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Improving Problem-Solving Ability in IPAS Through Problem-Based Learning Integrated with the TaRL Approach in Grade V Elementary School

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Abstract

Problem-solving ability is an essential skill that needs to be developed from an early stage to train students to analyse situations and determine appropriate solutions. However, several studies indicate that students' problem-solving ability is still relatively low. This study aimed to examine the effectiveness of a problem-based learning (PBL) model integrated with the Teaching at the Right Level (TaRL) approach in improving problem-solving ability in IPAS learning among fifth-grade elementary school students. This study employed a pre-experimental method with a one-group pretest–post-test design involving 15 fifth-grade students from an elementary school at Pati regency. The research instruments consisted of written tests used for the pretest and post-test and observation sheets to assess students' problem-solving processes. Data analysis was conducted through method triangulation by comparing the results of written test analysis with classroom observation results. The written test data were analysed using descriptive statistics and N-Gain analysis. The results showed that the implementation of the PBL model integrated with the TaRL approach contributes to the improvement of students' problem-solving ability in IPAS learning. The written test analysis indicated an increase in the average score from the pretest to the post-test of 13.34%, along with an increase in the number of students who achieved criteria for learning objectives. The N-Gain analysis result of 0.56 indicated a moderate improvement in students' problem-solving ability. In addition, the comparison between the written test results and classroom observations showed a consistent pattern in students' problem-solving performance.

Keywords: Problem-Based Learning, tTaching at the right level, PBL, TaRL, IPAS, Problem-Solving.

Introduction

Problem-solving ability is an essential skill that needs to be developed from an early stage, as it helps students analyse situations and determine appropriate solutions in everyday life. This skill is closely related to critical thinking, which is one of the key competencies in 21st-century learning (Bariyyah, 2021). Therefore, developing problem-solving ability is important to train students in understanding problems, analysing information, and determining effective solutions independently (Halimah et al., 2023).

Problem-solving ability refers to the process of identifying problems and developing appropriate solution strategies, particularly for non-routine problems (Rambe & Afri, 2020). According to Polya (Siolimbona et al., 2023), problem-solving is explained as an effort to develop a problem-solving strategy through four stages: 1) understanding the problem, 2) designing a solution plan, 3) implementing a solution plan, and 4) re-examining the process and results.

Furthermore, Krulik & Rudnick (Shodiqin et al., 2020) introduced heuristics, which are five stages of problem-solving that can be applied at all levels of teaching. These stages include: 1) *read*, 2) *explore*, 3) *select a strategy*, 4) *solve*, and 5) *look back and extend*. In this heuristics approach, all stages are inseparable. The reading and exploring stages often take place simultaneously as does the thinking process. Similarly, in the problem-solving stage, there is also a process of considering and determining which strategy to use.

However, students' problem-solving abilities are still relatively low. Results from the Programme for International Student Assessment (PISA) 2022 indicate that Indonesian students' performance in science remains below the OECD average, particularly in interpreting scientific phenomena and applying knowledge to real-life contexts. This indicates that students' higher-order thinking and problem-solving skills still need improvement.

Based on observations in the fifth grade at one elementary school in Pati Regency, Central Java, Indonesia, it was found that students' problem-solving skills remain at a low level, which is consistent with the results of the PISA evaluation. During the learning process, students showed a lack of enthusiasm when answering questions verbally and lacked skill in finding appropriate solutions to problems. The results of working on problems with problem solving seem brief without systematic explanations. In fact, some students found it difficult to understand the problems and were unsure how to proceed. This shows that students' problem-solving skills need to be improved so that they can be applied not only in learning activities but also in their daily lives.

One subject that can facilitate the development of problem-solving skills is the Natural and Social Sciences (IPAS), which integrates scientific and social concepts to help students understand real-life phenomena. Through IPAS learning, students are expected to connect conceptual knowledge with real-world problem situations. This subject is the right place to train students to develop solution strategies based on conceptual understanding to help improve problem-solving skills. Simarmata et al. (2022) stated that mastery and understanding of concepts affect the problem-solving process. Solving non-routine problems not only requires memorisation of procedures and concepts but also requires the ability to synthesize various concepts and connect the links between concepts that have been learned to find effective solutions (Sari & Aripin, 2018).

One learning model that supports the development of problem-solving ability is Problem-Based Learning (PBL), which engages students in solving real-life problems through investigation and discussion (Auliah et al., 2023; Hayun & Syawaly, 2020; Ramadhani et al., 2024). In the context of fifth-grade students, PBL activities can be implemented through observing phenomena, discussing problems in groups, collecting information, and presenting solutions. These activities provide opportunities for students to actively practise problem-solving stages.

Ardianti et al. (2021) explain PBL as a learning model where students are faced with real problems as a stimulus at the beginning of learning to trigger learning motivation and effort to solve problems. PBL exposes real contextual problems to students to be solved both individually and in groups using critical thinking and problem-solving skills so that new knowledge is constructed through the process (Rifai et al., 2020).

The implementation of PBL generally follows several main steps, including observing problems, posing questions, collecting relevant information, analysing data to determine possible solutions, and communicating the results of the problem-solving process (Hariyanti, 2021). These stages guide students to actively explore problems and develop solution strategies through investigation and discussion.

Although PBL shows a positive effect on problem-solving skills, it also has some shortcomings in its implementation. Hermansyah (2020) found that without sufficient understanding of the underlying reasons for the problem-solving process, PBL does not significantly contribute to students' understanding of the material. Other research indicate that one of the obstacles to the implementation of PBL is the mindset and ability of students who have diverse abilities and mindsets, thus requiring appropriate approaches to support students' learning according to their needs (Auliah et al., 2023; Helyandari et al., 2020).

However, differences in students' initial abilities can become a challenge in implementing PBL effectively. Therefore, an appropriate approach is needed to accommodate students' diverse learning needs. One approach that can be integrated with PBL is the Teaching at the Right Level (TaRL) approach, which groups students based on their level of understanding rather than their grade level (Febriani & Shaliha, 2023). Through initial assessment, teachers can identify students' learning levels and provide appropriate support based on these needs (Suharyani et al., 2023). Based on this information, teachers can design learning support that is more targeted and responsive to students' needs.

Although there are many studies that examine the effectiveness of PBL or the TaRL approach in improving problem-solving skills, there are limited studies that specifically integrate the PBL model with the TaRL approach in improving problem-solving skills through IPAS learning at the elementary schools. Most studies still focus on the application of PBL in the context of mathematics learning and do not consider differences in students' initial abilities and learning readiness of diverse students. The TaRL approach is also more widely used to improve literacy and numeracy skills (Suharyani et al., 2023; Wulandari et al., 2024).

This study aims to integrate the Problem-Based Learning (PBL) model with the TaRL approach to improve problem-solving skills in IPAS subjects in grade V elementary school. By applying the TaRL-based PBL model, it is expected that students can develop problem-solving skills according to their cognitive levels through problem-based learning in real-life contexts so that they can construct their knowledge independently.

Methodology

This study used an experimental method with a pre-experimental design, using a one group pretest–post-test design (Creswell, 2023). In this design, a single group of students was observed before and after the implementation of the learning intervention. The pretest was administered to identify students' initial problem-solving abilities, while the post-test was conducted after the implementation of learning using the Problem-Based Learning (PBL) model integrated with the Teaching at the Right Level (TaRL) approach. The comparison between pretest and post-test results was used to describe changes in students' problem-solving abilities following the intervention.

The participants in this study were 15 fifth-grade students from an elementary school in Pati Regency, Central Java, Indonesia. This class was selected purposively because it represented a heterogeneous range of students' learning abilities.

The research instruments consisted of pretests and post-tests with written problem-solving questions in the form of three types of problem packages with HOTS, MOTS, and LOTS levels each consisting of 3 items used to measure students' problem-solving skills and observation sheets used to observe students' activities during the learning process. The classification of these levels was based on Bloom's revised taxonomy, where LOTS includes remembering and understanding (C1-C2), MOTS includes applying and analysing (C3-C4), and HOTS includes evaluating and creating (C5-C6). These questions were designed to assess students' ability to understand problems, determine solution strategies, and evaluate the results of their solutions.

The research data were analysed using method triangulation by comparing the results of written tests and observation sheets to increase the validity and reliability of the research results. The written tests were used to measure students' problem-solving abilities, while the observation sheets were used to record students' learning activities during the implementation of the Problem-Based Learning model integrated with the TaRL approach.

The indicators used to assess students' problem-solving abilities were adapted from Polya's stages of problem-solving (Shodiqin et al., 2020), which include (1) understanding the problem, (2) planning the solution strategy, (3) implementing the solution, and (4) reviewing the results. These indicators were used both the written tests and the observation sheets. The observation data were collected directly by the researcher during the learning process. In the written tests, the indicators were used to analyse students' answers to contextual problems, while in the observation sheets, they were used to observe students' participation during learning activities, such as identifying problems, discussing solution strategies, implementing solutions in group work, and presenting the results of their discussions.

The written test data were analysed using descriptive statistical analysis to describe the improvement in students' problem-solving abilities in IPAS learning. The results were also compared with the Minimum Learning Achievement Criteria (KKTP) for IPAS subjects, which were set at ≥ 75.

Furthermore, the improvement in students' scores was analysed using the normalised gain (N-Gain) formula:

$$(g) = \frac{Post\ test - \Pr e\ test\ score}{Highest\ possible\ score - \Pr e\ test\ score}$$

The interpretation of the N-Gain values was based on Hake's gain index criteria (Fadaei, 2019), which consists of three levels as shown in Table 1.

Table 1 Gain Index Criteria.

Gain Index	Criteria
g > 0,70	High
0,70 ≥ 0,30	Medium
0,30 ≥ g	Low

After calculating the N-Gain score, the results were used to describe the improvement in students' problem-solving abilities. In addition to the written test analysis, observation data were analysed to examine students' problem-solving processes during the learning activities. The results of the analysis were used to describe the data on students' problem-solving abilities. Observation data were analysed based on the development category of Polya's (Shodiqin et al., 2020) problem-solving stages using the indicators presented in Table 2.

Table 2 Problem-solving stage indicators.

Problem Solving Stage	Indicator	Category
Understanding the Problem	Able to mention what is known and asked in the problem using their own words.	Good
	Able to mention what is known and asked in the problem.	Fair

	Not yet able to mention what is known and asked in the problem.	Poor
Making a Solution Plan	Able to explain the solution strategy precisely and lead to the correct answer.	Good
	Able to explain the solution strategy appropriately but has not led to the correct answer.	Fair
	Not yet able to explain the solution strategy appropriately.	Poor
Implementing the Solution Plan	Able to solve the problem by applying the solution strategy made appropriately with correct results.	Good
	Able to solve the problem by applying the solution strategy made appropriately but the results are not yet correct.	Fair
	Not yet able to solve the problem correctly.	Poor
Rechecking and Developing	Able to check the process and answers and draw appropriate conclusions.	Good
	Able to check the process and answer but not yet able to give the right conclusion.	Fair
	Not yet able to check the process and answers and draw conclusions appropriately.	Poor

Adaptation of Putri & Putri (2022)

The written test results were then compared with the observation results to examine the alignment between students' problem-solving performance in the written tests and their participation during the learning process. The comparison was conducted using the same indicators adapted from Polya's problem-solving stages. In the written tests, these indicators were reflected in students' answers when solving contextual problems, while in the observation sheets, they were used to assess students' learning activities during group discussions, problem identification, formulating strategies, implementing solutions, and presenting results. The comparison of these indicators was used to examine the consistency between students' problem-solving abilities and their learning activities during the implementation of the PBL model integrated with the TaRL approach.

Results and Discussion

Before the implementation of learning using the PBL model integrated with the TaRL approach, this study began with giving an initial test to map the initial abilities of students as the basis for grouping in the TaRL approach. The students were grouped into three levels: high with advanced category (HOTS), medium with intermediate category (MOTS), and low with beginner category (LOTS). The initial test results are presented in Table 3.

Table 3. Results of Mapping the Initial Abilities of Students.

Group Type	Category	Number of Students
HOTS	Advanced	3
MOTS	Intermediate	10

LOTS	Beginner	2

The results of the initial test mapping (Table 3) were used as the basis for organising the class into groups. Among the 15 students, five groups were formed: one HOTS group consisting of three members, three MOTS groups consisting of three, three, and four members, respectively, and one LOTS group consisting of two members. Each group received different learning support according to their level. The LOTS group received more intensive assistance compared to the MOTS and HOTS groups. Students in the LOTS group received more structured guidance such as step-by-step explanations, additional examples, and closer teacher facilitation during problem-solving activities. Meanwhile, students in the MOTS and HOTS groups were encouraged to work more independently through discussion and the exploration of problem-solving strategies. This differentiated support aims to align instruction with students' learning levels, which is the core principle of the TaRL approach.

The next stage was giving a *pretest* to measure students' initial problem-solving abilities, followed by the implementation of the treatment in the experimental class through the implementation of the Problem-Based Learning (PBL) model integrated with the TaRL approach and the administration of a *post-test* containing problem solving questions at the end of learning. Based on the final written test scores, the results presented in Table 4 were obtained.

Table 4. Results of Descriptive Statistical Analysis.

Statistical Data	*Pretest* Results	*Post-test* Results
Number of Students	15	15
Maximum Score	100	100
Highest Score	90	100
Lowest Score	40	60
Average	71.33	84.67
Standard Deviation	15.98	13.02

Table 4 shows an increase in the mean, highest score, and lowest score in the *post-test* results compared to the *pretest* results. The average increase of 13.34% indicates the effectiveness of the implementation of the PBL model integrated with the TaRL approach in IPAS learning in improving problem-solving skills. The results of the *pretest* and *post-test* assessments are presented in Table 5.

Table 5. Frequency Distribution of Students' Written Test Scores.

Interval	Category	Frequency		Description
		Pretest	*Post-test*	
0-75	Low	7	4	Below KKTP
75-89	Medium	5	3	Above KKTP
90-100	High	3	8	Above KKTP

Based on the *post-test* results presented in Table 5, it was found that 11 students were able to exceed the KKTP score of 75. This shows that the Problem-Based Learning model integrated with the TaRL approach influenced students' problem-solving skills as indicated by the increase in the number of students who achieved the minimum criterion compared to the pretest results, in which only eight students achieved the criterion.

Table 6. Frequency and Percentage Distribution Based on N-Gain Categories.

Gain Index	Category	Frequency	Average N-Gain
g > 0,70	High	4	0,56
0,70 ≥ 0,30	Medium	9	
0,30 ≥ g	Low	2	
Total		**15**	

Table 6 shows that four students met high criteria, nine students met medium criteria, and two students were categorised within the low criteria. The average normalised gain was 0.56, which is categorised within the medium criteria. These results indicate that the implementation of PBL integrated with the TaRL approach was moderately effective in improving students' problem-solving skills in IPAS learning for fifth grade students.

Furthermore, the observation results were analysed based on the indicators of the problem-solving stages adapted from Polya. The results of the written test analysis are presented in Table 7.

Table 7. Results of the Problem-Solving Instrument Analysis (*Post-test)*.

Problem Solving Stage	Percentage			
	Problem 1	Proble m 2	Problem 3	Average
Understanding the Problem	93,33%	86,67%	86,67%	88,89%
Develop a solution plan	86,67%	86,67%	76,67%	83,34%
Implementing the solution plan	80,00%	76,67%	73,33%	76,67%
Making a Solution Plan	80,00%	73,33%	73,33%	75,55%

(Analysis Result, 2025)

Based on the analysis of the post-test results from three questions containing problem-solving tasks, it was found that most students were able to develop their problem-solving skills. A total of 88.89% of students were able to understand the problems presented. Meanwhile, 83.34% were able to develop a problem-solving plan. In addition, 76.67% and 75.55% of students were able to implement the planned solution strategy and review and evaluate their solutions, respectively.

The results of the written tests and observations show a similar tendency. The written tests indicate students' ability to complete problem-solving tasks, while the observation results show that students were actively involved in the stages of problem-solving during the learning process. Although the indicators measured through written tests and observations were different, both sets of results provide complementary information. The written tests reflect students' cognitive achievement in solving problems, whereas classroom observations describe how students engaged in the problem-solving process during learning activities.

In the learning process, the implementation of the PBL model integrated with the TaRL approach was carried out through contextual problems in IPAS learning for fifth-grade students. For example, students were presented with problems related to environmental issues in their daily lives and were asked to identify the main problem, determine relevant information, and discuss possible solutions in groups. Through the PBL stages, students collaboratively developed solution strategies and presented the results of their discussions.

The TaRL approach enabled teachers to provide learning support according to students' ability levels. Students in the LOTS group received more structured guidance, while students in the MOTS and HOTS groups were encouraged to explore solution strategies more independently. Through this process, students actively engage in the stages of problem-solving, including understanding the problem, planning solutions, implementing strategies, and reviewing the results.

These findings are consistent with previous studies that report that the problem-based learning model can improve students' learning outcomes and problem-solving abilities in science learning (Muchlisin et al., 2023). Other studies also indicate that the integration of PBL and the TaRL approach contributes positively to students' problem-solving abilities (Istiqomah et al., 2024; Ristiyaningtiyas et al., 2024; Widyastuti et al., 2024).

However, the results also show that approximately 26.67% of students continued to experience difficulties in developing problem-solving abilities. Based on classroom observations, some students required more time and guidance, particularly in understanding the problem and formulating solution strategies. In addition, differences in students' initial abilities affected the learning process, especially in managing group discussions and providing appropriate support to each group.

These findings indicate that the implementation of PBL integrated with the TaRL approach presents several challenges in classroom practice. For instance, the need for teacher readiness and creativity in designing meaningful problem situations was observed during the learning process. This finding is consistent with previous studies that report that teacher readiness is a key factor in the successful implementation of PBL (Palmin & Anwar, 2022). Furthermore, time constraints and differences in students' initial abilities were also found to influence the effectiveness of learning activities. These findings are in line with other studies which state that limited time and diverse student abilities can pose challenges in implementing PBL and TaRL (Auliah et al., 2023; Mubarokah, 2022; Satriani et al., 2024). Overall, these findings indicate that the implementation of PBL integrated with the TaRL approach supported students' engagement and contributed to the development of their problem-solving abilities in IPAS learning.

Conclusion

This study aimed to examine the implementation of the Problem-Based Learning (PBL) model integrated with the Teaching at the Right Level (TaRL) approach to support students' problem-solving abilities in IPAS learning for fifth-grade elementary school students. The results show that the implementation of PBL combined with the TaRL approach contributed to the improvement of students' problem-solving abilities. This improvement is indicated by the increase in the average score from 71.33 in the pretest to 84.67 in the post-test, with an average increase of 13.34%. In addition, the number of students who achieved the Minimum Learning Achievement Criteria (KKTP) also increased from 8 to 11 students. The N-Gain score of 0.56 indicates a moderate improvement in students' problem-solving ability after learning intervention.

The analysis based on Polya's problem-solving stages also shows that most students were able to perform the stages of understanding the problem, making a solution plan, implementing the solution plan, and rechecking the results. These findings indicate that the implementation of PBL integrated with the TaRL approach supported students' engagement in problem-solving activities and help them develop systematic strategies for solving problems in IPAS learning.

The findings of this study imply that the integration of the PBL model with the TaRL approach can be used as an alternative instructional strategy for elementary school teachers to facilitate students' problem-solving abilities through contextual learning activities. By grouping students according to their learning levels, teachers can provide more appropriate learning support that helps students to participate more actively in the problem-solving process.

However, this study has not examined in depth the factors influencing students continued to experience difficulties in developing their problem-solving abilities. Therefore, further research is recommended to investigate other factors such as teacher readiness, students' characteristics, learning facilities, and classroom management that may influence the development of students' problem-solving abilities.

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