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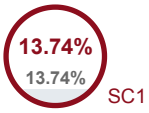

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A Problem-Based Learning Model to Increase Self-Efficacy of Grade IV Elementary School Students

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Abstrak. This study aims to determine the effect of the Problem-Based Learning (PBL) model on improving the self-efficacy of fourth-grade elementary school students in science subjects. The research was conducted at SDN Ngampelsari, Sidoarjo Regency, East Java, Indonesia, involving 32 fourth-grade students. Self-efficacy refers to students' belief in their ability to face challenges, complete tasks, and achieve learning goals. It plays a critical role in enhancing motivation, learning behavior, and academic success. This study employed a quantitative method with a pre-experimental design, using a one-group pretest-posttest format. The instrument used was a self-efficacy questionnaire distributed before and after the implementation of the PBL model. The model was applied through structured learning activities involving real-life problem solving, collaboration in group work, and the development of critical thinking skills to find solutions. The contextually meaningful tasks helped students actively engage with the material and with one another. The data collected were analyzed using the Wilcoxon Signed Rank Test and N-Gain analysis. The Wilcoxon test showed a significance value of 0.000, which indicates a statistically significant difference in students' self-efficacy before and after treatment. The average N-Gain score was 0.7835, categorized as high. These findings demonstrate that the PBL model had a strong positive effect on students' psychological readiness for learning by enhancing their confidence, active participation, and persistence when facing challenges. In conclusion, the Problem-Based Learning model is not only effective for improving cognitive outcomes but also contributes to the development of students' non-cognitive competencies. It is recommended for wider implementation in elementary schools to promote meaningful, student-centered, and empowering learning environments aligned with 21st-century education goalsy.

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Introduction

Education is a key pillar in the development of a country. The success of a nation's development is largely determined by the quality of education implemented. A developed country is characterized by high-quality education that is relevant to the times. In the 21st century, demands and competition in the world of education have become increasingly complex with the advancement of technology and the rapid pace of globalization. Advances in Science and Technology (S&T) demand improvements in the education system, particularly in the development of critical thinking skills, problem-solving, creativity, and collaboration (Rawung et al., 2021).

In this context, 21st-century learning must align with the needs and challenges of real life. It should not only emphasize the transfer of knowledge but also encourage students to develop skills in cooperation, critical thinking, self-control, information filtering, and effective communication (Suradika et al., 2023). This is increasingly important because the challenges faced by students in the future are not only academic but also social, economic, and technological.

One of the efforts made by the Indonesian government to address these challenges is through the implementation of the Merdeka Curriculum. This curriculum prioritizes the development of the Pancasila learner profile and emphasizes the strengthening of 21st-century skills known as the 4Cs: Creative thinking, Critical thinking and Problem solving, Communication, and Collaboration (Suradika et al., 2023). In its implementation, students are required to be active, critical, analytical, and creative

in analyzing and identifying
problems and seeking appropriate solutions to address them.
To support these abilities, students need to have self-confidence, internal motivation, and independence in learning (Yudha et al., 2022; Paulina et al., 2023; Suartini et al., 2023). Self-efficacy plays an important role in shaping positive learning attitudes and behaviors, increasing participation in learning activities, and strengthening perseverance in completing challenging tasks (Sri, 2022; Karmila & Raudhoh, 2020). Without motivation and independence in learning, students will find it difficult to develop critical thinking and problem-solving skills, which are the essence of 21st-century learning (Supriyatin & Masanggeni, 2022).
At the primary school level, Science Subjects plays an important role in shaping learners' early understanding of science, social and humanities issues. Science Subjects is designed to equip learners with basic skills in analyzing real problems in the surrounding environment. Unfortunately, Science Subjects often lacks contextualization and does not actively involve students, resulting in low interest and motivation to learn (Guru et al., 2024).
One solution that can be applied to overcome this problem is the **application of the Problem-Based Learning Model.** This **learning model encourages students to be** active in solving real complex problems, by thinking critically, collaboratively, and creatively (Ardianti et al., 2021; Profesi et al., 2024). The Problem-Based Learning Model is an approach that not only emphasizes mastery of material, but also the development of higher-order thinking skills and scientific attitudes.
According to Ardianti et al. The Problem-Based Learning model has main characteristics in the form of using problems as a stimulus for learning, group work in solving problems, and emphasis on reflection and evaluation of the learning process. Through this approach, students are not only recipients of information, but also active

actors who build understanding and knowledge through exploration of real problems (Ardianti et al., 2021).
Research conducted by Handini et al. at the higher education level showed that the **application of the Problem-Based** Learning Model was able to improve students' concept understanding, collaborative skills, and critical thinking skills (Nurul Handini et al., 2024). This is also reinforced by the findings of Sujanem and Suwindra who developed an interactive e-module based on the Problem-Based Learning Model for physics learning and proved effective in improving students' critical thinking skills. Similar findings were also found at the elementary school level (Sujanem & Putu Suwindra, 2023). Jayanti and Pertiwi developed e- modules based **on the Problem-Based Learning** Model to improve students' analytical skills and curiosity, with positive results (Jayanti & Pertiwi, 2023).
Active involvement **in the learning process through** the Problem-Based Learning Model makes students more confident and independent in learning. They learn to organize their own learning strategies, manage their time, and take responsibility for their learning achievements (Yudha et al., 2022; Karmila & Raudhoh, 2020). In the long run, learning with a Problem-Based Learning Model approach has the potential to form learners who are able to think critically, act solutively, and have a high sense of social responsibility.
The application of Problem-Based Learning Model in elementary school can also be adjusted to the characteristics and needs of students. Teachers have an important role as facilitators who guide and direct students in exploring and solving problems. The use of interactive and contextual media can also increase the effectiveness of learning. A study conducted in a public elementary school in Belitung showed that the use of interactive map media in **a Problem-Based Learning model** can improve **student learning outcomes in** Social Studies (Guru et al., 2024).
Furthermore, consistent implementation **of the Problem-Based Learning Model** can create an active and collaborative learning culture in schools. **This is in line with the results of** a study by Rahmadana et al. which showed **that** the proper application of **the Problem-Based Learning Model** can significantly improve the critical thinking **skills of elementary school students** (Guru et al., 2024). Learning is no longer a burden, but rather a fun and meaningful process.
However, the **application of the Problem-Based Learning Model** also has challenges, including teacher readiness in designing and facilitating problem-based learning, time constraints, and the availability of supporting learning resources. Therefore, it is important for educational institutions to provide continuous training and support to teachers to effectively implement **the Problem-Based Learning Model** (Profesi et al., 2024).
The Problem-Based Learning (PBL) model is one of the most effective learning

approaches in developing a range of 21st century skills, including critical thinking, problem solving and collaboration skills. The Problem-Based Learning model places real problems or daily life situations at the center of the learning process. The model is designed so that students are actively involved in finding solutions to problems through a process of investigation, exploration and reflection. Through active engagement in solving relevant problems, students not only gain a deeper conceptual understanding, but also experience an increase in their self-efficacy (Profesi et al., 2024).
Self-efficacy is defined as an individual's belief in his or her ability to complete specific

tasks, face challenges, and achieve set goals. The concept was first introduced by Albert Bandura, who emphasized that self-efficacy plays an important role in influencing a person's motivation, behavior, and learning achievement (Sri, 2022). In the context of basic education, self-efficacy is very important because it is the basis for students to dare to try, not give up easily, and be able to learn independently and collaboratively.
The Problem-Based Learning Model has a systematic syntax or implementation stages. According to John Dewey, the syntax of the Problem-Based Learning Model consists of five steps, namely: (1) Identify and select real problems relevant to students' lives, (2) Define and limit the problem to focus the search for solutions, (3) Collect relevant information and data to understand the problem more deeply, (4) Make plans and develop problem-solving strategies, and (5) Reflect and evaluate the process and results of problem solving (Nurul Handini et al., 2024).
Practically, the steps for implementing the Problem-Based Learning Model in the classroom also include: (1) Introduction to the problem to be studied, (2) Encourage students to learn independently and actively, (3) Provide direction in individual and group investigations, (4) Develop and present the work or solution found, and (5) Analyze and evaluate the learning outcomes (Nurul Handini et al., 2024). This whole process aims to foster learning independence, improve critical thinking skills, and last but not least, build students' self-efficacy.
High self-efficacy allows students to feel confident in their ability to complete complex learning tasks. This belief encourages them to keep trying despite facing difficulties, as well as being able to bounce back when they fail (Jayanti & Pertiwi, 2023). Unfortunately, not all students have high self-efficacy. Many students, especially at the elementary school level, experience difficulties in developing critical thinking skills due to a lack of confidence. When students feel unable to complete tasks, they tend to avoid challenges or look for shortcuts, such as copying answers from the internet. This behavior indicates a weakness in self-efficacy, which ultimately has an impact on the low quality of learning and academic achievement (Sri, 2022).
The importance of strengthening self-efficacy through the right learning model is becoming increasingly relevant in the current education curriculum. In the Merdeka Curriculum, the role of the teacher is no longer just a conveyor of information, but as a facilitator who guides students to be able to learn independently, think critically, and solve problems contextually. In this context, the Problem-Based Learning Model offers a suitable approach because it directly trains students to identify, analyze, and find solutions to problems they face in everyday life.
There is a close relationship between self-efficacy and learning independence (Karmila & Raudhoh, 2020). Students who have high self-efficacy tend to be more initiative in the learning process, able to manage time, determine appropriate learning strategies, and complete tasks effectively. This is reinforced by findings stating that self-efficacy also has a positive impact on students' thinking processes, especially in terms of openness to new ideas, creativity in finding solutions, and thoroughness in analyzing information (Sujanem & Putu Suwindra, 2023).
Smith et al. identified five indicators of self-efficacy that can be used to measure the extent to which a student has confidence in his ability, namely: (1) Confidence in performing certain tasks, (2) Confidence to motivate oneself in completing tasks, (3) Believe that individuals are able to try hard, persevere, and persevere, (4) Able to survive and rise from failure, and (5) Able to solve problems in various situations or conditions.

The five indicators are very relevant in the implementation of PBL, because in the process of problem solving, students are indirectly tested on each of these indicators (Suartini et al., 2023).
Thus, the application of the Problem-Based Learning Model not only improves academic skills, but also provides a positive psychological impact in the form of increased self-efficacy. This is in line with the goal of holistic education that emphasizes not only

cognitive outcomes, but also the development of students' character and personality. Learning that provides space for students to experience, explore, and reflect on knowledge directly will create meaningful and in-depth learning experiences.

To optimize the application of the Problem-Based Learning Model in improving students' self-efficacy, several strategies are needed that teachers can implement, including: providing constructive feedback, creating a safe and supportive learning environment, providing opportunities for students to work in groups, and encouraging students to set goals and evaluate their own learning progress. In addition, it is important for teachers to provide challenges that are appropriate to students' ability levels, so that they remain motivated and do not feel overwhelmed.

Overall, the Problem-Based Learning Model is a very potential approach in building the self-efficacy of elementary school students. Through the process of solving real and meaningful problems, students not only learn to understand academic concepts, but also learn to recognize their potential, develop learning strategies, and build confidence in facing various challenges. Therefore, this model is very feasible to be widely integrated in the learning system in elementary schools, as part of the effort to form a generation of learners who are resilient, adaptive, and ready to face future challenges.

The Problem-Based Learning (PBL) Model has been widely researched as an effective approach in improving students' critical thinking skills. Several previous studies have shown that the application of the Problem-Based Learning Model in grade IV elementary school students is able to train students to solve problems independently, as well as face real-world challenges through systematic stages in learning (Rahmadana et al., 2023). Through a contextualized problem-solving process, students not only learn to understand the subject matter, but also develop critical and logical thinking patterns in finding solutions.

In addition, a number of studies have also revealed that students' self-efficacy has a significant effect on their ability to solve problems (Supriyatin & Masanggeni, 2022). Self-efficacy, which is an individual's belief in their ability to complete tasks and face challenges, has an important role in the success of the learning process. Students with high self-efficacy tend to have greater motivation, are able to organize learning strategies, and persevere in completing learning tasks, including in situations that demand critical thinking skills.

However, based on the results of initial observations conducted by researchers on November 28, 2024 at SDN Ngampelsari, it is known that fourth grade students still show a low level of self-efficacy. This problem is characterized by students' lack of confidence in completing tasks independently, as well as a tendency to be passive in the learning process. This low self-efficacy is thought to be caused by a lack of critical thinking practice, limited experience in solving real problems, and a lack of ongoing support and guidance from teachers.

Seeing these conditions, researchers are interested in examining how the application

of the Problem-Based Learning Model can be used as a solution to increase students' self-efficacy, especially in class IV Natural and Social Sciences subjects on Chapter 5 material "Stories About My Region". This material was chosen because it is closely related to students' daily lives and provides a great opportunity to be applied in the form of contextual problems that are relevant to their experiences.

The Problem-Based Learning model provides opportunities for students to solve problems actively, independently, and collaboratively. In this process, students are required to identify problems, collect and analyze information, design solutions, and evaluate. This process not only develops critical thinking skills, but also provides a challenging and meaningful learning experience. Thus, the Problem-Based Learning Model is believed to be able to increase students' self-efficacy because it provides space for students to experience learning success through their own efforts.

Self-efficacy is a very important psychological aspect in education, because it affects students' motivation, perseverance, and learning strategies. Students who have high self-efficacy tend to be more confident in completing tasks, able to manage academic stress, and have high enthusiasm in facing learning challenges. Therefore, increasing self-efficacy is one of the important goals in developing learner-oriented learning.

This study aims to determine the effect of Problem-Based Learning Model on self-efficacy of fourth grade elementary school students. It is expected that the results of this study can make a positive contribution to the development of effective learning theory and practice, especially in the context of learning at the elementary level. In addition, this research is also expected to provide strategic recommendations for teachers and educators in designing learning activities that are able to encourage students to be more confident, think critically, and be active in facing real learning problems..

Method

The type of research used in this study is quantitative research with a pre-experimental design. Quantitative research is a systematic investigation that uses numerical data to examine relationships and effects between variables. The pre-experimental approach is applied when researchers aim to determine the influence of a treatment or intervention on a particular outcome, but it is not feasible to assign subjects randomly or establish a full control group (Sugiyono, 2020). In this study, there was no comparison or control group; all participants received the same intervention. The research was conducted at SDN Ngampelsari, located in Sidoarjo Regency, East Java, Indonesia, during the even semester of the 2024/2025 academic year. The subjects were 32 fourth-grade students who were selected using a saturated sampling technique. This technique involves including the entire population available, which is suitable when the sample size is limited and manageable. The independent variable in this study was the Problem-Based Learning (PBL) model, while the dependent variable was students' self-efficacy in learning science. Self-efficacy refers to students' belief in their own abilities to complete tasks, solve problems, and overcome learning challenges.

The research design implemented was the One-Group Pretest-Posttest Design, which is a type of pre-experimental design that involves measuring the dependent variable before and after treatment within the same group. While it lacks the rigor of true experiments, this design allows researchers to assess treatment effectiveness by comparing pretest and posttest scores. The treatment in this study was the application of the PBL model in the science subject, particularly in the unit titled "Stories About My Region." This unit was selected for its relevance to students' local contexts and its

potential to support inquiry-based learning. PBL is known for its emphasis on contextual learning and active student engagement, where learners are presented with authentic problems and are encouraged to collaborate in finding solutions. Through this method, students were expected to develop not only content knowledge but also soft skills such as critical thinking, perseverance, and confidence.

The implementation of the research consisted of four main stages. The first stage was preparation, which involved the development of teaching materials, including lesson plans, student worksheets, and modules that incorporated PBL syntax. At this stage, the researcher also prepared the primary instrument: a self-efficacy questionnaire. This instrument was constructed with reference to psychological and educational literature and was aligned with five main indicators: confidence in completing tasks, motivation to act, perseverance in facing obstacles, resilience in the face of failure, and decision-making ability in various learning contexts. The second stage was the pretest phase, where the self-efficacy questionnaire was administered to all participating students before the intervention. The aim was to collect baseline data about students' beliefs in their own capabilities. Each item in the questionnaire used a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree."

In the third stage, the treatment was implemented. The PBL model was applied in science classes through structured learning activities in which students were encouraged to explore the potential and environmental richness of their local areas. Students were divided into small groups and were tasked with identifying real-world problems, conducting investigations, developing practical solutions, and presenting their findings. The role of the teacher was to serve as a facilitator, guiding discussions, providing feedback, and supporting student inquiry without directly giving answers. The learning followed classic PBL steps: (1) problem orientation, (2) individual and group inquiry, (3) collaborative solution development, (4) class presentations, and (5) reflection and evaluation. This structure aimed to foster an active learning environment where students could enhance both their knowledge and self-efficacy.

The fourth stage was the posttest phase, in which the same self-efficacy questionnaire was given to students after the learning activities were completed. The goal was to determine whether students' self-efficacy improved as a result of the intervention. The results from the posttest were then compared with the pretest scores to identify any significant changes. The primary research instrument—the self-efficacy questionnaire—was subjected to validity and reliability testing prior to full deployment. Validity was assessed using item-total correlation techniques, while reliability was measured using Cronbach's Alpha. The instrument showed a high level of internal consistency, with reliability coefficients above 0.70, indicating that the questionnaire was suitable for measuring the intended construct.

Data collection was conducted directly in the classroom setting during both the pretest and posttest sessions. The researcher supervised the process to ensure that

students understood the questions and responded sincerely. The quantitative data obtained were then analyzed using several statistical procedures. The first step of data analysis was to test the normality of the data distribution using Shapiro-Wilk and Kolmogorov-Smirnov tests. Since the data did not meet the criteria for normal distribution, non-parametric tests were chosen. The second step was to apply the Wilcoxon Signed-Rank Test to examine whether there was a statistically significant difference between the pretest and posttest scores. This test is especially appropriate for related samples when the assumption of normality is violated. It measures changes in

median values and determines the impact of an intervention within a single group. To assess the magnitude of change, N-Gain analysis was conducted. The N-Gain score was calculated by comparing the difference between pretest and posttest scores with the maximum possible gain. The results were interpreted using the following criteria: low (N-Gain < 0.3), medium (0.3 ≤ N-Gain < 0.7), and high (N-Gain ≥ 0.7). This analysis helped to quantify the level of effectiveness of the PBL model in improving self-efficacy. All statistical computations were performed using the latest version of SPSS software. The interpretation of results was aimed at answering the research question: whether the Problem-Based Learning model has a significant and meaningful impact on improving students' self-efficacy in science learning. The analysis also provided implications for the use of PBL as a strategy to foster independent, confident, and motivated learners in primary education.

Result

Normality Test

In this study, the normality test was carried out to determine whether the students' self- efficacy data on the pretest and posttest were normally distributed. Normality test is an important step in data analysis because it determines the selection of the right statistical method, whether using a parametric or non-parametric approach. The test was carried out using the latest version of the SPSS program, through two methods, namely Kolmogorov-Smirnov and Shapiro-Wilk. The basis for decision making in the normality test is as follows: If the significance value (Sig.) > 0.05, then the data is considered normally distributed. If the significance value (Sig.) < 0.05, then the data is considered not normally distributed. The results of the data normality test are shown in the following table:

Table 1. Normality Test

Data	Kolmogorov-Smirnova Sig	Shapiro-Wilk Sig
Pretest	.003	.006
Posttest	.000	.000

Based on the results in the table, it is known that the pretest data has a significance value of 0.006 in the Shapiro-Wilk test, while the posttest data has a significance value of 0.000. Both values are below the significance limit of 0.05, which means that neither the pretest data nor the posttest data are normally distributed. Although the Kolmogorov-Smirnov value also shows similar results, the main decision still refers to the Shapiro-Wilk test because this method is more suitable for relatively small sample sizes, such as in this study involving 32 students.

The implication of this finding is that the assumption of data normality is not met. This has a direct impact on the selection of statistical analysis methods to be used in hypothesis testing. Since the data is not normally distributed, parametric methods such as paired sample t-test cannot be used. Instead, researchers chose to use a non-parametric approach that does not require normal data distribution.

The appropriate non-parametric test to test the difference between two paired data, namely pretest and posttest, is the Wilcoxon Signed-Rank Test. This test is designed to assess whether there is a significant difference between two interconnected samples under non-normal data conditions. The advantage of the Wilcoxon Test is its ability to provide valid and reliable results, even though the basic assumptions of parametric

statistics are not met.

Thus, it can be concluded that the results of the normality test are an important foundation in determining the statistical analysis technique used. The non-fulfillment of the normality assumption on student self-efficacy data before and after the application of the Problem-Based Learning Model indicates that the use of non-parametric analysis is the right approach. This provides a strong methodological basis for researchers in

continuing to test research hypotheses accurately and in accordance with the characteristics of the data obtained.

Hypothesis Test

In this study, hypothesis testing was conducted to determine whether there was a significant difference between the pretest and posttest scores of students' self-efficacy after the application of the Problem-Based Learning Model. However, based on the results of the previous normality test, it is known that the posttest data is not normally distributed. Therefore, the hypothesis analysis in this study did not use a parametric approach, but instead used a non-parametric test, namely the Wilcoxon Signed Ranks Test.

The Wilcoxon test is an alternative to the paired sample t-test which is used when the data does not meet the assumption of normality. This test aims to determine whether there is a significant median difference between two groups of interrelated data, in this case the pretest and posttest scores of students' self-efficacy. The use of this test is considered appropriate for the data conditions in this study, so that it can provide valid analysis results. The results of the Wilcoxon test can be seen in the following table:

Table 2. Hypothesis Test

Data	Z Asymp. Sig. (2-tailed)
Pretest - Posttest	-4.961b .000

Based on the table above, the significance value (Asymp. Sig. 2-tailed) is 0.000. This value is smaller than the significance level of 0.05, so it can be concluded that the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted. That is, there is a significant difference between the pretest and posttest scores of students' self-efficacy after the application of the Problem-Based Learning Model.

These results indicate that the Problem-Based Learning Model has a significant positive effect on increasing the self-efficacy of grade IV elementary school students. This increase is reflected in the increase in self-confidence, independence in learning, and the ability of students to face and solve problems actively. This finding is in line with the theory that contextual and problem-based learning can encourage students to have more confidence in their abilities, which is the essence of self-efficacy in the learning process.

N-Gain Test

In this study, N-Gain analysis was used to determine the effectiveness of increasing students' self-efficacy after the application of the Problem-Based Learning Model. This analysis aims to measure the extent of changes in students' self-efficacy scores from before (pretest) to after (posttest) treatment is given. The formula used in the calculation of N-Gain is as follows:

N-Gain = (Posttest Score - Pretest Score) / (Maximum Score - Pretest Score)

Table 3. N-Gain Test

Number	Pretest	Postest	N-Gain	Effectiveness
1	28	36	1	High
2	27	32	0,556	Medium
3	29	36	1	High
4	26	35	0,9	High
5	28	33	0,625	Medium
6	27	32	0,556	Medium
7	30	36	1	High
8	28	34	0,75	High
9	29	36	1	High
10	27	32	0,556	Medium
11	24	31	0,583	Medium
12	28	34	0,75	High
13	26	31	0,5	Medium
14	26	32	0,6	Medium
15	30	36	1	High
16	25	30	0,455	Medium
17	26	32	0,6	Medium
18	26	31	0,5	Medium
19	26	36	1	High
20	29	36	1	High
21	26	35	0,9	High
22	25	32	0,636	Medium
23	28	36	1	High

24 28 36 1 High
25 30 36 1 High
26 26 32 0,6 Medium
27 25 30 0,455 Medium
28 24 33 0,75 High
29 29 36 1 High
30 27 36 1 High
31 26 34 0,8 High
32 26 36 1 High

Based on the results of the N-Gain calculation of 32 students, the results are listed in Table 3. The results show that 19 students (59.4%) experienced an increase in self-efficacy in the high category, while 13 students (40.6%) were in the medium category. There were no students in the low category. This finding indicates that most students experienced a significant increase in self-efficacy after participating in problem-based learning. Furthermore, the descriptive statistical analysis of the N-Gain data is presented in Table 4 below:

Table 4. Hypothesis Test

	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain	32	.45	1.00	.7835	.20953
Valid N (listwise)	32				

Based on the data, it is known that the minimum value of N-Gain is 0.45, the maximum value is 1.00, and the average N-Gain is 0.7835 with a standard deviation of 0.20953. The average value of 0.7835 is in the high category, which means that in general **the application of the Problem-Based Learning Model is quite effective in** increasing students' self-efficacy.

These results reinforce **that problem-based learning can have a positive impact on** increasing students' self-confidence, independence, and ability to face and solve learning problems actively. By providing challenging and contextual learning experiences, students are encouraged to play an active role in the learning process, which ultimately forms confidence in their abilities.

Discussion

The results of the pretest and posttest data analysis showed **a significant increase in the** self-efficacy of fourth grade students after the implementation of the **Problem-Based Learning (PBL) model.** Pretest scores were generally lower than posttest scores, reflecting an overall improvement in students' self-confidence following the intervention. Despite the posttest data not being normally distributed, the Wilcoxon Signed Ranks Test was applied as an appropriate non-parametric method. The test yielded a significance value of 0.000 (<0.05), indicating a statistically significant effect of the PBL model on self-efficacy improvement. The Z value of -4.961 reinforced the strength of the intervention effect, confirming the rejection of the null hypothesis and acceptance of the alternative hypothesis.

To support this result, an N-Gain analysis was conducted to measure the effectiveness of the improvement. The average N-Gain value obtained from 32 students was 0.7835 with a standard deviation of 0.20953, which falls under the high-effectiveness category. Detailed analysis showed that 59.4% of students achieved high gains and 40.6% moderate gains, with no students in the low category. This demonstrates the model's broad impact across ability levels, making it inclusive and suitable for diverse learners. These results affirm previous findings by Triningsih and Mawardi, who found that PBL significantly increases students' engagement and competence across various skill levels (Triningsih & Mawardi, 2020). This finding also reinforces the assertion that student-centered learning models foster better psychological outcomes compared to teacher-centered approaches, which often overlook individual student needs and potential.

The findings are consistent with those of Jayanti and Pertiwi, who reported that PBL encourages student independence and accountability. The model supports active engagement, which is key in developing both cognitive and affective domains of learning (Jayanti & Pertiwi, 2023). This confirms Bandura's theory that self-efficacy develops through mastery experiences. When students solve problems and succeed, their belief in their capabilities grow students face a challenge, attempt to resolve it, and succeed, they build confidence in their abilities (Sri, 2022). In the same vein, Julia and Sumaryoto emphasize the interconnection between critical thinking ability, learning motivation, and academic achievement. When students believe in their competence, they are more motivated to engage in complex thinking and perform better academically (Julia &

Sumaryoto, 2024).
In this study, the implementation of PBL created a dynamic environment where students worked collaboratively to analyze problems, generate solutions, and reflect on their experiences. This active participation helped improve their confidence, motivation, and resilience are key indicators of self-efficacy. Moreover, the contextual nature of the problems presented in PBL activities enabled students to relate their learning to real-life situations, thereby deepening their understanding and making learning more meaningful. Ariadila et al. assert that such contexts are essential for fostering critical thinking and learning autonomy. Their research also aligns with this study in showing how students who are frequently exposed to contextual, problem-based tasks tend to develop better self-regulation and learning responsibility (Ariadila et al., 2023).
Furthermore, the collaborative aspect of PBL played a crucial role in strengthening social-emotional skills. When students engaged in group discussions and problem-solving, they built interpersonal trust, communication skills, and a shared sense of responsibility. These findings are in line with Supiarmo et al. who found that peer scaffolding in problem-solving settings fosters student confidence, persistence, and interpersonal support. The reciprocal interaction among peers during PBL sessions enabled students to give and receive feedback, negotiate understanding, and evaluate collective outcomes—important components in the development of emotional resilience and self-belief (Supiarmo et al., 2021).
This research illustrates that the PBL model is highly relevant for improving students' non-cognitive attributes in early education. In many traditional classrooms, self-efficacy is neglected due to an overemphasis on test scores and memorization. Yet, self-efficacy is foundational for learning success because it affects how students approach tasks, persist through challenges, and regulate their behavior. By applying PBL, students are encouraged to take ownership of their learning, thereby transforming from passive recipients of information into active problem-solvers and thinkers. This approach aligns with 21st-century education goals that emphasize the importance of character, creativity, and lifelong learning.
From a long-term perspective, building self-efficacy in elementary students contributes to their academic resilience. Students with strong self-efficacy are more likely to engage in challenging tasks, respond positively to failure, and pursue goals persistently. They also tend to reflect more effectively and utilize feedback constructively. These outcomes support the findings of Ardianti et al. who noted that PBL helps develop students' holistic competence, not limited to knowledge acquisition. When students believe in their capacity to succeed, they are more likely to self-monitor, adapt strategies, and embrace learning challenges rather than avoid them (Ardianti et al., 2021).
The implications of this study also extend to pedagogical practice. Teachers are encouraged to adopt PBL as part of their instructional repertoire, especially in subjects like science, which naturally lend themselves to inquiry and exploration. The process of designing meaningful problems, facilitating group activities, and guiding student reflection requires professional development and teacher readiness. Therefore, schools and education departments must support teachers with ongoing training, resources, and

mentoring to effectively implement PBL. When done properly, the PBL model not only improves learning outcomes but also transforms classroom culture into one that is inquiry-driven, student-focused, and inclusive.
Additionally, this study provides insight into the inclusiveness of the PBL approach. The fact that all students showed improvement and none fell into the low gain category. This shows that PBL can reach students of different academic levels. The approach accommodates different learning styles and provides multiple entry points for students to engage, which is particularly beneficial in mixed ability classes. The use of group work also encourages social cohesion and empathy, as students learn to listen, support and appreciate diverse perspectives. This further reinforces the social constructivist view that learning is a collaborative process shaped by interaction with others.
Moreover, the success of this study adds to the growing body of literature that recognizes the value of non-cognitive outcomes in education. As stated by Julia and Sumaryoto student success should not only be measured by test results, but also by their ability to think critically, solve problems creatively, and manage their own learning (Julia & Sumaryoto, 2024). The PBL model effectively targets these areas by requiring students to plan, analyze, evaluate, and communicate their findings which all contribute to higher self-efficacy.
The study also strengthens the argument for integrating PBL within the broader curriculum framework at the elementary level. Educational policy should reflect the

importance of student agency, confidence, and autonomy. National education systems that aim to produce independent learners and critical thinkers must promote methodologies like PBL that have proven impact on psychological readiness and character development. When students are given the tools to manage their learning, they are better prepared for future educational challenges and life beyond school.

In terms of limitations, this study was conducted in a single elementary school with a limited sample size and without a control group. Although the results are compelling, future studies are encouraged to expand the sample size, include multiple schools, and use randomized controlled trials to further validate the effectiveness of the PBL model. Longitudinal studies could also explore whether increases in self-efficacy are sustained over time and whether they translate into long-term academic and behavioral gains.

Conclusion

This study aimed to examine the effect of the Problem-Based Learning (PBL) model on the self-efficacy of fourth-grade elementary school students in science subjects. The results showed a significant increase in students' self-efficacy after the implementation of the PBL model, with a Wilcoxon significance value of 0.000 and an average N-Gain score of 0.7835, classified as high. These findings confirm the research objective and indicate that the PBL model effectively supports students' confidence, motivation, and learning persistence.

The PBL approach creates an active, contextual, and collaborative learning environment that empowers students to engage meaningfully in problem-solving processes. The findings are consistent with prior studies affirming that students' self-efficacy improves when they are trusted to take initiative, make decisions, and reflect on

their learning. These improvements are particularly critical in early education to develop long-term resilience, learning independence, and critical thinking.

Despite these promising results, this study is limited by its use of a single research site and the absence of a control group. Therefore, future research is recommended to employ larger samples, randomized experimental designs, and longitudinal approaches to examine the sustained impact of PBL on both cognitive and non-cognitive outcomes.

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