

# EFFICACY OF TEACHING AT THE LEVEL RIGHT APPROACH COMBINED WITH THE PROBLEM-BASED LEARNING MODEL ON SCIENCE LEARNING OUTCOMES AT MIDDLE SCHOOL

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ARTICLE INFO	ABSTRACT
<p><b>Article History:</b> Received 21/05/2025 Revised 20/06/2025 Approved 24/08/2025 Published 27/09/2025</p> <hr/> <p><b>Keywords:</b> Level Right (TaRL), Middle School, Problem-Based Learning, Science Learning, Teaching</p>	<p>This research seeks to evaluate the efficacy of the Teaching at the Right Level (TaRL) strategy in conjunction with the Problem-Based Learning (PBL) model on the scientific learning outcomes of eighth-grade students at middle school Islam Terpadu Khairul Imam. This research addresses the inadequate scientific problem-solving abilities and science learning outcomes of Indonesian students, necessitating a more interactive and individualized instructional technique. The methodology used is a quasi-experimental design with a nonequivalent control group. The sample included two purposively chosen eighth-grade classes: one experimental class (n=25) underwent the TaRL–PBL intervention, whereas the control class (n=25) simply used the lecture approach. Data was gathered via a pretest and posttest consisting of 15 multiple-choice questions and thereafter examined for normality, homogeneity, and independent sample t-test using SPSS v.30. The findings indicated that the average posttest score of the experimental group (91.73) was much higher than that of the control group (68.53), with a significant difference (2-tailed) of <math>0.001 &lt; 0.05</math>. The experimental class achieved a score of 85.58, or 86%, on the N-Gain Test, indicating that the TaRL technique combined with the PBL model is an effective learning strategy.</p>
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## INTRODUCTION

Education serves as an important foundation for preparing future generations to face challenges in a dynamic era (Malik, 2018; Tavares et al., 2022). In the framework of Indonesian education, learning does not only include the delivery of information but also the development of students' critical thinking, creativity, and problem-solving skills (Hunaepi & Suharta, 2024). The Independent Curriculum emphasizes the importance of adaptive and differentiated learning, which adjusts educational practices to align with students' readiness, interests, and learning profiles (Masrukhah et al., 2024; Taek, 2024). Therefore, educators must function not only as conveyors of information but also as facilitators who are able to manage classes adaptively.

However, the implementation of science education still shows little student engagement and poor learning outcomes (Loveys & Riggs, 2019). The 2018 PISA study ranked Indonesian students' scientific problem-solving skills 72nd out of 77 countries, highlighting shortcomings in the cognitive and application dimensions of science education (Masrukhah et al., 2024). These poor results highlight the need to replace conventional learning methods that solely rely on lectures with a more participatory and contextual approach.

A new strategy known as TaRL has been considered successful in differentiated learning (Afandi et al., 2024). According to Anggriani et al. (2023), and Meinawati et al. (2024), TaRL is a method that better aligns the learning process with students' real situations by grouping them based on ability level, not age or grade level. This method considers various



student skills and encourages learning methods that build on previous knowledge systematically (Suharyani et al., 2023; Meinawati et al., 2024).

The widespread use of the PBL model in conjunction with TaRL has greatly enhanced students' problem-solving skills (Mustafa et al., 2024; Rofiqi, 2024; Anshar et al., 2025). By having them work together to find solutions to issues that they encounter in their daily lives, PBL makes students the focal point of their education. We teach students to think critically and collaborate by walking them through the steps of identifying an issue, researching it, presenting their findings, and reflecting on their work (Sangkong et al., 2025). This model effectively improves science learning outcomes by facilitating active and meaningful concept development among students (Smith et al., 2022).

In the learning process, the combination of the TaRL method with the PBL model offers a wide range of possibilities. Both PBL and TaRL support each other (Muri et al., 2025). Researchers Resqueta et al. (2024) conducted classroom action research in which they found that students in diverse classes experienced substantial improvements in mathematics learning outcomes after using a combination of PBL and TaRL. The effectiveness is indicated by the fact that the research was conducted in a classroom. This technique can also be adapted for use in the context of science education, which emphasizes the development of skills that require higher-order thinking (Resqueta et al., 2024).

This research aimed to evaluate the efficacy of the TaRL strategy in conjunction with the Problem-Based Learning (PBL) model on students' scientific learning results (Wachyudi et al., 2024; Mustafa et al., 2024). This research seeks to enhance the formulation of learning techniques that successfully accommodate diverse student characteristics, consequently elevating the overall quality of learning results in heterogeneous classrooms (Listiani et al., 2024).

This unique synergy creates a learning framework that is both adaptive (TaRL) and challenging and immersive (thanks to PBL). Previous research has tended to examine TaRL or PBL individually. Testing the effectiveness of integrating TaRL and PBL into a single learning design represents a significant novel contribution. This study fills this gap by investigating how entry-level adaptation (TaRL) can maximize the cognitive benefits of problem-based learning (PBL) for all students, including those with learning disabilities, thereby improving science learning outcomes more equitably and significantly. The novelty lies in the hypothesis that for students to participate and succeed in the PBL process, which demands higher-order thinking skills, they must first be assured of a foundation in science concepts appropriate to their readiness level (TaRL). In short, the novelty is testing the effectiveness of a TaRL-PBL hybrid model specifically designed to address learning gaps and improve mastery of science concepts in junior high school students, a strategy rarely studied as a combination of strategies.

This study presents a new exploration of the synergistic use of the TaRL method and the PBL model, especially in science education at the junior high school level, an area that has rarely been studied in an integrated manner. This study will demonstrate the efficacy of a combined approach to abstract and conceptual scientific issues, such as energy, work, and simple machines, in contrast to previous studies that emphasize mathematics or fundamental learning themes. This study aims to improve differentiated and contextually based educational practices in science education in Indonesia.

## METHOD

The study used is a quasi-experimental design, characterized by the presence of a control group, although it does not entirely regulate external factors that affect the outcome. Sampling was conducted via the purposive sampling approach, which involves selecting samples based on certain criteria deemed suitable for research purposes. This study was performed at Khairul Imam Integrated Islamic Junior High School, Suka Maju Village, Medan Johor District, Medan City, targeting class VIII students during the even semester of the 2024/2025 academic year. The research population included all 74 pupils from class VIII of Khairul Imam Integrated Islamic Middle School. This study used Class VIII Ibnu Sina, including 25 students, as the control group, and Class VIII Al Hayyan, also consisting of 25 students, as the experimental group. The study used a pre-experimental design with a nonequivalent control group model in Table 1.

**Table 1.** Nonequivalent Control Group Design

Group	Pre-test	treatment	Post-test
experiment	O <sub>1</sub>	X	O <sub>3</sub>
control	O <sub>2</sub>	-	O <sub>4</sub>

### Description

- X : Treat with the TaRL Model Problem Based Learning approach
- O<sub>1</sub> : Pretest of the experimental group
- O<sub>2</sub> : Pretest of the control group
- O<sub>3</sub> : Posttest of the experimental group
- O<sub>4</sub> : Posttest of the control group

This research used a test instrument as its data-gathering approach. The test instruments used are a 15-question multiple-choice exam that has been through the validity and reliability testing phases. The scientific curriculum's focus on work, energy, and simple machines informed the selection of the testing tools. The next steps in data analysis include running tests for homogeneity and normalcy. The hypothesis test employs the independent sample T-test to ascertain the existence of a statistically significant relationship between the independent and dependent variables. We used SPSS 30.0 to analyze the results of the independent sample t-test. This research is based on the following hypothesis:

- H0: The problem-based learning model's TaRL approach has no discernible impact on students' final grades.
- Ha: The TaRL method significantly impacts student learning results via the Problem-Based Learning paradigm.

Following the completion of the analytical test, an n-gain test was carried out using SPSS Version 30.0. To determine the degree to which the TaRL Approach is beneficial when used in conjunction with the PBL Model, using the criteria that are shown in the following Table 2.

**Table 2.** Gain Score Distribution

Presentase	Category
< 40	Ineffective
40 – 55	Less effective
56 – 75	Quite Effective
>76	Effective

Building upon the gain score criteria above, the treatment is said to be effective if the student's learning outcomes obtain an n-gain score  $> 0.3$  with medium or high criteria.

## RESULTS AND DISCUSSION

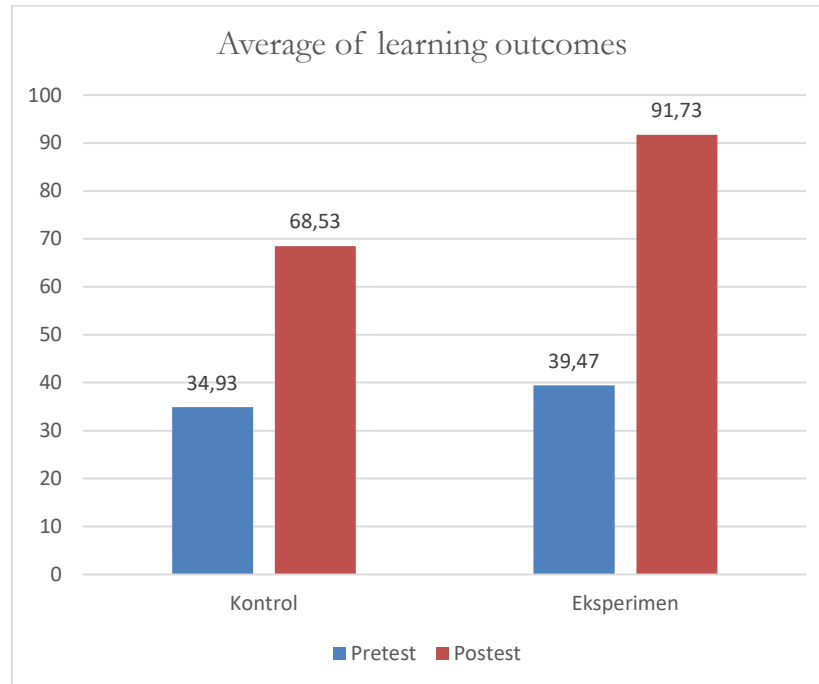
### Results

The initial phase of this study involves the preparation of testing instruments and educational materials, including lesson plans, teaching resources, and student worksheets. The test instrument was evaluated in classes that had undergone identical learning to generate valid questions, enabling the grid to be utilized in the final assessment (posttest) between classes VIII Ibnu Sina and VIII Al Hayyan, which yielded disparate findings. The results revealed the mean value achieved by each class. Table 3 below delineates the outcomes of the pretest and posttest data for class VIII students at Islamic Junior High School Terpadu Khairul Imam, in comparison to the control and experimental groups.

**Table 3.** Descriptive Statistical Analysis of Pretest and Posttest

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Control Pretest	25	20.00	53.33	873.35	34.9340	10.41303
Control Posttest	25	53.33	80.00	1713.30	68.5320	9.91088
Pretest Experiment	25	20.00	53.33	986.67	39.4668	9.79749
Experimental Posttest	25	80.00	100.00	2293.32	91.7328	7.52219
Valid N (listwise)	25					

Table 3 presents the results, illustrating the scores achieved on both the pre-test and post-test for each class. The average pretest score for students is 34.93, the maximum score is 53.33, and the minimum score is 20.00. This information relates to the control class. Subsequently, the mean score attained by students on the posttest was 68.53, the highest score recorded was 80.00, and the lowest score was 53.33. In the experimental class, the mean pretest score of students is 39.46, with a maximum score of 53.33 and a minimum score of 20. The mean score of students on the posttest is 91.73, with the greatest score being 100.0 and the lowest score being 80.0.



**Figure 1.** Average learning outcome diagram

Figure 1 illustrates an enhancement in the average learning results for the class subjected to the TaRL Model Problem-Based Learning intervention. This increase surpasses that of the class instructed by the Problem-Based Learning paradigm. A subsequent data analysis test was conducted, namely a normality test for each class, aimed at ascertaining if the values of the two classes were normally distributed.

**Table 4.** Normality Test Analysis Results

Class	Test	Kolmogorov-smirnov		
		Statistic	Df	Sig.
VII Ibnu Sina (Control)	Pretest	0.938	25	0.036
	Posttest	0.912	25	0.018
VII AlHayyan (Experiment)	Pretest	0.948	25	0.200
	Posttest	0.877	25	0.034

Table 4 reveals that the results of the Kolmogorov-Smirnov normality test demonstrate a significant pretest gain for the control group, with a value of 0.036, which exceeds 0.05, whilst the pretest results for the experimental group are noted at 0.018, also beyond 0.05. The posttest for the control group indicates a significance value of 0.200, exceeding 0.05. The posttest results for the experimental class reveal a significant value of 0.034, in comparison to 0.05. This implies that when the significance value surpasses 0.05, the data may be regarded as regularly distributed. A homogeneity test is performed to determine if the sample derives from a homogeneous population. The homogeneity test determines that a data group is deemed homogeneous if the significance value surpasses 0.05, indicating that the variances among the groups are equal.

**Table 5.** Homogeneous Test Analysis Results

Learning Outcome	Levene Statistic		Sig.
	Based on Mean	Based on Median	
	2.933	1.988	0.37
			0.121

Table 5 reveals a Mean value of 0.37, surpassing 0.05. Consequently, it can be inferred from these findings that the variance of the Pretest-Posttest data for both the control and experimental groups is homogeneous. After completing the necessary normality and homogeneity tests, the next step to validate the hypothesis in this study will involve conducting a t-test, analyzed using SPSS Version 30.0, specifically the Independent Sample t-Test, to evaluate the posttest data from the experimental and control groups. The criteria for decision-making in this test dictate that if the p-value above 0.05, then  $H_0$  is rejected, and  $H_a$  is accepted.

**Table 6.** Hypothesis Analysis Test Results

Learning Outcome	Levene's Test for Equality of Variances		T-test for Equality of Means		
	F	Sig.	t	df	Sig. (2 Tailed)
	6.419	0.15	-6.395	48	<0.001

Table 6 reveals a significant two-tailed value of 0.001, which is below 0.05. Consequently, it can be inferred that a disparity exists in the average learning results of students between the implementation of the TaRL approach in conjunction with the problem-based learning model and the lecture technique alone. The decision results in the rejection of the null hypothesis ( $H_0$ ) and the acceptance of the alternative hypothesis ( $H_a$ ). The disparity in student learning outcomes between the control and experimental classes is substantial, with the experimental class implementing the TaRL approach in conjunction with the Problem Based Learning model exhibiting superior results compared to the control class, which solely utilizes the Problem Based Learning model. The TaRL approach promotes active student involvement in the learning process, especially via group discussions, problem-solving, and joint presentations of their work (Wulandari et al., 2024). Following the conclusion of the hypothesis test, the next stage entails conducting an n-gain test. The n-gain scores are further assessed using criteria adopted from Kurniawan et al. (2024). Table 7 displays the outcomes of the n-gain analysis.

**Table 7.** N-Gain Analysis Results

	Class	Descriptives	Statistic
Persentase_NGain	Experiment	Mean	85.58
		Minimum	57.15
		Maximum	100.00
	Control	Mean	50.00
		Minimum	14.29
		Maximum	75.00

The experimental class achieved an average N-Gain score of 85.58, with 86% of its participants categorized in the effective group, as indicated by the results of the N-Gain score test calculation presented above. A maximum N-Gain score of 100% is attainable, with a minimum threshold of 57%. The control class, exhibiting an N-Gain value between 14% and 48%, is categorized as less effective, with a mean N-Gain score of 50.00. It is evident that eighth grade science students significantly benefit from the integration of the TaRL approach with the PBL paradigm. The outcomes of eighth grade science programs delivered through the lecture format are less remarkable.

### Discussion

The amalgamation of TaRL (diagnosis and categorization) with PBL (contextualization of scientific concepts) establishes a dynamic feedback loop (formative assessment). A UNICEF study emphasized the necessity of ongoing feedback to tailor the learning process to student characteristics (Lennox et al., 2021; Reuge et al., 2021). Simultaneously, a classroom action study on heat content indicated that the application of PBL markedly enhanced learning outcomes by fostering reflection within a continuous improvement cycle. The Teaching at the Right Level (TaRL) technique has consistently proven effective in closing the gap in fundamental literacy and numeracy skills, which are crucial for junior high school scientific teaching. A recent systematic review by Ismail et al. (2024) demonstrated that TaRL interventions enhanced students' achievement scores by an average of 0.45–0.60 SD, particularly among low-achieving groups, thereby reinforcing their foundational scientific literacy and numeracy before the comprehension of intricate scientific concepts. Hidayati and Sugianoor (2024) determined that TaRL elevated high school students' daily science test scores. Classifying pupils according to their real abilities, rather than traditional metrics, enables educators to concentrate remedial instruction on essential scientific principles such as measurement, graphs, and proportions, so ensuring that each student receives customized support aligned with their learning requirements.

PBL increases science learning by concentrating on actual problems, allowing students to create hypotheses, design small experiments, and analyze observational data. A meta-analysis by Barrow found that PBL improved critical thinking and science conceptual knowledge by 0.35–0.50 SD compared to the expository method (Nicholus et al., 2023). PjBL research in junior high school biology classes led to an 18-point rise in post-test scores (from 55 to 73) and improved skills in describing the photosynthesis mechanism (McKinney, 2023). PBL lets students experience the scientific process through problem solving and theory memorization, improving retention and transmission. Together, TaRL and PBL reinforce learning. TaRL emphasizes foundational understanding, while PBL fosters critical thinking and real-world application (Widodo et al., 2025). The combining these two tactics boosted the average science (Usmadi et al., 2025).

Continuous execution allows formal feedback. Teachers conduct TaRL analysis to identify student issues and generate personalized problem scenarios (PBL) to correct conceptual flaws. This iterative technique promotes learning and decreases science misconceptions.

Experiments from design studies improve TaRL–PBL integration. Usmadi et al. (2025) created a TaRL-based arithmetic sequence project-based learning (PBL) model using Understanding by Design (UbD). They met all learning objectives, and student reflections praised the focused and meaningful learning experience (Usmadi et al., 2025). Leasa et al. (2024) also found that the TaRL–PBL intervention in junior high schools raised students' descriptive science self-efficacy by 28% and improved scientific discussion group collaboration. These findings show that tiered diagnosis and scaffolded problem solving improve students' cognitive and affective skills (Ismail et al., 2024).

**What TaRL Does for Differentiated Learning.** The TaRL method starts with a diagnostic evaluation to group students by ability, then scaffolds basic comprehension before moving on to more complex content (Sefriyana et al., 2025). Tier-based identification and correction of pupils' conceptual weaknesses have been successful (Ismail et al., 2024). **Cognitive Benefits of Problem-Based Learning.** PBL helps students tackle real-world problems collaboratively, strengthening critical thinking, problem-solving, and science process abilities. By engaging students in the scientific context, PBL improves science process skills and conceptual understanding (Situmorang & Syahrial, 2023).

**Theoretical Framework of Cognitive Learning and Cognitive Load Regulation.** The Cognitive Load Theory (Sweller) posits that educational design should reduce unnecessary load and enhance relevant load to facilitate the development of students' cognitive schemata (Wong et al., 2012; Sweller, 2023; Chen et al., 2023; Evans et al., 2024). The amalgamation of TaRL scaffolding with PBL frameworks facilitates incremental and organized learning, enabling students to assimilate intricate material without cognitive overload (Barbieri & Rodrigues, 2025). The integration of TaRL and PBL in enhancing motivation and learning. The integration of TaRL and PBL not only tailors the content to the students' capabilities but also enhances intrinsic motivation through active engagement in problem-solving and collaborative conversations. The CAR study on mathematics materials has shown a notable enhancement in engagement and educational outcomes following the installation of PBL-Role Playing with TaRL (Mustafa et al., 2024).

In practical contexts, the integration of TaRL and PBL provides middle school science educators with a definitive approach to designing adaptable and pertinent curriculum. During the TaRL assessment phase, educators ascertain the proficiency of each student in various scientific topics, including force, energy, and heat. Consequently, educators then organize work groups of pupils who exhibit either similarities or differences. In PBL, each group is required to apply their acquired knowledge to real-life scenarios, shown by the utilization of analog temperature measurement. This pattern advances the Independent Curriculum's objective of student-centered learning by prioritizing inquiry, cooperation, and critical thinking. The research indicates that the combined use of the TaRL technique and the PBL model significantly enhances the efficacy of middle school science instruction, improving both scientific reasoning and learning motivation

## CONCLUSION

The study's results indicated that the TaRL approach combined with the PBL model had an impact on learning outcomes, evidenced by a significant level of 0.15, which is greater than 0.05. The study's results indicated that the TaRL approach, when combined with the PBL model as a learning method, achieved an N-gain value of 86%, demonstrating that a significant proportion of students experienced a notable improvement in learning outcomes compared to the traditional lecture method.

As a suggestion, junior high school science teachers are strongly advised to adopt a combination of the Level-Appropriate Learning Approach (TaRL) and the Problem-Based Learning Model (PBL). Conduct a diagnostic assessment at the beginning of the lesson to map each student's level of mastery of basic science concepts (according to TaRL principles) before entering the PBL stage. Use the diagnostic results to provide different interventions/treatments (differentiation) at the PBL problem introduction stage, ensuring all students have adequate cognitive prerequisites to solve complex problems. Further research can examine the effectiveness of this TaRL-PBL model by considering moderating variables including learning style (divergent vs. convergent) and learning motivation. In addition, conduct long-term (longitudinal) research to see the sustainability of improvements in students' science learning outcomes after the TaRL-PBL intervention ends.

## AUTHOR CONTRIBUTIONS

All authors participated in the conceptualization, design, data collection, analysis, interpretation, writing, and revision of the article. All authors approved the finalized manuscript.

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## CONFLICT OF INTEREST STATEMENT

The author asserts no conflicts of interest exist in publishing this paper. This research and results were not influenced by financial, personal, or other affiliations, and supervisors performed their professional duties. We did our best to perform and deliver the research with integrity and transparency.

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