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INTEGRATING METACOGNITIVE INTO TARL-BASED ASSESSMENT: EVIDENCE FROM DIFFERENTIATED LEARNING IN PRIMARY EDUCATION

Dyah Triwahyuningtyas [1*], I Ketut Suastika [2], Nyamik Rahayu Sesanti [3], Azamul Fadhly Noor Muhammad [4]

[1,2,3] Universitas PGRI Kanjuruhan Malang, Indonesia
[4] Universitas PGRI Yogyakarta, Indonesia
Email: dyahtriwahyu@unikama.ac.id[1], suastika@unikama.ac.id[2], nyamik@unikama.ac.id[3], azamul@upy.ac.id[4]

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Corresponding Author: Dyah Triwahyuningtyas
Email: *dyahtriwahyu@unikama.ac.id*

Abstract

This study aims to examine how Teaching at the Right Level (TaRL)-based assessment facilitates students' metacognitive development in primary education. While prior studies have primarily focused on cognitive outcomes, limited research has explored how TaRL-based assessment promotes students' metacognitive processes. A mixed-method design was employed involving 28 sixth-grade students categorized into Advanced, Developing, and Needs Guidance groups. Quantitative data were obtained from diagnostic tests and achievement scores, while qualitative data were collected through interviews, observations, and student reflections. The findings indicate that differentiated TaRL-based assessments enhance students' awareness, regulation, and evaluation skills across varying ability levels. The Advanced group demonstrated consistent metacognitive strategies, whereas the Developing and Needs Guidance groups showed gradual improvement with scaffolding. These findings suggest that TaRL-based assessment not only improves academic performance but also serves as a mechanism for fostering metacognitive development. This study contributes to the growing literature on adaptive learning by integrating metacognitive indicators into differentiated assessment design.

Keywords: Assessment, Teaching at the Right Level, Metacognition

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1. INTRODUCTION

Recent research in global settings has demonstrated that Teaching at the Right Level (TaRL) effectively enhances both literacy and numeracy while also functioning as a flexible framework to promote higher-order thinking and self-regulated learning (Banerjee et al., 2023; Piper et al., 2020). Even with these discoveries, there remains insufficient evidence on how TaRL-based assessments can explicitly enhance students' metacognitive awareness and regulation. Metacognition, highlighted in worldwide educational studies, is a crucial factor for lifelong learning and adaptability in changing learning contexts (Efklides, 2018; Veenman, 2022). Nonetheless, the majority of TaRL studies conducted so far have concentrated on cognitive results instead of students' reflective practices or the strategies they employ. This gap underscores the necessity for a structured investigation into the relationship between TaRL and metacognition in primary education, especially in developing nations where educational disparities are significant. By placing this research within the larger context of adaptive teaching and learning assessment, this study helps to connect practical application with theoretical understanding. It offers empirical insights for policymakers and educators to develop evidence-based interventions that combine differentiated instruction with metacognitive strategy training, thus improving both equity and quality in education

Metacognition refers to a person's understanding and regulation of their own thought processes, encompassing the skills to plan, observe, and assess learning techniques (Ishak et al., 2025). This skill fosters efficient learning and problem-solving by allowing students to contemplate, assess, and make intentional choices (Arianto & Hanif, 2024). Therefore, incorporating metacognition into education enhances academic performance while equipping students to tackle the intricate and situational challenges of daily life (Bashirudin Yusuf, Muhamad Firdaus and Kunci, 2024).

Metacognition plays a crucial role in the effectiveness of students' learning and problem-solving. Research shows that task-based learning models can enhance students' metacognitive skills, which improves learning outcomes (Syahmani et al., 2023). Metacognitive strategies help students plan, monitor, and evaluate their thinking processes, thereby enhancing problem-solving abilities (Bashirudin Yusuf, Muhamad Firdaus and Kunci, 2024) (Zamzami & Zamzami, 2025). Reflection in learning also enhances metacognitive awareness and critical thinking skills (Susilo et al., 2022). Therefore, the integration of metacognition strengthens conceptual understanding while preparing students to face complex challenges.

Assessment plays a crucial role in monitoring student learning progress, both formatively and summatively (Yuni et al., 2025). Well-designed assessments provide accurate information on learning outcomes, thinking skills, and areas for improvement (Ana Khoirunnisak et al., 2024). In other words, through assessment, teachers can identify students' strengths and weaknesses in understanding concepts and developing higher-order thinking skills (Khan and Sarfraz, 2024).

Observations at an elementary school in Malang City showed that most sixth-grade students lacked awareness of their learning strategies. Many students did not actively plan, monitor, or evaluate their own thinking processes. Student participation in group discussions was uneven; more confident students tended to dominate the conversation, while shyer or less confident students rarely contributed. A lack of teacher guidance in facilitating effective assessment exacerbated this situation. As a result, students' conceptual understanding, collaboration skills, and metacognitive awareness were suboptimal.

Approach Teaching at the Right Level (TaRL) adapts learning to student abilities, increases motivation, and strengthens planning, action, observation, and reflection (Reswari et al., 2025). TaRL makes learning student-centered and increases cognitive engagement (Ningrum et al., 2023). In the context of assessment, TaRL allows for the differentiation of student worksheets tailored to student ability levels, from developing, developing as expected, to advanced, thus supporting the development of metacognition, active participation, and in-depth conceptual understanding (Urfah *et al.*, 2024).

This study aims to examine the integration of metacognition in sixth-grade elementary school students in TaRL-based assessments, focusing on how students manage their thinking processes during assessments and how the TaRL approach facilitates metacognitive development. Previous research has examined metacognition and assessment, but there has been no systematic analysis of the application of Teaching at the Right Level (TaRL) in elementary school student assessments. Therefore, the novelty of this study lies in the application of TaRL-based assessments tailored to students' ability levels to explore how students manage their thinking processes and develop metacognition gradually. Therefore, this study provides conceptual contributions to the development of metacognition as well as practical recommendations for teachers in designing

adaptive and effective assessments. This study addresses the following research question: How does TaRL-based assessment facilitate students' metacognitive processes—awareness, regulation, and evaluation—across different ability levels in primary education?

2. METHOD

2.1 Types and Approaches of Research

This research uses a mixed method (*mixed method*), which is a combination of quantitative and qualitative approaches. The quantitative approach is used to analyze the results of cognitive diagnostic assessments and student achievement scores on student-based worksheets. *Teaching at the Right Level* (TaRL), while a qualitative approach was used to explore students' thinking processes and metacognitive integration through interviews, observation, and reflection. The use of mixed methods allows for a comprehensive picture, both in terms of measuring numerical achievement and in-depth understanding of students' learning experiences (Charismana et al., 2022). This aims to ensure that the data obtained not only represents students' quantitative achievement results but also reflects the actual conditions during the implementation of TaRL-based assessments in the metacognitive integration of 6th-grade elementary school students at an elementary school in Malang City, East Java, in the even semester of the 2025/2026 academic year.

2.2 Research Subjects

The study subjects consisted of 28 sixth-grade elementary school students, with 15 boys and 13 girls. Based on the initial assessment results, students were classified into three ability categories in the context of metacognitive development: beginning to develop, developing, and advanced. This classification was used to adjust the material and difficulty level of the TaRL-based assessment worksheet, so that differentiated learning can be effective and students can manage their thinking processes according to their respective ability levels.

2.3 Research Instruments

The researcher acted as the primary instrument and facilitator in the assessment process. The instruments used included cognitive diagnostic tests (quantitative) designed based on 6th-grade learning achievement indicators and used to identify students' strengths and weaknesses in knowledge, skills, and metacognitive strategies. Qualitative instruments included interview guides, observation sheets, and student reflection notes. Based on the assessment results, the researcher designed Student Worksheets (LKPD) in three different versions according to student ability categories. LKPD A is intended for students beginning to develop, LKPD B for developing students, and LKPD C for advanced students.

The research instruments were validated through expert judgment involving two specialists in mathematics education and educational assessment. The validation ensured the alignment between assessment indicators and metacognitive constructs. Reliability of the diagnostic test was measured using Cronbach's Alpha, which yielded a coefficient greater than 0.70, indicating acceptable internal consistency.

2.4 Data Collection Techniques

Data collection was conducted using two approaches: (a) quantitative through diagnostic tests and student worksheet scores; (b) qualitative through interviews, observations, document analysis, and student reflections. Interviews lasted 20–25 minutes per student, observations were conducted during two 40-minute learning sessions, and student worksheet analysis was conducted after each assessment session. Student reflections were collected at the end of each session, so all data reflected students' thinking processes in real time. By combining quantitative and qualitative data, researchers obtained a comprehensive picture of students' metacognition integration in problem-based assessment. *Teaching at the Right Level* (TaRL).

2.5 Research Procedures

The research procedure was conducted chronologically. First, the researcher conducted an initial assessment to identify the level of metacognitive abilities of 6th-grade students through a diagnostic test (quantitative). Second, based on the assessment results, the researcher designed assessment worksheets (LKPD) in three categories (A, B, and C) tailored to the students' ability levels. Third, a TaRL-based assessment was implemented by providing LKPDs according to the categories, so that students had the opportunity to practice their skills in planning, monitoring, and evaluating their thinking strategies. Fourth, research data were collected through quantitative test results and qualitative findings (interviews, observations, LKPD analysis, and student reflections). Fifth, data analysis techniques, quantitative data were analyzed using descriptive statistics, including percentage scores to measure student achievement across groups. Qualitative data were analyzed using thematic analysis involving data reduction, coding, categorization, and interpretation. Triangulation of data sources (interviews, observations, and student reflections) was applied to ensure the validity and reliability of findings.

3. RESULTS

This study was conducted on sixth-grade elementary school students, focusing on the integration of metacognitive skills in a Teaching at the Right Level (TaRL)-based assessment. Students were divided into three categories:

Advanced, Developing, and Needs Guidance. Each group was given different numeracy problems within the topic of triangle angles. The assessment process was analyzed and categorized according to the following metacognitive indicators: awareness, regulation, And evaluation. To strengthen clarity, the results are presented by combining qualitative metacognitive indicators with quantitative achievement data across three student groups.

3.1 Results of Advanced Group Analysis

In the assessment, the Advanced group was given a problem about the length of a scout stick, requiring students to convert units of length and add them based on the available information. Results showed that students with high metacognitive abilities were able to plan strategies, organize the solution process, and evaluate the results reflectively.

At the level awareness students quickly recognized important information and determined strategies appropriate to the group's level of understanding. One student immediately directed that the data be converted to decimal form to make it easier for all members to calculate.

SM01: "The length of the stick for each child is changed to decimal form first, starting from the easiest (K1)"

This statement demonstrates an early awareness of choosing a strategy that is not only easier for herself but also understandable for other members. This aligns with the TaRL principle, where more advanced students help connect the solution to the group's ability level.

At the level regulation students monitor the progress of the work by reminding them to keep the steps consistent and focused. They also assign roles, for example, designating one person to write down the answers to create a more structured result.

SM01: "only one person writes ... so there's no confusion"

This activity demonstrates that students focus not only on the content of the problem but also on the orderliness of the solution process. In the context of TaRL, this regulation is crucial to ensure that all members, with varying abilities, can participate.

At the level evaluation, the group does not immediately accept the final answer, but re-checks its conformity with the information in the question.

SM01: "Let's check again, if we add them up, does the result match the total length? If so, then the answer is correct."

This evaluation reflects reflective awareness, reassessing strategies and outcomes. In the TaRL approach, this type of evaluation ensures that understanding reaches all group members. Overall, the assessment in the Advanced group demonstrated a complete integration of metacognition. High-ability students not only achieved correct answers but also strengthened the understanding of all members through the processes of awareness, regulation, and evaluation.

3.2 Results of Developing Group Analysis

The Developing group was given a problem about donuts in a bookstore that required understanding story information, calculations, and conclusions. Assessment results showed that this group's metacognition was not as strong as the Advanced group's, but they were making efforts to recognize information, organize their steps, and conduct simple evaluations.

At the awareness stage, students are able to understand some information, but not consistently. One student attempted to identify important data, although clarification was still needed.

SB02: "So we first look at the price of the donuts written in the question, then divide it by the number of people."

This statement demonstrates an initial, albeit rudimentary, awareness of the strategy. In the context of TaRL, this reflects how students in the Developing category adapt their thinking to their abilities.

In the regulation stage, students try to direct the assessment process by reminding students to carry out calculations in stages.

SB02: "Just try one by one so you don't make a mistake."

This regulation demonstrates an effort to keep the process streamlined and easier to follow. The TaRL principle is evident when students in this category are given space to contribute according to their level, even though their role still requires support.

At the evaluation stage, the evaluation that appears is still limited to checking the final answer without reviewing the strategy.

SB02: "So the result is like this, if the number is right then it's correct"

This evaluation demonstrates initial awareness in assessing outcomes, although reflection on the process is not yet in-depth. Overall, the assessment in the Developing group shows intermediate metacognition: awareness, regulation, and evaluation are present, but not yet consistent. With the TaRL approach, students in this category still have the opportunity to learn at their level while receiving additional guidance.

3.3 Group Analysis Results Need Guidance

The Need for Guidance group was given a problem about purchasing a book that required understanding price and quantity information. Assessment results showed that this group still displayed metacognitive skills, although the quality was still limited.

At the level awareness, students begin to try to recognize important information, but with doubt.

SPB03: "So the price of one book is multiplied by the number of books, right?"
This statement demonstrates initial strategic awareness, although it's often followed by re-questioning. Within the TaRL framework, this indicates that lower-level students are still given space to identify basic information within their capacity.
At the level regulation, students try to organize the course of the solution with simple directions.
SPB03: "try to count it slowly, don't do it all at once"
This regulation shows an attempt to control the process, although it is not yet consistent and often requires correction from the teacher or more skilled peers.
At the level evaluation, evaluation is limited to seeing the suitability of the final figures without reflecting on the strategy.
SPB03: "If the result matches the money in the question, then it's correct, right?"
This simple evaluation remains important because it reflects an effort to assess students' outcomes based on their abilities. Overall, the assessments for the Need Guidance group demonstrated rudimentary metacognitive integration: awareness emerged with hesitation, regulation was unstable, and evaluation was shallow. However, TaRL-based assessments provided opportunities for students in this category to remain actively engaged while receiving support to progress to the next metacognitive stage.

Table 1. Summary of Metacognitive Indicators Observed

Metacognitive Component	**Indicators Observed**	**Evidence from Data**
Awareness	Identifying relevant information, selecting strategies	Student statements, initial planning
Regulation	Monitoring progress, organizing steps	Group discussion, role assignment
Evaluation	Checking results, reflecting on correctness	Rechecking answers, group validation

Table 1 presents a comparison of students' metacognitive development across three groups. The findings indicate that students in the Advanced group demonstrated high levels of awareness, regulation, and evaluation, reflecting strong metacognitive control. In contrast, students in the Developing group showed moderate but inconsistent metacognitive engagement, while those in the Needs Guidance group exhibited limited awareness and regulation, with evaluation primarily focused on final answers. These results suggest that TaRL-based differentiated assessment effectively supports the gradual development of metacognitive skills in alignment with students' ability levels.

Figure 1. Students' Achievement Scores Across TaRL-Based Assessment Groups

Quantitative analysis in figure 1 illustrates the differences in students' achievement scores across the three groups. The Advanced group achieved the highest score (89%), followed by the Developing group (72%) and the Needs Guidance group (58%). This distribution confirms that differentiated TaRL-based assessment effectively aligns with students' ability levels while supporting both academic performance and metacognitive development. Furthermore, qualitative data from reflection notes confirmed that students in the Advanced group frequently used metacognitive strategies, while students in the Developing and Needs Guidance groups

demonstrated emerging but less consistent awareness and regulation. These results collectively highlight that differentiated assessments fostered both academic improvement and metacognitive engagement.

4. DISCUSSION

This study aimed to explore the integration of metacognition in sixth-grade elementary students through a Teaching at the Right Level (TaRL)-based assessment. By employing a TaRL approach tailored to student proficiency levels, the research sought to analyze how students manage their thought processes during assessment and how this approach facilitates the development of metacognition (Urfah *et al.*, 2024). The findings indicate that the TaRL-based assessment, implemented through differentiated Student Worksheets (LKPD), significantly enhances student engagement and motivation (Syahiril *et al.*, 2025). This result affirms that a personalized learning approach, such as TaRL, is crucial in creating a learning environment that is responsive to individual needs, thereby enabling students to participate more actively and better understand the material (Mustafa *et al.*, 2024).

These findings are consistent with prior research that emphasizes the importance of student-centered learning in boosting cognitive engagement. The results show that when students are given tasks appropriate to their level, they are more likely to engage in metacognitive thought processes. This is evident in their ability to monitor, evaluate, and regulate their own learning strategies. While other studies have focused on metacognition or TaRL in isolation, this research provides new insights by combining the two, particularly within the context of elementary student assessment (Muhajang and Suryanti, 2024) Therefore, this study makes a significant contribution to educational literature by demonstrating how a well-designed assessment can serve as a tool to promote and measure metacognition (Khan and Sarfraz, 2024).

Furthermore, the implementation of TaRL and differentiated LKPD in this assessment has significant practical implications for teachers and educational practitioners. This approach offers a clear framework for educators to design assessments that not only measure student knowledge but also encourage them to develop metacognitive skills (Güner and Erbay, 2021). By providing materials and questions that align with students' readiness levels, teachers can minimize frustration and confusion, and build students' confidence to take ownership of their learning. This can ultimately create a more effective and empowering learning culture in the classroom.

Although the findings of this study are promising, there are some limitations that need to be acknowledged. This research utilized a descriptive qualitative method with a limited number of sixth-grade subjects from a single elementary school in Malang City. Therefore, the generalizability of the findings to a broader population or other educational levels may be limited. Additionally, metacognitive data were collected through interviews, observations, and document analysis, which may not fully capture the complex internal thought processes. Future research could benefit from utilizing mixed methods or more diverse instruments to measure metacognition more comprehensively.

Based on these limitations, future research is recommended to further investigate the effectiveness of TaRL in developing metacognition across various educational levels and subjects. Larger studies with more diverse samples could provide stronger evidence about the long-term impact of this approach. Additionally, future research could explore the use of digital tools or technology to facilitate TaRL-based metacognitive assessment, which could provide richer and more accurate data on how students think (Nainggolan, Kusumo and Sekti Hari Purnami, 2024) Thus, this study paves the way for further exploration into the role of assessment in empowering students to become more independent and metacognitive learners.

The findings of this study reinforce prior evidence that adaptive assessments tailored to students' learning levels can reduce inequities and enhance learning outcomes (Banerjee et al., 2023; Piper et al., 2020). Beyond cognitive gains, this study contributes to the growing body of work highlighting the role of assessment in fostering metacognitive development (Efklides, 2018; Veenman, 2022). Specifically, the differentiated design of LKPD in this study mirrors the principles of formative assessment that actively involve students in monitoring and reflecting on their own progress (Black & Wiliam, 2018). Moreover, the observed improvements in self-regulation and evaluation align with global research emphasizing that scaffolding reflective practices within assessment tasks strengthens students' autonomy and long-term learning capacity (Zimmerman & Schunk, 2021). These insights suggest that TaRL-based assessments should be considered not only as tools for remediation but also as frameworks for nurturing higher-order learning processes.

This study contributes to the limited body of research integrating adaptive learning frameworks with metacognitive assessment, particularly in developing country contexts. While TaRL has been widely recognized for addressing learning gaps, this study demonstrates its extended role in fostering higher-order thinking through structured assessment design. This finding strengthens the argument that effective educational interventions

should not only target learning outcomes but also the cognitive processes underlying student learning.

5. CONCLUSION

This study demonstrates that TaRL-based assessment functions not only as a strategy for differentiating instruction but also as an effective mechanism for fostering students' metacognitive development. By integrating awareness, regulation, and evaluation into assessment practices, students across varying ability levels are able to progressively develop self-regulated learning skills. The findings highlight that assessment should move beyond measuring learning outcomes to actively shaping students' thinking processes. This study provides both theoretical contributions to the field of metacognition and practical implications for designing adaptive, equitable, and reflective assessment practices in primary education.

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