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# Bridging the Learning Gap: Implementing Teaching at the Right Level in Secondary School Mathematics

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**Abstract:** The study evaluates whether and to what extent the Teaching at the Right Level (TaRL) intervention improves students' learning in mathematics across cognitive, affective, and psychomotor domains. This study employed a pre-experimental one-group pre-test/post-test design, in which a single cohort of 35 Grade XI students at Senior High School I, Takalar, South Sulawesi, Indonesia, was assessed before and after the implementation of the TaRL approach. Data were gathered using pre- and post-tests to measure cognitive improvement. The cognitive, affective, and psychomotor domains were assessed with structured observation sheets using a five-point Likert scale, which were then transformed to a 0-100 scale for clarity of interpretation. The result showed a significant increase in students' cognitive achievement, with the pre-test and post-test means of 83.42 and 93.22, respectively. Although the initial score was relatively high due to students' prior exposure to similar mathematical content, the statistical results confirmed a meaningful improvement beyond the baseline understanding. Observations of the affective domain revealed notable positive shifts; students demonstrated higher motivation, increased confidence in problem-solving, and more active participation during class activities, as reflected in an average converted score of 95.31. In the psychomotor domain, the mean score of 93.21 demonstrated students' enhanced ability to apply mathematical concepts in practical contexts through active engagement. These findings suggest that the Teaching at the Right Level (TaRL) approach effectively enhances students' learning outcomes within the studied context by promoting active, differentiated, and student-centered learning experiences. Since the study was conducted at a single institution with a small sample, additional research with larger populations and diverse educational contexts is necessary to substantiate and generalize these findings.

**Keywords:** affective, cognitive, mathematics, psychomotor, teaching at the right level (TaRL).

## ▪ INTRODUCTION

Education is generally acknowledged as the foundation of a country's advancement, with the quality of educational outcomes as a crucial factor in its future vitality. As academic programs and teaching frameworks continue to evolve, identifying effective teaching methods that enhance every student's capabilities becomes increasingly vital. Mathematics plays an essential role in the education system because it cultivates logical thinking, problem-solving, and abstract reasoning, which are necessary for innovation and the development of society (Ball, 1990; Mustafa et al., 2021). However, in mathematics education worldwide, problems persist. The result is a low level of student interest and performance, as many pupils find it difficult to understand very abstract mathematical ideas. According to Schoenfeld (2016), this type of difficulty is common and tends to occur, at least in part, because classroom teaching does not take into account students' varying prior knowledge and cognitive preparedness. This problem is exacerbated in high school, where courses such as calculus, algebra, and statistics demand more advanced thinking. Suppose students do not establish a conceptual understanding of the construct at this stage. In that case, they may experience difficulties not only in higher education but also in applying mathematics in real-world contexts.

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Boaler (2022) argued that fair mathematics learning involves teaching methods that are responsive to students' diverse abilities and promote greater conceptual understanding through active learning.

In Indonesia, the problem of unequal mathematical ability is particularly pronounced. The Program for International Student Assessment (PISA) 2022 results show that 70% of students in Indonesia are hardworking but perform below the minimum proficiency level in mathematics, with wide gaps between school types and regions (OECD, 2023). Similarly, data from the Minimum Competency Assessment indicate that the majority of senior high school students find it challenging to use mathematical reasoning in answering problem-solving questions (Kemendikbud, 2021), revealing stark disparities in attainment even among students in the same class. Studies conducted by Mustafa et al. (2024) in Indonesia, the challenge of unequal mathematical proficiency is particularly evident. The Program for International Student Assessment (PISA) 2022 reported that more than 70% of Indonesian students perform below the minimum proficiency level in mathematics, reflecting substantial disparities across regions and school types (OECD, 2023). Similarly, data from the Minimum Competency Assessment show that most senior high school students struggle to apply mathematical reasoning to problem-solving tasks, highlighting wide achievement gaps even within the same classroom (Kemendikbud, 2021). International evidence also supports this pattern. Smale-Jacobse et al. (2019) found that differences in mathematical performance among secondary students are strongly linked to variations in instructional adaptation, while Vithal (2023) emphasized that achieving equity in mathematics learning depends on teachers' ability to respond to learners' diverse abilities through inclusive and differentiated pedagogy. Taken together, these findings highlight the critical importance of developing instructional approaches that are sensitive to students' varying abilities to promote more equitable learning outcomes.

The Teaching at the Right Level (TaRL) approach is gaining traction as a viable and effective option. Originating from Pratham in India, TaRL categorizes students by learning level rather than grade, allowing teachers to teach based on what learners can do (Banerjee et al., 2017). International evidence has demonstrated success in literacy and numeracy with this approach in developing countries (De & Khemani, 2023; Pratham Education Foundation, 2019). In Indonesia, where gaps in ability are clear, TaRL has the potential to close learning gaps, create more inclusive classrooms, and ensure that all students progress at a suitable pace.

The practice of implementing TaRL is primarily increasing in developing nations. For instance, a study by Banerjee et al. (2007) conducted in India demonstrated that successfully implementing TaRL enhances students' comprehension across subjects. Given these favorable outcomes, additional investigation is required into how TaRL can be adjusted and implemented in educational settings across various nations, along with the potential challenges that may arise. Numerous studies have emphasized the vital importance of recognizing individual needs in education.

The TaRL presumes that among learners there are varied levels of understanding of the subject matter, and that all students, whatever their level, can and should be taught. As such, it focuses on the "in" between students' abilities. TaRL involves categorizing students by their reading and mathematics skills and providing instruction based on their proficiency. The TaRL model also promotes interactive and participatory pedagogy.

Students are encouraged to engage with the learning activities actively to learn more effectively. Further, TaRL advocates the use of teaching resources that match students' levels. TaRL has been piloted in several countries in Africa and Asia, with remarkable gains in student learning outcomes. In India, for instance, more than 40,000 schools have been reached with TaRL, and their reading and math literacy outcomes are showing remarkable improvement.

While the TaRL method has shown promise, several challenges remain in implementing it. One big problem is that not enough teachers really understand what the TaRL approach is all about. Therefore, awareness and support for the approach should be enhanced. Efforts to achieve this may include organizing training and mentoring programs for teachers and policymakers, as well as conducting broader campaigns to highlight the significance TaRL approach in enhancing students' learning achievements.

The TaRL approach can play an important role in mathematics learning. Mathematics learning must be designed to make the students enjoy it to encourage their interest in participating in the learning process (Mustafa et al., 2023). TaRL focuses on students' learning needs and aims to ensure that students understand the subject matter before moving on to higher levels. In mathematics learning, TaRL can help teachers adjust instruction to students' ability levels. Teachers are allowed to treat students with different learning capabilities differently so that they can be taught based on their level of comprehension (Jauhari et al., 2023).

Although the TaRL approach holds significant promise, its practical application continues to face various obstacles. Several studies indicate that implementing TaRL effectively requires navigating a range of contextual factors and complexities across different educational settings. Hence, an in-depth examination is essential to determine how and to what extent the TaRL strategy can be optimally embedded within the education system to enhance student achievement.

In this article, we aim to provide an extensive overview of the TaRL methodology, evaluate its impact on students' learning outcomes, and identify the core features that make it effective. The TaRL approach has attracted greater research attention; however, most of the literature discusses its application in primary education and literacy programs, particularly in countries such as India and parts of Africa (Banerjee et al., 2017; Pratham Education Foundation, 2019). Over the last 10 years or so, researchers have increasingly recognized the TaRL methodology as an effective means of closing learning gaps by grouping students based on their actual competence rather than their grade level. Studies have shown very large effect sizes in foundational literacy and numeracy improvements from TaRL-based interventions in India and several African countries (Banerjee et al., 2016; Pratham Education Foundation, 2019). However, it remains common practice worldwide that TaRL struggles to be sustained and scaled, with many sources citing the need for ongoing teacher training, integration with national curricula, and the development of credible and dependable assessment frameworks (Smale-Jacobse et al., 2019; Vithal, 2023). Nevertheless, few studies have investigated how TaRL principles can be applied to effective mathematics learning at the secondary level, especially in emerging education systems such as Indonesia's, despite these understandings. The recent educational policy reform, the *Merdeka* Curriculum, prioritizes differentiated teaching and Competency-Based Learning (CBL), motivating teachers to create learning activities tailored to students' readiness levels and unique learning profiles. However, many teachers are still unable to conduct diagnostic tests and adjust their teaching to students' actual abilities (Kemendikbud, 2021). This situation is both a challenge and an opportunity: to mainstream TaRL as a supplementary model that supports the vision of the *Merdeka* Curriculum for individualized and inclusive learning. Therefore, the present study aims to fill this research gap by investigating the extent to which a TaRL methodology can be adapted for teaching mathematics in Indonesian senior high schools under the *Merdeka* Curriculum scheme to address entrenched achievement inequalities and provide a more solid pedagogical foundation for differentiated learning.

Research examining how TaRL can be adapted for secondary-level mathematics learning in Indonesia remains scarce. This research gap opens an opportunity to investigate the alignment of TaRL with the *Merdeka* Curriculum framework in mathematics education. This study contributes to the literature by presenting evidence on the effect of TaRL on students' cognitive, affective, and psychomotor learning outcomes. The study also contributes to theory development by broadening the concept of differentiated instruction within flexible curriculum design in the context of Indonesia's *Merdeka* Curriculum. It shows, in particular, how the TaRL approach conceptualizes Vygotsky's Zone of Proximal Development (ZPD) through diagnostic testing and grouping, thereby strengthening the theoretical connection between learner-centered pedagogy and curriculum flexibility in mathematics education. In addition, the current study advances the theoretical framework by synthesizing TaRL with constructivist learning theory and Vygotsky's ZPD into a unified pedagogical approach. ZPD principles also inform the design of the TaRL methodology in an operational sense, through diagnostic testing and group placement based on learner ability, helping instructors determine not only what a student knows but also what they are capable of learning. Teaching is then "scaffolded" to help students reach from what they can do on their own to what they can do with help. This fluid calibration ensures the process occurs within each student's best learning zone, making it a personalized and expanding experience. Unlike traditional mathematics instruction, which relies on a one-size-fits-all teaching approach regardless of learners' preparedness, the TaRL method provides a more responsive and just approach to advancing conceptual understanding and enduring enthusiasm for mathematics among learners.

TaRL is an instructional approach that groups learners by their current learning level rather than by grade, and teaches from that level (Banerji & Chavan, 2016). TaRL is an implementation of Ki Hadjar Dewantara's educational philosophy. By using learners' achievements, skill levels, and individual needs as the foundation for lesson design, the learning process becomes genuinely centered on the students. The primary goal of this approach is to enhance learners' numeracy and literacy competencies while deepening their understanding of subject matter aligned with the intended learning outcomes. In this model, students are not restricted by their formal grade level; rather, they are organized by developmental stage or grouped with peers of similar ability. Core to TaRL is organizing children by learning groups and teaching from where they are, a feature shown to yield significant gains in literacy and numeracy (Duflo et al., 2011).

TaRL is an instructional approach that begins teaching from students' actual learning levels rather than their formal grade level, focusing on rebuilding foundational skills through targeted, level-appropriate activities and ability-based grouping (Akdi & Belamhitou, 2024; Banerji & Chavan, 2020). However, learning is tailored to students' achievements, ability levels, and needs to ensure the expected learning outcomes are achieved. TaRL is an implementation of Ki Hadjar Dewantara's educational philosophy. By considering learners' achievements, ability levels, and needs as a reference for designing learning, we make every effort to be learner-centered (Ahyar et al., 2022). This approach has been used in several countries, including India, Kenya, Australia, etc. In a research study in India, among 200 schools that followed a reading skills training program, there was a 19% increase in the number of learners able to read short paragraphs or stories. Learners were initially grouped by ability level, then given one hour of instruction each day. Similarly, a study in India demonstrated a rapid improvement in reading skills. For example, in India, after a 60-day TARL program, the ability to read a paragraph or story increased from 34% to 53.1% in the treatment group, representing an improvement of approximately 19.1 percentage points in reading ability (Akdi & Belamhitou, 2024).

In mathematics education, the TaRL approach serves as an effective means to enhance students' comprehension of mathematical ideas. Educators can implement specially developed TaRL modules that guide learners through mathematical concepts in a step-by-step, systematic way. The TaRL framework aligns closely with Vygotsky's concept of the ZPD, which highlights the need to adapt instructional content to each learner's current level of understanding. When applied in mathematics instruction, this concept helps bridge gaps in students' understanding of mathematical principles and fosters more meaningful learning progress.

Pratham (2018) evaluated the impact of the TaRL approach in math and language learning in India. The results showed that implementing the TaRL approach can improve students' math learning outcomes in areas with previously low achievement levels. The study also showed that the TaRL approach can help improve students' learning motivation. In addition, Kremer et al. (2013) discussed the challenges of education and learning in developing countries and the TaRL approach as a solution to improve student learning outcomes. This review also covers findings from research demonstrating that TaRL-based interventions can improve student maths learning outcomes in contexts where learning outcomes were previously low. The Indonesian education system has undergone a range of reforms, but there are still problems, particularly at the junior high school level. The TaRL approach has become an effective strategy for closing learning gaps and enhancing performance (Ismail et al., 2024). This review also elaborates on findings from other research indicating that the TaRL method can be instrumental in enhancing students' mathematics learning outcomes in regions where learning outcomes were previously low.

The implementation of TaRL in mathematics learning has a significant positive impact on student achievement. However, implementation challenges need to be addressed through a holistic approach that involves all education stakeholders. This study aims to evaluate the impact of implementing the TaRL approach on mathematics learning outcomes, specifically focusing on students' cognitive, affective, and psychomotor domains. While prior studies have examined TaRL in literacy and primary education contexts, limited evidence exists regarding its application in high school mathematics learning in Indonesia. This research thus contributes empirical data and theoretical insight into how TaRL can enhance mathematics learning in line with the goals of the *Merdeka* Curriculum, while also identifying challenges and opportunities for its sustainable integration. In line with this purpose, the study addresses the following research questions: (1) To what extent does the implementation of the Teaching at the Right Level approach improve students' cognitive learning outcomes in mathematics?. (2) How does the Teaching at the Right Level approach influence students' affective development, including motivation and attitudes toward learning mathematics?. (3) In what ways does the application of the Teaching at the Right Level approach enhance students' psychomotor skills in applying mathematical concepts to practical contexts?.

This study is grounded in a growing body of international research that emphasizes adaptive learning strategies to address disparities in mathematical achievement (Tomlinson, 2021; De & Khemani, 2023; Stern & Schneider, 2021). The TaRL approach, validated through large-scale implementations in India and several African countries (Banerjee et al., 2017; Pratham Education Foundation, 2019; OECD, 2023), has demonstrated consistent improvements in both literacy and numeracy outcomes. Building on these findings, this study contextualizes the TaRL model within the Indonesian high school mathematics curriculum to explore its potential to reduce learning gaps and foster equitable educational progress.

## ▪ METHOD

### Participants

The participants in this study were 35 Grade XI students from SMAN 1 Takalar, South Sulawesi, comprising 12 males and 23 females. According to school records, most students came from lower-middle socioeconomic backgrounds, with the majority of parents working as farmers or small-scale traders. The initial diagnostic test revealed varying levels of mathematical proficiency: 11 students were categorized as high, 15 as moderate, and nine as low, indicating meaningful heterogeneity in learning readiness.

Although TaRL is typically implemented in classrooms with substantial disparities in foundational skills, access constraints at the research site necessitated selecting an existing intact class through purposive sampling. The selection was based on students' prior academic records and their ongoing engagement with mathematics learning under the Merdeka Curriculum. This curriculum emphasizes differentiated instruction and competency-based learning, aligning the class with TaRL's implementation goals.

The relatively broad distribution of ability levels within the class enabled a focused exploration of how TaRL may support improvements across cognitive, affective, and psychomotor learning domains while also acknowledging that the sample's composition, including several high-performing students, poses important implications for the interpretation and generalizability of the findings.

### Research Design and Procedures

This study employed a pre-experimental one-group pre-test/post-test design, in which a single cohort of students was assessed before and after the implementation of the TaRL approach. This design was appropriate because the researcher did not manipulate the independent variable directly; instead, the researcher examined the effects of an existing instructional approach on student achievement. The study followed several sequential phases, namely (1) Preparation Phase, obtaining institutional permission from the school, and introducing the study objectives to teachers and students. (2) Teacher Training, a short workshop was held to familiarize mathematics teachers with the procedures and materials for implementing TaRL in the classroom. (3) Implementation phase, teachers conducted mathematics lessons using the TaRL approach for approximately four weeks, focusing on grouping students by ability level and providing scaffolded instruction aligned with their learning readiness. (4) Data Collection Phase, students completed pre-tests before and post-tests after the intervention period, and their affective and psychomotor performance was also assessed during classroom activities. (5) Evaluation and Reflection Phase, the data were collected, scored, and analyzed to assess the degree of learning gain associated with TaRL.

**Instruments**

Three instruments were used in this study: (1) the Mathematics Achievement Test, designed to assess students' conceptual understanding before and after the TaRL intervention. The test consisted of 5 essay questions on mathematical problem-solving that align with the Merdeka Curriculum. The items were adapted from the Pratham Foundation's TaRL numeracy modules and validated by mathematics education experts. (2) Affective Observation Sheet, developed to measure students' attitudes, motivation, and engagement during TaRL sessions. The instrument used a 5-point Likert scale and was adapted from the affective learning framework of Krathwohl et al. (1973). (3) Psychomotor Performance Rubric, used to assess students' ability to apply mathematical concepts in practical tasks such as manipulating shapes, graphing, and problem demonstrations. The rubric was validated through expert review and pilot testing with an internal reliability of 0.82.

**Data Analysis**

Quantitative data from the pre-test and post-test were analyzed using descriptive and inferential statistics. Descriptive statistics (mean, standard deviation, and percentage gain) were used to present students' overall performance. To measure the effectiveness of the TaRL implementation, a paired sample t-test was conducted to determine the significance of the difference between pre-test and post-test scores. The effect size (Cohen's d) was also calculated to determine the magnitude of improvement.

Affective and psychomotor data were analyzed using mean score comparison and percentage achievement analysis. Qualitative notes from observations were used to triangulate the quantitative findings, providing contextual insight into students' engagement and teacher–student interaction during the TaRL implementation.

## ▪ RESULT AND DISSCUSSION

The results of this study are presented in two main dimensions: qualitative and quantitative. The qualitative dimension creates a space to feel the learning atmosphere of TaRL, through stories and direct experiences from the teachers and students involved. Qualitative data is in the form of observations on affective and psychomotor aspects. Meanwhile, the quantitative dimension provides a strong analytical framework for measuring the extent to which TaRL improves students' understanding of mathematical concepts. Quantitative data includes cognitive aspects (pre-test and post-test).

**Quantitative Data Analysis (Pre-Test and Post-Test)**

The pre-test was carried out to determine learning outcomes in cognitive aspects, while those for psychomotor and affective aspects were obtained from observation sheets during learning.

**Table 1.** Descriptive statistics of students' cognitive performance (pre-test and post-test)

| Cognitive Measurement | Mean | Standard Deviation |
|---|---|---|
| Pre-test Cognitive Performance | 83.42 | 11.68 |
| Post-test Cognitive Performance | 93.21 | 7.61 |

The descriptive statistics show an increase in students' overall cognitive performance following the implementation of the TaRL approach. The mean pre-test score was 83.42 (SD = 11.68), indicating a relatively strong baseline understanding aligned with curriculum content previously learned by students. After the intervention, the mean post-test score increased to 93.21 (SD = 7.61). Although the initial average score was already high, the reduction in standard deviation suggests that students' scores became more homogeneous after the intervention, indicating a narrowing of the learning gap among students. This pattern aligns with TaRL's underlying principle, which aims to reduce variation in achievement by providing instruction matched to students' actual proficiency levels.

In general, the students seem to have had a reasonably good grasp of the material tested, with an average score of 83.42 out of 100. However, the significant score difference (a range of 45) indicates a significant gap in students' mastery of the material. Some students were very capable (the highest score of 95), while others needed much more help (the lowest score of 50). The small standard deviation of 11.68 at least tells us that, while there are outliers, the majority of  students fall within a band not too far from the mean.

The relatively high average pre-test score (83.42) indicates that participants had stronger prior knowledge of mathematical concepts. This result is due to the research sample being a brilliant student at SMAN 1 Takalar who has participated in many enrichment and extramathematics programs. Hence, the high pre-test scores are more indicative of the sample's high level of academic achievement than of a difficulty level that is too high.

As predicted, this manipulation resulted in slower reaction times in the third-person condition compared with the first-person condition, consistent with previous studies. However, this requirement also indicates potential ceiling effects, in which limited room to improve could conceal observable improvement in post-test performance. Therefore, although the results provide strong evidence for the internal validity of TaRL as a means of improving students' conceptual and affective engagement, to date, they should be viewed as tentative and cannot be generalized to settings with less able and/or more diverse student bodies. Further research is suggested to replicate this work with samples spanning a wider ability range to fully capture TaRL's impact across varying learner profiles. If the scores for learning outcomes in the cognitive aspect are grouped into four categories, the frequency distribution and percentages are shown in Table 2.

**Table 2.** Frequency distribution and percentage of pre-test score of cognitive aspect

| Score | Category | Frequency | Percentage (%) |
|---|---|---|---|
| 0 – 20 | Very Low | 0 | 0 |
| 21 - 40 | Low | 0 | 0 |
| 41 – 60 | Medium | 3 | 8.6 |
| 61 – 80 | High | 15 | 42.8 |

| | | | |
|---|---|---|---|
| 81 – 100 | Very High | 17 | 48.6 |

Seventeen students achieved a high score, for a 48.6% share, and 15 students scored in the high category, for a 42.8% share. Moreover, the medium student category accounts for 8.6%. In general, the mean pre-test score is in the high category. The distribution of students before the start of the study regarding cognitive completeness of learning in the TaRL study online intervention shows that the majority are already above the minimum competence standards. Among the 35 students participating, 32 scored between 70% and 100%, indicating they had met the school's competency standard in mathematics. Three students (8.6%) had scores below 70%, indicating they were not yet competent. These findings imply that, while most students had sufficient prior knowledge before the intervention, the class varied in conceptual readiness. If the learning outcome scores are grouped into four categories, the frequency distribution and percentages are shown in Table 3.

**Table 3.** Frequency distribution and percentage of post-test scores of the cognitive aspect

| Score | Category | Frequency | Percentage (%) |
|---|---|---|---|
| 0 – 20 | Very Low | 0 | 0 |
| 21 - 40 | Low | 0 | 0 |
| 41 – 60 | Medium | 0 | 0 |
| 61 – 80 | High | 3 | 8.6 |
| 81 – 100 | Very High | 32 | 91.4 |

Based on the data presented in Table 3, 32 students scored very high (91.4%), while three scored in the high category (8.6%). Post-test results did not identify any students who scored in the sufficient or insufficient categories. Following the implementation of the TaRL-based learning intervention, cognitive learning completeness increased significantly. Thirty-five (100%) students scored between 70% and 100% mastery, indicating that all students attained the minimal competency level after the instructional treatment. All students scored above the minimum mastery level. This enhancement shows that all students attained full mastery of the mathematical skills tested after the intervention, further indicating a positive change in the group's overall cognitive outcomes.

To shed light on changes in student cognitive performance before and after the TaRL programme, pre-test and post-test score distributions were analyzed across five performance categories: Very Low, Low, Medium, High, and Very High (Based on Table 2 and Table 3). This grouping was done to analyze not only changes in the mean scores but also the distributions of students across different proficiency bands. This comparison also illustrates whether the intervention was stimulative of upward movement in students' cognitive mastery. The figure below shows the percentage of students in each category for both the pre-test and post-test, providing a more nuanced view of learning progress than simply reporting average score differences.

The distribution of students' cognitive scores before and after the intervention demonstrates a clear improvement following the implementation of the TaRL approach. According to Table 2, the pre-test results indicate that the students were initially distributed across three performance levels. Overall, 48.6% of students were classified as

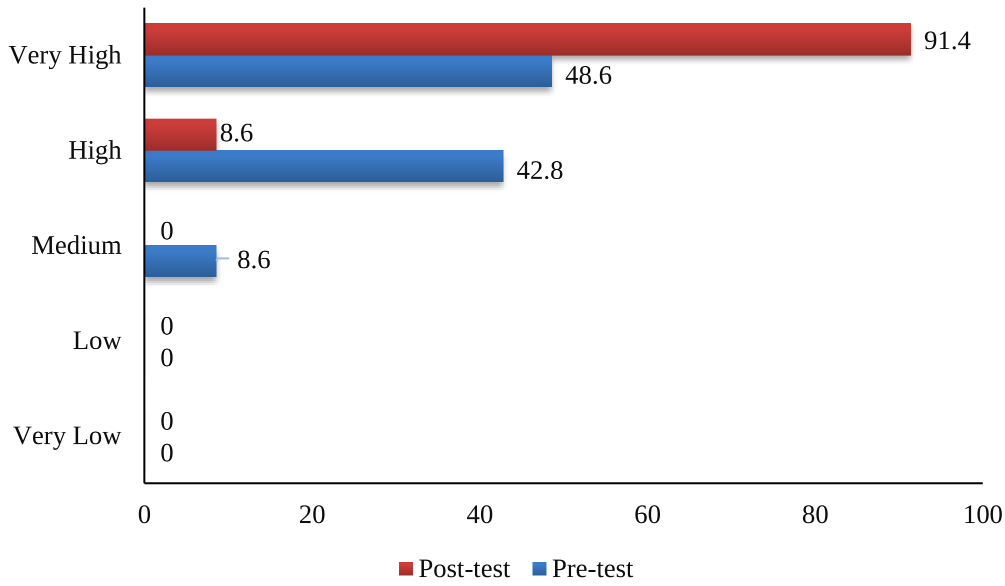


**Figure 1.** Percentage distribution of cognitive achievement levels before and after tarl implementation

Very High (81–100), 42.8% as High (61–80), and 8.6% as Medium (41–60). Importantly, no students obtained a score in either the Low or Very Low category. This distribution implies that, while students possessed relatively strong prior knowledge, there was still a discernible difference in the depth of their knowledge. Table 3 illustrates a marked change in the distribution of the scores after the learning session. In the post-test, 91.4% of students were in the Very High category, and the rest (8.6%) were in the High category. Significantly, no student was in the Medium, Low, or Very Low categories. This large concentration of scores, at least in the two highest categories, also shows a remarkable increase in students' thinking and a narrowing of the performance gap.

The visualization above strengthens this conclusion. The horizontal bars reveal a very strong increase for the Very High group from 48 in the post-test, indicating a strong overall shift toward higher levels of mastery. On the other hand, the Medium level, which represented a minority of students in the pre-test, was completely wiped out in the post-intervention. This trend indicates that TaRL not only increased students' cognitive achievement but also made their performance more uniform, thereby diminishing variation within the group.

The findings demonstrated a statistically significant positive effect of the TaRL approach on students' mathematics achievement. The analysis of quantitative data revealed a statistically significant increase in post-test scores relative to pre-test scores, indicating that students' comprehension of mathematical concepts improved after the TaRL intervention.

The findings of this study have significant implications for the design of a more flexible and effective mathematics curriculum. The curriculum can be enriched with TaRL paired-learning strategies to better match students' levels of understanding. In addition, teacher training programs that focus on applying TaRL principles to mathematics learning are needed to help teachers overcome implementation challenges more effectively. The findings of this study indicate that the success of TaRL in improving students' mathematical understanding is strongly associated with three classroom mechanisms observed during implementation: (1) structured ability grouping, (2) targeted use of differentiated learning materials, and (3) teacher facilitation that encourages peer collaboration and active feedback.

Data from classroom observations revealed that students in lower-ability groups showed greater gain scores (M = 12.4) compared to higher-ability students (M = 5.8), suggesting that differentiated tasks directly addressed their learning gaps. This implies that TaRL can be most effective when teachers are trained not only in its conceptual framework but also in diagnostic assessment practices that allow accurate grouping of students by proficiency level. Therefore, the practical implication drawn from this study is that the implementation of TaRL should be integrated into the *Merdeka* Curriculum not merely as a philosophy of differentiation but as a structured classroom model that includes (1) diagnostic grouping at the start of each unit, (2) tiered learning tasks adjusted to students' competence levels, and (3) continuous teacher reflection on student progress. This evidence-driven structure provides a more concrete guide for educators and policymakers seeking to scale TaRL in the Indonesian high school context.

The pre-test and post-test scores were compared to evaluate changes in students' mathematics learning outcomes. The mean pre-test score was 83.42 (Table 1), while the mean post-test score increased to 93.21 (Table 4), indicating a gain of 9.8 points. This improvement suggests a positive development in students' conceptual understanding following the implementation of the TaRL-based instruction. However, to verify whether this difference was statistically significant or merely due to chance, a paired-samples t-test was conducted on the pre- and post-test scores, and the result confirmed a significant difference ($p < 0.05$). It is recognized that the relatively high pre-test score may raise concerns regarding a potential ceiling effect. To clarify this, it should be noted that (1) the pre-test and post-test instruments were developed based on the fundamental competency indicators of mathematical topics that had already been introduced to students in previous lessons, allowing them to demonstrate a relatively strong baseline understanding before the intervention; and (2) the high pre-test average reflects students' readiness and prior conceptual mastery of fundamental mathematics concepts rather than an instrument limitation. Nevertheless, the statistically significant post-test improvement ($p < 0.05$) indicates that the potential ceiling effect did not hinder the detection of meaningful learning gains. These results reinforce the interpretation that the TaRL approach deepened students' comprehension and facilitated measurable progress beyond their prior understanding. Based on the computation, the obtained t-value was 5.88, suggesting that a fairly significant difference exists between the two scores. Furthermore, the resulting p-value is $1.23\times10^{-6}$, which is much less than the usual threshold value of 0.05 for the significance level.

Results from a paired t-test revealed a significant difference between pre-test and post-test scores, indicating that students' cognition was significantly enhanced after receiving the TaRL treatment. Nonetheless, as this trial did not employ an official comparison group, the findings should not be taken as proof of TaRL's effectiveness. The increase, however, is indicative of a trend compatible with mechanisms integral to the TaRL system, i.e., structured placement, learning materials designed with specific learning needs in mind, and individualized attention. Additional analyses were conducted to enhance the internal validity. The analysis of gain scores demonstrated that those with the lowest pre-test scores gained the most on the post-test, further substantiating the idea that TaRL is a potent means of addressing learning deficiencies among under-performing students. Moreover, block analysis at the item level demonstrated that the most pronounced improvements occurred for conceptual items (as opposed to procedural ones), consistent with TaRL's focus on conceptual understanding and mastery learning.

The qualitative results from class observations and teacher interviews again confirmed that group instruction, on-the-spot feedback, and opportunities for peer learning (all TaRL principles) are advantageous for learners. These triangulated findings imply that the lack of a control group in the study design limits claims of causality. However, a cohesive, multidimensional body of evidence supports TaRL's effectiveness in improving mathematics learning in actual classrooms.

These results indicate that the pre-test and post-test mean scores differed significantly. Therefore, the null hypothesis stating that there is no difference between the two scores can be rejected. This statistically significant increase suggests that the improvement is unlikely to be due to chance alone, but may be associated with the learning activities conducted during the intervention period. While the design of this study does not allow for strong causal claims, the findings suggest a potential positive effect of the TaRL approach on students' cognitive understanding.

The TaRL application in this study successfully addressed the gap between lower- and higher-ability students, as reflected in the decrease in standard deviation from 11.68 in the pre-test to 7.61 in the post-test. This indicates that after the learning, more homogeneous results were achieved, with smaller variations in student scores. The results of these statistical tests support the claim that the learning approach used had a very positive effect on improving students' mathematics learning outcomes.

**Qualitative Data Analysis (Affective and Psychomotor)**

Furthermore, observations were made of the psychomotor and affective aspects during the classroom learning process with the implementation of the TaRL learning approach. The observation data are presented as follows.

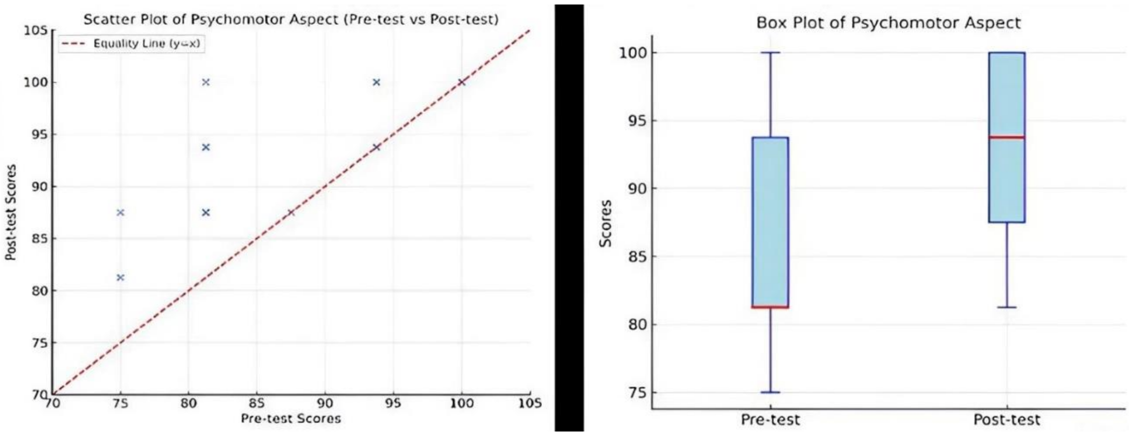


**Figure 2.** Visualization of psychomotor aspect before and after the implementation of TaRL

The psychomotor aspect in this study refers to students' ability to demonstrate learning outcomes through observable actions, such as manipulating learning media, constructing geometric figures, and explaining problem-solving procedures using physical representations. Based on the scatter plot shown in Figure 2, there is a clear upward trend, where nearly all data points lie above the equality line (y = x). This indicates that most students improved their psychomotor performance after implementing the TaRL approach. Students who initially achieved lower pre-test scores (ranging from 75 to 81.25) showed marked progress in their post-test results, reflecting the positive impact of differentiated learning tailored to individual competency levels. The box plot of the comparison confirms the result. The median score median from about 83 on the pre-test to 93 on the post-test, and the spread of the scores was visually reduced. This reduction in variance means that the TaRL approach not only improves overall psychomotor achievement but also levels the playing field among students of different skill levels. In effect, the intervention helped reduce achievement disparities between high- and low-performing students, resulting in a more equitable learning environment. The uniformity of the post-test results also implies that the students gained procedural knowledge and applied skills more efficiently through repeated, scaffolded practice. Qualitative classroom implementation experiences confirm these statistical results. The lower-ability students also showed greater interest in carrying out tasks such as drawing diagrams and showing the steps in solving problems. In contrast, the higher-ability students extended their conceptual understanding by undertaking more challenging tasks. Those teachers who also commented on the small-group organization supported the idea that grouping students by skill facilitated more specific feedback and increased opportunities to practice. Together, these results demonstrate that the TaRL approach fosters a holistic learning environment that bridges conceptual learning and hands-on experience, thereby enhancing students' engagement and psychomotor outcomes in mathematics.

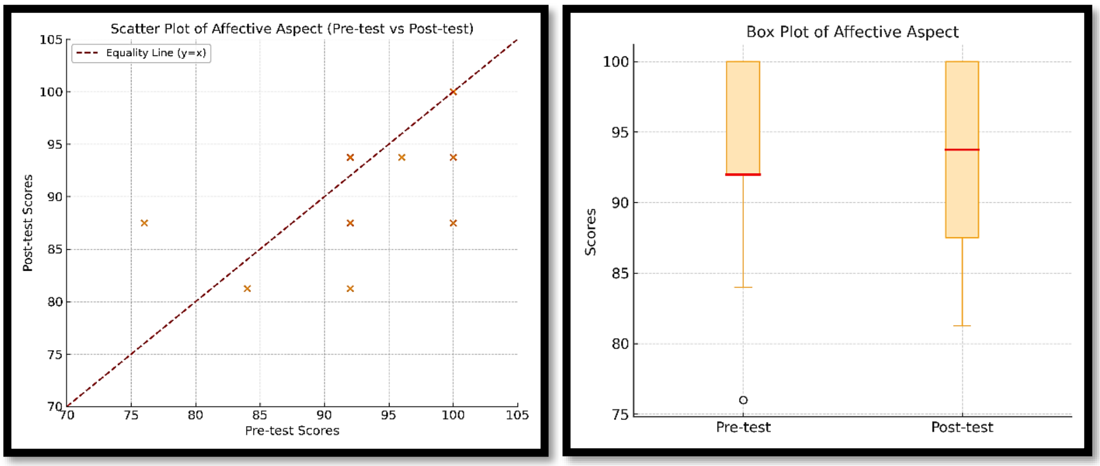


**Figure 3.** Visualization of affective aspect before and after the implementation of TaRL

The affective component of this research concerns students' emotional participation, attitudes, and motivation in learning mathematics. As shown in Figure 23, the scatterplot indicates that many points lie above the equality line, suggesting that most students achieved positive gains in the affective domain after implementing the TaRL method. Some students who began with average pre-test results (between 85 and 92) made significant improvements on the post-test, demonstrating newfound enthusiasm, confidence, and determination when working on math problems. The boxplot also supports these conclusions. The median score rose from about 92 in the pre-test to 94 in the post-test; the interquartile range also decreased, indicating lower variability in students' affective reactions. This trend suggests that TaRL generates a more consistent level of motivation and enjoyment among students, regardless of their pre-existing attitudes. Furthermore, the modest rise in lower-quartile values indicated that students who were least engaged with the activity at the start also experienced positive emotional transformations after their instruction was adapted to their learning level. Classroom observations qualitatively corroborate these quantitative findings. Students felt more at ease and less anxious in mathematics classes because they believed the activities were within their reach and appropriate for their level. Increased peer interaction, collaboration, and confidence among the weaker students were also noted by the teachers. These results indicate that TaRL delivery can improve not only cognitive outcomes but also affective learning about feelings and spirit, to a greater extent, by creating an enabling, inclusive, and motivation-driven classroom environment.

Classroom observations and interviews also provided important insights into how TaRL impacts students' learning experiences. For example, a high-achieving student (S-17), who demonstrated a strong conceptual understanding from the outset, shared that grouping based on ability allowed her to “focus more and not have to wait for others who have not yet grasped the basic concepts.” This quote demonstrates that TaRL not only helps lower-ability students but also provides a platform for accelerated learning for higher-ability students. Conversely, a previously less active student (S-32) shared that she felt "more confident because she was studying with friends of similar ability, so she was not embarrassed to ask questions." These findings suggest that the TaRL structure created a safer social environment for previously passive students, fostering increased motivation and confidence.

The qualitative data also revealed the TaRL pedagogical mechanisms that most contributed to improved understanding: scaffolding and rapid feedback. A teacher stated, "Because small groups are more homogeneous, I can directly help students who are struggling without disrupting the flow of the lesson." Field observations indicated that teacher-student interactions became more intense and personal, accelerating the remediation of misconceptions.

Qualitative data reinforces the quantitative findings that improvements in cognitive scores and changes in student attitudes do not occur solely due to “exposure to the material,” but rather due to changes in the learning structure, the quality of interactions, and increased self-confidence, which are at the heart of the TaRL approach. The information in Figures 1 and 2 suggests favorable student achievement in the psychomotor and affective domains of learning. Nevertheless, I think it is still necessary to keep in mind efforts to enhance these aspects to make student accomplishment in two dimensions feasible. This link indicates that TaRL's application is significant not only for students’ cognitive achievement but also for the psychomotor and affective domains. TaRL can also harness the potential of all facets of students’ abilities by creating a learner-centered, responsive teaching-learning environment that fosters more comprehensive and rewarding learning outcomes.

The findings of the impact evaluation paint an optimistic picture of the effects of adopting TaRL in mathematics instruction. Post-test results showed a significant improvement in students' mathematical concepts following the implementation of TaRL. This suggests that the TaRL model is effective not only in improving students' cognitive skills for learning mathematics content but also in enhancing students' achievement in absorbing the content. This improvement is consistent with the constructivist principle, which emphasizes students' active role in constructing their knowledge.

Constructivism emphasizes student-centered learning, recognizing and accommodating students' individual needs and abilities. TaRL implements this principle by identifying each student's ability level and tailoring the teaching materials accordingly. According to Jonassen and Land (2018), student-centered learning encourages higher engagement and motivation as students feel the learning is relevant to their abilities and needs.

Learning is relevant to their abilities and needs. Vygotsky's ZPD concept is central to the TaRL approach. ZPD is the distance between what students can do on their own and what they can achieve with help. TaRL ensures that teaching and learning activities are within students' ZPD, allowing them to develop with the right support. Research by Gauvain (2020) shows that ZPD-focused learning can improve academic outcomes by ensuring that students are constantly challenged yet still able to achieve learning goals. In constructivism, scaffolding is the process of providing the necessary support to help students achieve a deeper understanding or acquire new skills. TaRL provides adaptive scaffolding, adjusting assistance based on the student's progress. As the student's ability increases, the level of support is gradually reduced. Wood et al. (1976) emphasize that effective scaffolding can help students develop independence in learning and improve academic achievement.

The consistently high average scores indicate that students were engaged in learning activities that demanded active participation, such as group discussions, problem-solving, and collaborative projects. Richardson (1997) asserts that active learning approaches can improve student understanding and retention. In addition, the study's results showed the highest score of 100 and the lowest of 70, indicating that, despite variations in individual abilities, the collaborative learning environment may have helped all students achieve an adequate level of understanding. The study by Garcia-Carrion et al. (2020) demonstrated that dialogic teaching through structured social interaction between students and teachers led to measurable improvements in learning outcomes.

This finding is consistent with evidence from previous studies demonstrating the effectiveness of the TaRL approach in improving learning outcomes. Banerjee et al. (2016) found that TaRL interventions in India led to substantial gains in basic literacy and numeracy among elementary school students by regrouping learners based on their mastery levels. Similarly, the J-PAL (2020) synthesis report concluded that TaRL fosters constructivist learning by allowing students to engage with material aligned to their current understanding, promoting active knowledge construction. However, the present study extends these findings to a new context, secondary-level mathematics learning under Indonesia's *Merdeka* Curriculum. Unlike the foundational literacy-focused interventions in India, the Indonesian adaptation required integrating TaRL principles into more abstract, higher-order mathematical concepts, such as algebraic reasoning and problem-solving. While Banerjee et al. emphasized large-scale teacher-led group restructuring, this study implemented TaRL in smaller, ability-based classroom groups with teacher facilitation guided by diagnostic assessments. The results showed that although the overall gains were moderate compared to early-grade interventions, the TaRL approach effectively reduced performance disparities and strengthened students' affective and psychomotor engagement.

This contextual difference underscores the importance of curricular alignment and learner maturity for TaRL's success. In Indonesia's *Merdeka* Curriculum, the flexibility of lesson design and emphasis on differentiated instruction provided fertile ground for adapting TaRL beyond foundational learning. Consequently, the approach not only improved students' conceptual understanding but also enhanced classroom inclusivity by addressing diverse learning needs. This result complements but also extends the foundational-level evidence reported in India and Africa.

TaRL, by customizing the material according to the student's level of understanding, facilitates this constructive process by providing relevant and appropriate learning experiences. This aligns with J-PAL's (2020) findings that Teaching at the Right Level (TaRL) can foster constructivism among students. Constructivism is the belief that students construct their own knowledge and understanding of learning through their experiences and reflection. TaRL enables teachers to align students' learning to learning outcomes (Asiza et al., 2023). Reflection and metacognition are also important in constructivist learning theory. Reflective learners can assess their learning and adjust it if required. The high mean score might indicate that students had been taught/encouraged to reflect on their learning and act on it by working on their weaknesses. Dinsmore et al. (2020) found that metacognitive training enhances learning outcomes.

In the TaRL methodology, students are grouped in sections according to their competency in the content. Then the teacher offers subject matter appropriate to the student's level of comprehension. Within these small groups, students can communicate with one another and deepen their knowledge through guided discussion and activities. This is supported by research and fieldwork conducted by Banerjee et al. (2017) and Pratham (2019). The TaRL approach is effective in improving students' understanding of fundamental subject matter by tailoring instruction to their level of understanding. By being placed in small groups and allowed to interact with peers and through structured discussions and activities, students can build their understanding more effectively and thoroughly. Mustafa et al. (2024) stated that although the TaRL approach can improve students' understanding of the material, the challenge often faced is the variation in students' abilities, which requires better adjustments to the material and to grouping. They emphasize the importance of ongoing teacher training to adapt the material to students' different needs. In addition, Mustafa et al. (2024) stated that integrating TaRL with the problem-based learning (PBL) model can significantly improve student understanding but still requires continuous evaluation and adjustment to reduce the achievement gap between students. Furthermore, research by Pratham (2019) revealed that implementing TaRL, which prioritizes grouping students by their level of understanding, demonstrates significant sustainability when combined with active learning models such as PBL. This approach encourages active student engagement, which is a key element in the sustainability of learning. Given that grouping and adaptation of material are fundamental aspects of TaRL, a commitment is needed to continue assessing and improving from time to time, so that each student receives learning appropriate to their level of understanding.

The TaRL is structured into levels based on students' cognitive abilities. In the TaRL learning process, students are required to be more active, which emphasizes a student-centered approach (Meishanti et al., 2022). Although TaRL's main focus was on cognitive aspects, the study also showed improvements in students' psychomotor skills. Active responses to the learning materials supported the development of these skills. The concept of psychomotor by Bloom et al. (1956) provides a basis for understanding that practical tasks and problem-solving in mathematics learning can stimulate the development of students' psychomotor skills. When linked to psychomotor learning outcomes, TaRL can make a significant contribution to the development of students' motor skills, as shown in Table 4.

**Table 4.** Contribution of TaRL to students' motor skills

| Contribution Aspect | Explanation |
|---|---|
| Learning Adjustments | Teachers can identify individual students' psychomotor skill levels and devise learning programs that match their abilities. This allows students to learn most effectively according to their level of motor development. |
| Improved Motor Skills | Through the TaRL approach, teachers can design learning activities that emphasize the development of students' psychomotor skills. By providing appropriate and sustainable exercises, students can improve coordination, speed, accuracy, and strength when performing physical activities. |
| Measurement of Learning Outcomes | The TaRL also allows teachers to systematically measure students' progress in psychomotor aspects. With structured assessments in place, teachers can observe students' motor skill development and provide appropriate feedback to help them achieve their learning goals. |

In addition to cognitive and psychomotor outcomes, the present study also found positive changes in students' attitudes towards learning mathematics. In line with Albert Bandura's social learning theory, students can acquire positive attitudes and beliefs by observing, engaging in, and experiencing real-life examples in the classroom (Bandura, 1977). When connected to affective learning outcomes, the TaRL approach can foster emotional growth, nurture positive attitudes, and shape constructive values among students.

**Table 5.** TaRL contribution to students' affective skills

| Contribution Aspect | Explanation |
|---|---|
| Improved Learning Motivation | By presenting learning materials based on students' levels of understanding, TaRL can increase students' motivation to learn. Students feel more confident and motivated when they can master the material taught. |
| Developing a Positive Attitude towards Learning | Through the TaRL approach, which emphasizes an in-depth understanding of concepts, students can develop a positive attitude toward learning. They will feel more motivated to learn and actively participate in the learning process. |
| Increased Independence and Self-Confidence | By focusing on a thorough understanding of concepts, TaRL) helps students develop independence in learning and increase their confidence in their academic abilities. |

| | |
|---|---|
| Development of Learning Values and Ethics | Through a TaRL approach that pays attention to students' individual needs, teachers can help students develop positive values such as hard work, perseverance, responsibility, and good learning ethics. |

The results of this study show that introducing TaRL has a positive effect on pupils' cognitive, psychomotor, and affective domains in mathematics instruction. Constructivist, psychomotor learning theory, and social learning paradigms provide strong theoretical underpinnings for these findings. Sustained effectiveness of the model, in conjunction with local curriculum, teacher training, and support, will ensure the scalability and long-term impact of TaRL across different educational contexts.

A key limitation of this study is that the participants were predominantly high-achieving students. Theoretically, TaRL is designed to address heterogeneous learning gaps, and its strongest effects are usually observed among students with lower baseline proficiency (Banerjee et al., 2016; Pratham, 2019). The sample's high initial performance increases the likelihood of a ceiling effect, which in turn constrains the magnitude of improvement observable in the gain scores. Consequently, the results of this study should be interpreted with caution, as they do not fully capture TaRL's potential impact in contexts where learning disparities are more pronounced.

## ▪ CONCLUSION

The findings of this study indicate that implementing the TaRL approach in senior high school mathematics is associated with meaningful improvements in students' performance across cognitive, affective, and psychomotor domains. Rather than functioning solely as an achievement-raising tool, TaRL supports the development of a classroom environment where instruction is aligned with students' actual learning readiness, promotes active engagement, and enables differentiated pathways of understanding. These results extend the predominantly primary school-focused evidence base on TaRL, particularly from India and several African countries, to the Indonesian senior high school context. Beyond its empirical contribution, this study also provides a theoretical extension by demonstrating how TaRL principles can be recontextualized within the *Merdeka* Curriculum, reinforcing constructivist learning and operationalizing Vygotsky's ZPD through level-appropriate grouping and scaffolded learning tasks.

The implications of these findings highlight the importance of responsive and inclusive mathematics instruction, particularly the need for teacher professional development that emphasizes diagnostic assessment, proficiency-based grouping, and differentiated task design. Nevertheless, the study's methodological constraints must be acknowledged. This research was conducted with a relatively small sample and without a control group, and the presence of several high-achieving students may have influenced baseline scores and reduced observable gain scores. Therefore, the results should be interpreted with caution and not generalized beyond the studied context. Future research should employ more rigorous quasi-experimental designs, incorporate heterogeneous student populations, and triangulate findings with richer qualitative data, such as in-depth interviews and classroom discourse analysis, to better understand the mechanisms through which TaRL operates. Subsequent studies may also explore how TaRL can be integrated with digital assessment systems, adaptive platforms, or hybrid learning models to strengthen its applicability within Indonesia's evolving competency-based curriculum landscape.

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