magnetic force is a pull or push that is caused by a magnet, as explained by Sulistyanto et al. in 2019. Forces can either initiate the movement of an object or halt its motion. They play a significant role in determining how objects behave and interact with each other.

According to Susanto (2019), the force can indeed be defined as a push or pull that can cause objects to move, change direction, or even alter the shape of objects. Forces also have the ability to bring moving objects to a halt. To measure the magnitude of a force acting on an object, we can use a spring balance measuring instrument, also known as a dynamometer. Furthermore, Kudisiah (2020) explains that forces can be classified into various types based on their causes. This allows us to distinguish between different forces and understand their specific characteristics. Understanding the different types of forces helps us analyze and explain various phenomena in our everyday lives

There are several different types of forces to consider. Firstly, muscle force is generated by the muscles in our body. For example, when we kick a ball, we exert force using our leg muscles. Muscle force is highly flexible, as it can both push and pull. This force is controlled by biological coordination within humans. Secondly, the magnetic force is caused by magnets. Magnets possess the ability to attract or repel one another due to the magnetic field they generate. Magnetic force plays a significant role in various applications, such as magnetism in everyday objects, electric motors, and compasses. For example, when we bring a bar magnet close to an iron nail, the nail is attracted to the magnet and sticks to it. This is because magnets attract objects made of iron. The magnet has a special force called the magnetic force that pulls the iron nail towards it. This force is responsible for the nail attaching itself to the magnet. Understanding this magnetic force is important for things like electric motors and magnetic storage devices.

Thirdly, Earth's gravitational force is a force caused by the gravitational pull of the Earth on all objects on its surface. This force is what keeps us grounded and prevents us from floating in the air. It allows us to stand, walk, and go about our daily activities on the surface of the Earth. Fourthly, frictional force is a force that occurs when two objects come into contact and is caused by the interaction between their surfaces. An example of frictional force is the force applied to a bicycle brake. When the brake pads press against the wheel, frictional force is generated, which helps slow down or stop the motion of the bike.

Next is the electric force. It is a force that is produced by electric charges. For example, we can observe electric force in action with objects like plastic combs and rulers that have been rubbed with dry hair. These charged objects can attract small pieces of paper, showcasing the electric force at work. The last is the spring force that is generated by the work of an elastic object. This force can be seen in devices such as slingshots and bows. For instance, the elastic material on a slingshot can be stretched to store potential energy, and when released, it propels small stones forward.

In the elementary school's curriculum, force is an abstract concept that can present a

learning challenge for elementary school-age children. Its abstract nature makes it difficult for students to comprehend using traditional instructional methods. According to a study by Astiwi et al. (2020), the problem-based learning (PBL) model is considered effective in achieving teaching goals. It enhances students' thinking skills, improves their learning outcomes, and enhances their academic skills. PBL can be a valuable tool in helping students understand abstract concepts like force.

Force material is often perceived as challenging for students. One reason for this difficulty is that students tend to rely on memorization rather than gaining a deep understanding of the concepts. Instead of comprehending the underlying principles, they may simply recite facts without truly grasping their meaning. It is important to address this issue and encourage students to develop a thorough understanding of force through engaging and interactive learning strategies. This will help them build a solid foundation of knowledge and enhance their ability to apply the concepts effectively.

The role of the teacher in the learning process has evolved beyond simply transferring knowledge. Nowadays, teachers are seen as motivators and facilitators, empowering students to take an active role in their learning. It is crucial for students to actively participate in the teaching and learning process to achieve productive outcomes. By engaging students and encouraging their involvement, teachers can create an environment that fosters meaningful learning experiences and promotes the development of critical thinking and problem-solving skills.

According to Daniel D. Pratt (2019), teacher competence is a dynamic concept that changes as teachers progress through different stages of development. The nature of teacher competence evolves, and the various forms of competency that contribute to excellence in teaching are interconnected. This viewpoint emphasizes that teacher competence is not static, but rather a continuous process of growth and refinement, as educators acquire new knowledge, skills, and experiences throughout their careers. Pratt (2020) highlighted that teacher competence can be categorized into three stages: mastering skills and procedures, flexible problem-solving, and critical reflection on knowledge and values. These stages represent the progressive development of teachers' abilities and their capacity to adapt to different situations in the classroom.

Furthermore, Muzenda (2021) emphasized that teacher competence in the learning and teaching process is a multidimensional concept. It encompasses various interconnected aspects such as knowledge, communication skills, subject matter expertise, class management, teaching skills, and teacher attitudes. This broader perspective recognizes that effective teaching goes beyond subject expertise and includes a range of competencies that contribute to successful student learning outcomes.

Teacher Competency Standards are developed based on four main competencies: pedagogic competence, personality, social competence, and professional competence. These competencies are integrated into teacher performance. Pedagogic competence focuses on effective lesson planning, classroom management, and assessing student learning. Personality competence involves developing positive values and attitudes that create a conducive learning environment. Social competence emphasizes building positive relationships with students, colleagues, and the community. Professional competence includes continuous professional development and staying updated with educational practices.

Effective and efficient learning depends on the abilities and skills of teachers. They need to effectively apply their knowledge during educational interactions, maintain consistent use of teaching methods, manage the classroom, and optimize the teaching and learning process by using appropriate learning models. These efforts aim to enhance critical thinking skills in students.

According to Fisher (2019), critical thinking skills are an essential mental activity that is inseparable from human life. The ability to think critically varies among individuals and

needs to be nurtured from an early age. In recent years, the development of critical thinking skills has become increasingly popular in the field of education. This is because the advancing era demands individuals to enhance their thinking abilities through continuous development.

Salmon (2021) asserted, critical thinking is the ability to process both good and bad information, and it is highly essential for human life. In line with this, Duron et al. (2020), stated that critical thinking involves the ability to analyze and evaluate information. Critical thinkers can generate important questions and problems, formulate clear arguments, gather and evaluate relevant information, use abstract information, think from a wide perspective, and communicate effectively.

Expanding on this, Sihotang in Budiana (2020) argued that critical thinking can be interpreted as the ability to think clearly and rationally. By thinking critically, students can gain a better understanding of problems and find the best solutions to the challenges they encounter.

Moreover, critical thinking is a cognitive process that engages mental operations such as induction, deduction, classification, and reasoning. According to Enis, as cited in Fisher (2021), critical thinking is a reflective thinking method that is characterized by reason and logic. Its purpose is to determine appropriate actions and beliefs based on sound judgment and evidence.

According to Halpen, as quoted in Achmad (2020), critical thinking involves empowering deep cognitive skills or strategies to determine objectives. This process is followed by considering and directly referring to the desired target. It is a form of thinking that needs to be developed within the framework of problem-solving, formulating conclusions, considering various possibilities, and making decisions. Moreover, it is crucial to effectively utilize these skills in the appropriate context and situation. Critical thinking also involves the activity of evaluating and considering conclusions based on several supporting factors to make a decision. It is often referred to as directed thinking, as it focuses on a specific goal.

According to Morgan, as quoted in Suprapto (2020), learning to think is of utmost importance and can be framed within a cohesive framework. Firstly, thinking is essential for developing attitudes and perceptions that create a positive classroom environment. Secondly, thinking plays a crucial role in the acquisition and integration of knowledge. Thirdly, it helps to broaden one's horizons of knowledge by fostering curiosity and exploration. Furthermore, thinking enables individuals to actualize the meaningfulness of the knowledge they acquire, making connections and applying it to real-life situations. Lastly, thinking also contributes to the development of behaviour that promotes profitable thinking, such as critical analysis and problem-solving. By prioritizing the cultivation of thinking skills, educators can empower students to become active learners, capable of engaging with and applying knowledge in meaningful ways.

The previous research model was discovery learning, a type of learning where students actively build their knowledge. Afifah et al. (2020) argued that in this approach, students engage in experiments, analyze the results, and derive principles to build their understanding. By identifying problems, conducting experiments, collecting data, and drawing conclusions, students are expected to gain new knowledge. This hands-on, experiential learning method encourages students to be active participants in their learning process, fostering critical thinking, problem-solving skills, and the acquisition of new knowledge.

The discovery learning model is a learning theory which suggests that learning occurs when students are not simply presented with pre-packaged lessons, but rather when they are actively involved in organizing and constructing their knowledge. As Dale (2019) explained, a person's interaction with their environment plays a crucial role in the learning process. This is because the experiences an individual brings to the learning situation can greatly influence their learning outcomes. By actively engaging with

their surroundings and drawing upon their prior knowledge and experiences, learners can make meaningful connections, discover patterns, and develop a deeper understanding of the subject matter. This approach promotes active exploration, critical thinking, and problem-solving skills, ultimately leading to more effective and enduring learning outcomes. Vygotsky believed that learning happens through social interaction with teachers and peers. With their help, students can progress in their zone of proximal development. This zone is the gap between what they can do independently and what they can achieve with assistance. By working together and receiving guidance, students can reach their potential and expand their skills and knowledge. In education, fostering social interaction and providing support is crucial for facilitating learning and helping students grow within their zone of proximal development.

In elementary schools, if learning activities are solely focused on the classroom, students may become bored and unmotivated. This boredom can lead to disciplinary issues and a lack of engagement in learning. On the other hand, when learning activities extend beyond the classroom, students can become more interested in learning, improve their achievements, and gain new experiences.

The science learning model emphasizes hands-on experiences (learning by doing) to engage students, as mentioned by Ihsan et al. (2019). Afriansyah et al. (2020) highlighted the significance of concepts as the foundation for problem-solving, emphasizing the need for students to apply relevant rules based on acquired knowledge. In summary, active engagement and understanding of concepts are crucial in effective science education.

Concepts can be classified into two levels: concrete and abstract. Triana et al. (2020) described understanding as an intellectual activity that organizes existing knowledge. In science learning, Firdaus et al. (2019) explained that students engage in an intellectual process where they integrate new information with their existing knowledge to form new cognitive structures. Students can be considered to understand when they achieve the indicators of understanding. Learning outcomes can be categorized into three domains: cognitive, psychomotor, and affective. Understanding, as an indicator of the learning process, falls within the cognitive aspect.

Problem-Based Learning, as described by Nurhadi (2019), involves interactive activities between stimulus and response, creating a connection between learning and the environment. It is an educational approach that promotes collaborative group work to solve real-world problems. Persada et al. (2020) emphasize the use of problem simulation to pique students' curiosity before delving into a subject. In summary, Problem-Based Learning encourages active learning, group collaboration, and problem-solving, with problem simulation as an effective engagement strategy.

Problem-Based Learning is an approach that fosters critical and analytical thinking skills in students, as well as the ability to find and use relevant learning resources effectively. The learning environment assists and presents problems, while the brain's nervous system helps interpret the support to investigate, assess, analyze, and solve challenges. By presenting contextual problems, Problem-Based Learning stimulates active student engagement and learning. Problem-Based Learning is a student-centred approach that aims to support students in problem-solving rather than solely providing content. Arends (2019) identified three primary objectives of Problem-Based Learning: 1) Cultivating students' understanding of critical thinking and problem-solving, 2) Facilitating the learning of essential adult roles, and 3) Developing independent learning skills. This approach empowers students to actively engage in the learning process, fostering critical thinking, autonomy, and the ability to apply knowledge in practical situations.

Problem-Based Learning, according to Novika et al. (2019), aims to provide students with realistic learning experiences. The approach has three objectives: developing thinking and problem-solving skills, learning the roles of authentic adults through independent

investigations, and fostering independence as learners. It empowers students to think critically, tackle real-world problems, and become self-directed learners.

The problem-Based Learning (PBL) model, as described by Al' Fikry (2021), follows a constructivist approach and employs a scientific learning method. In this model, students engage in observing, asking questions, reasoning, experimenting, collaborating, and communicating information to address real-world problems, analyze data, and draw conclusions. PBL challenges students to develop their learning and teamwork skills while finding solutions to authentic problems. The essence of Problem-Based Learning (PBL) is to ignite students' curiosity by presenting them with problems to solve before they learn the corresponding concepts or materials. PBL aims to engage students and create a sense of relevance and purpose in their learning journey.

Problem-Based Learning (PBL) is a teaching model that aims to develop students' thinking, problem-solving, and intellectual skills (Asriningtyas, 2019). It aligns with constructivist principles and promotes collaborative learning through stimulating, open-ended questions (Nariman, 2021). PBL fosters critical thinking skills by presenting students with problems to solve.

Problem-Based Learning (PBL) is characterized by the introduction of a learning problem. It is based on cognitive psychology theories, like constructivism by Piaget and Vygotsky, emphasizing students' construction of knowledge and independent exploration of their environment to enhance learning outcomes (Sari et al., 2019).

In line with this, Astiwi et al. (2020) stated that Problem-Based Learning (PBL) is recognized as an effective instructional strategy in schools, emphasizing a scientific approach. Teachers are encouraged to cultivate students' social intelligence and problem-solving abilities within the school environment, enabling them to successfully navigate the complexities of globalization.

Halidayanti et al. (2019) proposed a five-step approach for implementing Problem-Based Learning (PBL) that includes: (1) Basic Concept, (2) Problem Definition, (3) Self-Learning, (4) Knowledge Exchange, and (5) Assessment. This framework adapts PBL to the specific material being taught.

Jacob et al. (2019) highlighted that Problem-Based Learning (PBL) fosters the development of problem-solving strategies, disciplinary knowledge, and skills by engaging students in solving presented problems. Similarly, Wurdinger et al. (2022) emphasized that PBL focuses on problem-solving processes and often involves collaborative small-group work to find solutions. This approach promotes critical analysis of problems and evaluation of the problem-solving process.

The lack of literacy among students has a detrimental impact on their critical thinking skills. Critical thinking involves the ability to analyze and articulate ideas effectively. The prevalence of belief in hoaxes or misinformation among many Indonesians highlights the low level of critical thinking, as people often accept information without verifying its truthfulness. Ennis (Paradise, 2023) identified twelve key indicators of critical thinking skills: formulating questions and analyzing arguments. Additionally, critical thinking involves clarifying, evaluating sources, making observations, drawing deductions, making inductions, and considering values. Also, defining and considering them, identifying assumptions, considering reasons, and combining information to make informed decisions.

Critical thinking using Discovery Learning according to Ratnawati (2020) is a direct learning model in which the teacher's role is more dominant than that of students, and does not use innovative media, so students tend to only listen, write, and memorize formulas or materials without fully understanding what is being conveyed. This resulted in the teacher giving examples of questions in the form of procedural students being able to follow the steps in solving the problem, but when the teacher gave practice questions in the form of stories that required a

level of critical thinking, students had difficulty solving them.

The Problem-Based Learning (PBL) model plays a crucial role in enhancing critical thinking skills. Assessment serves as a means to gather information for system and policy improvement, as well as to develop and enhance capabilities. Thinking is an ongoing human activity, even during sleep. According to Arsy et al. (2019), thinking is a goal-directed activity resulting in discoveries. Likewise, Crow et al. (2021) assert that thinking involves manipulating, managing, and transforming information.

Critical thinking is an integral part of the brain's thinking activities, involving reflective and evaluative thinking towards achieving a goal. Santrock et al. (2019) described critical thinking as a process of reasoning and problem-solving that delves into the complexities of "why" and "how" in the solving process. Critical thinking is recognized as a vital concept in modern education (Schafersman et al., 2021). Teachers acknowledge its significance in developing students' learning outcomes. Critical thinking is considered an essential skill, among others, to equip students for future life challenges.

Sanjaya (2020) highlighted the strengths of Problem-Based Learning (PBL), which includes challenging students, enhancing their motivation and engagement, facilitating the transfer of knowledge to real-world problem-solving, cultivating responsibility for their learning, providing opportunities for students to apply their knowledge, developing lifelong learning interest, and facilitating mastery of concepts to solve real-world problems.

Nuswowati et al. (2023) emphasized that Problem-Based Learning (PBL) focuses on the applicability of education to real-life contexts, utilizing meaningful problems as the foundation. Critical thinking entails actively interpreting and evaluating observations, communication, information, and arguments. Encouraging critical thinking cultivates active engagement and exploration in learning, going beyond rote memorization and passive acceptance of teacher explanations.

Leny (2019) conducted a study to examine the impact of implementing the discovery learning model on enhancing students' mathematical critical thinking skills and self-confidence. The research involved a sample of 116 students from a public high school, specifically Class X MIPA students in State Senior High Schools in East Bogor Regency. This study employed a quasi-experimental research design with a pretest-posttest control group setup. Research instruments included tests to measure students' mathematical critical thinking skills and questionnaires to assess their self-confidence.

Hartati (2019) conducted a study using a quasi-experimental design to examine the impact of Problem-Based Learning on students' critical thinking skills in Integrated Science. The sample consisted of 50 Class VII students from a Public Middle School in North Lampung Regency, selected through purposive sampling. The study's findings, supported by a significant t-test value of 0.026, reject H0 and accept H1. This suggests that implementing the PBL model in integrated science learning has a positive effect on enhancing students' critical thinking skills.

The objectives of this study were twofold: first, to determine the impact of the Problem-Based Learning model on students' critical thinking skills by calculating the average pretest and posttest results after implementing the model in science learning for Class IV. Second, to examine the increase in critical thinking skills among fourth-grade students using n-gain scores.

This research provides both theoretical and practical benefits. Theoretically, it serves as a valuable reference for utilizing the Problem-Based Learning model to enhance critical thinking skills in elementary science education. Practically, the model applied in this study offers a viable solution for teachers to promote higher levels of critical thinking among students and achieve optimal learning outcomesThe findings of this study can serve as a valuable reference for future researchers to conduct further research in related fields and explore more in-depth topics.

METHOD

This study employs a quantitative research method with an experimental research design. The experimental method is characterized as a research approach used to determine the effect of a specific treatment on controlled conditions. According to Sugiyono (2019), the experimental method encompasses various designs, including the quasi-experimental method.

The population in this study consisted of 50 students in class IV from one sub-district. Two classes, namely class IVA as the experimental group and class IVB as the control group, were randomly selected from this population. The researcher used a simple random sampling technique, which involves mixing the subjects in the population to ensure that all subjects are treated equally. For data collection, this study employed test and observation techniques.

RESULTS AND DISCUSSION

To evaluate the students' critical thinking skills in the experimental class, the researcher used the mean scores before and after implementing the Problem-Based Learning model. The following is the average difference test in Table 1.

Table 1. Independent Samples Test BK experiment

F	Sig	t	df	Sig. (2-tailed)
2.163	.148	5.988	48	.000

In Table 1, the mean difference test was conducted to determine the impact of the Problem-Based Learning (PBL) model on the critical thinking skills of class IV students in the Force subject. The experimental class was specifically focused on in this analysis. In the experimental class, the implementation of the Problem-Based Learning (PBL) model resulted in significant differences between the pretest and post-test scores. This indicates an increase in critical thinking skills. The significance of the PBL model's impact on critical thinking skills was measured using the n-gain test. The pretest and posttest values of both the experimental and control classes were compared to evaluate the effectiveness of the PBL model in enhancing critical thinking skills. Below is the n-gain test presented in Table 2

Table 2. *N-gain* Critical Thinking

Class	N-gain	Criteria
Experiment	0.75	**High**
Control	**0.70**	**Currently**

According to the results in Table 2, the average n-gain for the experimental class using the PBL learning model was 0.75, indicating a high level of improvement in critical thinking skills. On the other hand, the control class using the Directional Learning model had an average n-gain of 0.70, which falls into the medium category for critical thinking ability improvement.

According to Ceker et al. (2020), Problem-Based Learning (PBL) is a learning method that allows students to acquire and develop high-level skills such as problem-solving and critical thinking. This approach involves students engaging with real-life experiences to gather information and gain a deep understanding of their learning process. According to Chian (2019), Problem-Based Learning (PBL) emphasizes the growth of learning and skills. To promote a more humanizing approach to assessment, it is important to change students' attitudes. To achieve this, teachers should prioritize activities that explore and enhance the existing competencies of students during the teaching and learning process. This approach encourages a student-centred approach that values and nurtures each student's unique abilities.

According to Issufiyah (2023), the cognitive-constructivist perspective states that students, regardless of age, actively participate in acquiring information and building their knowledge. This perspective highlights the active role of students in learning, as they connect new information with their prior knowledge and experiences. The Problem-Based Learning model

engages students in interactive learning activities, allowing them to actively build knowledge. Students become the main participants in their learning as they engage in scientific activities with guidance from the teacher. This approach aims to enhance students' understanding of scientific concepts and improve the overall learning process in the classroom.

In Problem-Based Learning (PBL), the learning cycle involves a simplified process. It begins with students being presented with problems to solve. They then engage in hands-on activities or experiments to collect data and information. Based on this, they identify the key concepts that need to be understood and mastered to solve the problems. The next step involves students coming together in groups to have discussions and share their experiences. This allows for the exchange of ideas and promotes deeper understanding. Finally, through collaboration with their peers, students work together to determine solutions to the given problems. This process encourages active learning, critical thinking, and teamwork, as students actively engage in problem-solving and knowledge application.

According to Wynn et al. (2019), Problem-Based Learning (PBL) is a teaching method that focuses on presenting problems to students. They solve these problems by utilizing their knowledge and skills from various sources. PBL is recognized by teacher educators, as stated by Caswell (2019). It is considered a valuable methodology for developing teachers to meet the expectations of 21st-century professional practice.

Previous research conducted by Mustika (2019) has examined the use of Problem-Based Learning (PBL) to enhance critical thinking skills. The findings indicate that students' critical thinking skills showed a moderate increase. The results of previous studies utilizing the PBL learning model demonstrated a significant improvement in students' average critical thinking abilities, increasing from 39.4 to 68.9 with an impressive n-gain of 48.6. Nufus (2021) conducted a study on the use of the Problem-Based Learning (PBL) model in environmental management material. The findings showed that a high percentage of students (95.83%) expressed satisfaction with this approach. Additionally, the experimental class demonstrated better mathematical critical thinking abilities, with an average score of 15.83 compared to the control class's average score of 12.94. These results support the notion that implementing the PBL model can effectively enhance critical thinking skills, which is consistent with previous research. The increase in average critical thinking skills can be observed, particularly in the updated study focused on Force material for fourth-grade elementary school students. The experimental class achieved an average score of 85.06, while the control class obtained a score of 75.08. These findings indicate a significant difference in the improvement of critical thinking skills when utilizing the PBL model

The Problem-Based Learning (PBL) model allows students to gain meaningful experiences in the learning process through group investigations aimed at solving contextual problems presented by the teacher. This aligns with Aunurrahman's (2019) perspective that behaviour changes occur through interactions between individuals and their environment, enabling them to effectively engage and interact with their surroundings.

The learning process can significantly enhance students' critical thinking skills. As stated by Hamalik (2019), learning outcomes are reflected in students' comprehension of Force material. Learning leads to behavioural changes, transitioning from a state of not knowing to knowing and from not understanding to understanding.

The Problem-Based Learning (PBL) model enables students to develop a deeper understanding of fraction material by connecting it to their daily lives, going beyond formal mathematics. This approach not only enhances students' comprehension but also improves their motivation in learning science. According to Amir (2020), the PBL model facilitates critical thinking skills, allowing students to understand concepts better and remember them more easily during the science learning process. When knowledge is acquired in a context closely related

to real-life practice, it is more likely to be remembered effectively. By incorporating practical contexts and hands-on activities, students can better grasp and understand the material.

According to Slameto (2020), the Problem-Based Learning model promotes active student engagement in the learning process. Students are encouraged to actively participate by completing assignments, asking questions, collaborating in groups to solve problems, sharing opinions on others' work, and presenting their work to the class. Active student learning activities enhance understanding and retention of material as students actively experience the learning process themselves. When students engage in their activities, the knowledge becomes more than just passing information; it is processed and expressed in different forms. Students ask questions, share opinions, participate in discussions with the teacher, complete assignments, create graphs and diagrams, and grasp the essence of the lessons presented. Active student participation results in a comprehensive understanding and acquisition of knowledge

CONCLUSION

The research findings indicate a significant influence of the Problem-Based Learning (PBL) model on the development of critical thinking skills in fourth-grade students studying Force material. Firstly, the students demonstrated satisfactory levels of critical thinking skills, meeting the expected criteria for proficiency. Additionally, the average critical thinking skills observed in the PBL group were notably higher than those observed in the group that received conventional teaching methods. The research findings show a significant average increase in students' critical thinking skills in the experimental group compared to the control group. This indicates that the Problem-Based Learning (PBL) model positively improves students' critical thinking abilities, surpassing the control group's average critical thinking skills.

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