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The Effect of Treffinger Learning Based on Teaching at the Right Level (TaRL) Assisted by Modules in Improving Mathematical Literacy

Muhammad Hasanul Muna[1]✉, **Wardono, Iqbal Kharisudin**
Universitas Negeri Semarang, Indonesia

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Abstract

This study investigates the effect of Treffinger learning based on Teaching at the Right Level (TaRL) assisted by modules on students' mathematical literacy. The research employed a quantitative approach with a quasi-experimental design, specifically the nonequivalent control group design. The participants were two tenth-grade classes of a Madrasah Aliyah, with one class assigned as the experimental group, which received Treffinger learning combined with TaRL and supported by modules, and the other class as the control group, which received conventional learning. Instruments used in the study included a mathematical literacy test adapted from PISA tasks, observation sheets on lesson implementation, and a student response questionnaire. Data analysis consisted of normality and homogeneity tests, an independent sample t-test, a proportion test, and normalized gain (N-Gain). The results showed that the experimental class achieved better outcomes in mathematical literacy compared to the control class. The mean posttest score of the experimental class was 76.5, while the control class obtained 65.2, with the t-test indicating a significant difference (sig. 0.001 < 0.05). Furthermore, the experimental class reached a higher level of mastery with a mean N-Gain of 0.58 (medium-high) compared to 0.39 (medium) in the control class. These findings suggest that Treffinger learning based on TaRL assisted by modules is effective in improving students' mathematical literacy.

✉Correspondence Address:
Klaling 01/03, Jekulo, Kudus
E-mail: hasanulmuna@gmail.com

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INTRODUCTION

The Programme for International Student Assessment (PISA) is an international assessment program conducted by the Organisation for Economic Co-operation and Development (OECD), which works to build policies toward better lives. PISA measures the ability of 15-year-old students to apply their knowledge and skills in reading, mathematics, and science to real-life challenges (OECD, 2003). First administered in 2000, PISA is conducted every three years and assesses three main domains: reading literacy, mathematical literacy, and scientific literacy.

Mathematics is considered an essential component of PISA because of its crucial role in human life. It helps individuals solve various problems (Biehler et al., 2002; Peters, 2022). According to Ernest (2016), mathematics is also central to understanding post-normal situations complex, urgent, and uncertain circumstances since it enables people to describe, predict, and communicate phenomena. Even teachers need to continuously deepen their understanding of school mathematics, despite having studied it previously (Peters, 2022).

Nevertheless, Indonesian students' mathematical performance remains low. Results from PISA consistently place Indonesia at the lower ranks: 38th of 40 countries in 2003 (OECD, 2004), 50th of 57 in 2006 (OECD, 2007), 61st of 65 in 2009 (OECD, 2010), 64th of 65 in 2012 (OECD, 2014), 62nd of 70 in 2015 (OECD, 2016), and 73rd of 79 in 2018 (OECD, 2019). In 2018, the majority of Indonesian students performed below level 2, which is categorized as low achievement. Level 2 is considered insufficient for making judgments and decisions in real-life situations requiring mathematical literacy (OECD, 2019).

Mathematical literacy is defined as the capacity to formulate, employ, and interpret mathematics in various contexts, including mathematical reasoning and the use of concepts, procedures, facts, and tools to describe, explain, and predict phenomena (OECD, 2019). It is also related to the ability to analyze, reason, and communicate ideas effectively when formulating, solving, and interpreting solutions to problems in different situations (OECD, 2010). Jablonka (2003) states that mathematical literacy enables individuals to see the world through the lens of mathematics. It focuses on learning how to think rather than what to think. One of its core aspects is reflecting on the role of mathematics in the world (Büscher, 2018). Stacey and Turner (2015) emphasize that mathematical literacy involves applying mathematical content concepts, facts, procedures, and tools in real-life contexts, not only in school but also in post-school situations. Furthermore, Guida (2021) highlights its importance in addressing both local and global issues.

One promising approach to improving mathematical literacy is the Treffinger learning model, which encourages creative thinking, thereby helping students better understand and solve problems (Novitasari et al., 2020). Treffinger's model consists of three levels: learning basic thinking tools, learning and practicing problem solving models, and dealing with real problems and challenges (Treffinger, 1986). Previous studies have shown the effectiveness of this model in fostering creative thinking and problem-solving (Hermayuni et al., 2021; Novitasari et al., 2020; Putri & Panggabean, 2020).

In addition to learning models, learning tools such as modules play an important role. A module is a teaching material designed for independent study by students (Hilaliyah et al., 2019). Well-designed modules—attractive, clear, and contextual facilitate students' understanding (Suastika & Rahmawati, 2019). Several studies confirm that modules are effective in enhancing mathematical literacy (Hilaliyah et al., 2019; Purnama et al., 2022).

Another strategy is Teaching at the Right Level (TaRL), which focuses on mapping students' basic skills, grouping them accordingly, and providing appropriate learning experiences (Wafi et al., 2025; Setya et al., 2025). TaRL has proven effective in improving foundational learning outcomes in developing countries, including Indonesia, particularly in reading and numeracy. This approach is also relevant in mathematics learning, as it helps address the

heterogeneity of students' abilities in the classroom.

Based on an interview with a mathematics teacher at MA NU Nurul Ulum Kudus, several challenges were identified in classroom practice: (1) students' low comprehension of the material, (2) monotonous learning models, and (3) limited variety of learning media. These issues encouraged the researcher to investigate the effect of Treffinger learning based on TaRL assisted by modules on students' mathematical literacy.

METHOD

The type of research employed was a quasi-experiment with a nonequivalent control group design. The population of the study consisted of all tenth-grade students at MA NU Nurul Ulum Kudus, with two classes selected as the sample: the experimental class (taught using Treffinger learning based on TaRL assisted by modules) and the control class (taught using conventional learning). The research instruments included a mathematical literacy test based on PISA-type tasks, an observation sheet, and a student response questionnaire. Data analysis involved normality and homogeneity tests, an initial mean equivalence test, a final mean difference test, a proportion test, and the calculation of gain scores.

RESULTS AND DISCUSSIONS

The results of the pretest mean equivalence test indicated no significant difference between the experimental and control classes. This finding suggests that both groups had relatively equal initial abilities, and thus, any difference in outcomes observed after the treatment can be attributed to the implementation of different learning models.

Table 1. The results of the pretest mean equivalence test

Significance		Mean Difference	Std. Error Difference
One-Sided (p)	Two-Sided (p)		
.281	.562	-.62500	1.07189

In the posttest results, the average mathematical literacy score of the experimental class reached 76.5, compared to only 65.2 in the control class. This difference was further supported by the t-test, which produced a significance value of $0.001 < 0.05$, confirming that there was a statistically significant difference between the two groups. Therefore, Treffinger learning based on TaRL assisted by modules was more effective in improving students' mathematical literacy compared to conventional instruction.

Table 2. Results of the Mean Difference Test of Mathematical Literacy Ability

Significance		Mean Difference	Std. Error Difference
One-Sided (p)	Two-Sided (p)		
<.001	<.001	12.90625	1.77228

Beyond the average scores, mastery level was also considered an important indicator. The analysis revealed that the proportion of students achieving mastery in the experimental class was higher than that in the control class. This finding indicates that the intervention not only improved the mean score but also expanded the proportion of students who successfully met the minimum competency standards. The proportion test further reinforced this result with a significance value of < 0.05, demonstrating that the difference in mastery levels between the two groups was statistically significant.

Furthermore, the gain score analysis showed that the increase in mathematical literacy in the experimental class reached 0.58, categorized as medium–high, whereas the control class only achieved 0.39, categorized as medium. These findings suggest that although both groups experienced improvement, the experimental class achieved a greater level of progress. The higher gain score in the experimental class indicates that Treffinger learning based on TaRL assisted by modules facilitated a more optimal development of mathematical literacy.

Table 3. Results of the Gain Score Mean Difference Test in Mathematical Literacy

Significance		Mean Difference	Std. Error Difference
One-Sided (p)	Two-Sided (p)		
<.001	<.001	.32628	.04485

Theoretically, these results align with the characteristics of the Treffinger model, which emphasizes creativity, problem-solving, and divergent thinking (Treffinger, 1986). Through this model, students are trained not only to solve routine problems but also to deal with complex real-world situations. This is consistent with the concept of mathematical literacy as defined by OECD (2019), which emphasizes the ability to formulate, employ, and interpret mathematics in various contexts.

The integration of Treffinger with Teaching at the Right Level (TaRL) provides additional benefits, as instruction is adjusted to students' initial levels of ability. By mapping these abilities, students receive targeted learning that minimizes large gaps within the classroom. Previous studies by Wafi et al. (2025) and Setya et al. (2025) also showed that TaRL is effective in improving foundational learning in developing countries, including Indonesia. In the present study, the implementation of TaRL helped address classroom heterogeneity, which is one of the major challenges in mathematics education.

The use of modules as a learning aid also contributed significantly to the improvement of mathematical literacy. Modules allow students to study independently, systematically, and contextually, which helps them understand the material more effectively. This is in line with the findings of Hilaliyah et al. (2019) and Purnama et al. (2022), who confirmed that modules are effective in enhancing mathematical literacy. Well-structured modules, designed to be engaging and student-centered, strengthen the effectiveness of the Treffinger-based TaRL approach.

Overall, the findings of this study are consistent with previous research, which indicated that innovative learning models, particularly those that emphasize creative problem solving and are supported by independent learning materials, significantly improve students' mathematical literacy (Hermayuni et al., 2021; Novitasari et al., 2020; Putri & Panggabean, 2020). Thus, Treffinger learning based on TaRL assisted by modules can be recommended as an effective alternative instructional strategy to enhance the quality of students' mathematical literacy at the secondary school level.

CONCLUSION

Treffinger learning based on Teaching at the Right Level (TaRL) assisted by modules has a significant effect on students' mathematical literacy. Students in the experimental class achieved higher average scores, better mastery levels, and more significant improvements compared to the control class. This learning model can serve as an alternative for teachers to enhance students' mathematical literacy in schools.

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