International Journal of Education, Vocational and Social Science
https://e-journal.citakonsulindo.or.id/index.php/IJEVSS
E-ISSN : 2963 4954
IJEVSS

The Effect Of React Learning On Mathematical Problem Solving From The Perspective Of Mathematical Disposition

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Abstract

Mathematical problem-solving is a fundamental competency that is often hindered by conventional, teacher-centered expository instruction. This study examines the effect of the REACT (Relating, Experiencing, Applying, Cooperating, and Transferring) learning model on mathematical problem-solving skills, with a specific focus on the moderating role of students' mathematical dispositions. A quasi-experimental method utilizing a 2×2 factorial posttest-only control group design was applied to fifth-grade students in Ciracas, East Jakarta. The sample comprised four classes selected via cluster random sampling, divided into an experimental group receiving REACT instruction and a control group receiving Expository instruction. Data were collected using a problem-solving essay test based on Polya's indicators and a mathematical disposition questionnaire adapted from NCTM standards. Data analysis using Two-way Analysis of Variance (ANOVA) demonstrated that the REACT model significantly improves problem-solving abilities compared to expository learning ($F = 13.6$; $p = 0.000$). Furthermore, a significant interaction emerged between the learning model and mathematical disposition ($F = 22.2$; $p = 0.000$). Tukey's post-hoc test revealed that students with a high mathematical disposition benefited significantly more from the REACT model ($p = 0.000$). Conversely, no significant difference in problem-solving ability was observed between the two learning models for students with a low mathematical disposition ($p = 0.885$). The findings indicate that while REACT provides a meaningful, context-driven learning experience, its optimal effectiveness relies heavily on the affective characteristics of the students.

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Keywords: REACT model, mathematical problem-solving, mathematical disposition, elementary education, contextual learning.

INTRODUCTION

Mathematical problem-solving ability is a primary competency that students must possess in mathematics learning, as it involves mastering concepts, analyzing problems, selecting and executing strategies, and evaluating solutions. This ability is essential for developing Higher Order Thinking Skills (HOTS) required for daily life and technological advancements, a priority also emphasized by the National Council of Teachers of Mathematics (NCTM) as a standard process in mathematics education.

However, research indicates that the mathematical problem-solving ability of students in Indonesia remains relatively low. Results from the Programme for International Student Assessment (PISA) show that Indonesian students' mathematical literacy is below the OECD average, with students struggling to understand information, connect mathematical concepts to real-life contexts, select strategies, and provide logical reasoning. National studies also report that elementary students struggle with non-routine and contextual problems requiring mathematical reasoning.

A suspected factor contributing to this low ability is the dominance of expository or teacher-centered learning processes. In such environments, teachers explain concepts and provide examples followed by similar exercises, causing students to memorize procedures without deep conceptual understanding. Consequently, students struggle with problems differing from the provided examples because the learning lacks opportunities for independent knowledge construction.

An alternative model to improve these skills is REACT (Relating, Experiencing, Applying, Cooperating, and Transferring) learning. REACT is a contextual learning model emphasizing active student involvement in building knowledge through learning experiences. Students connect concepts to daily experiences (Relating), discover concepts through exploration (Experiencing), apply concepts to various problems (Applying), work together and exchange ideas (Cooperating), and use acquired knowledge in new situations (Transferring).

Previous studies demonstrate the positive impact of REACT on mathematical thinking. Nurhasanah and Luritawaty (2021) and Hasanah et al. (2019) concluded that the REACT model significantly improves mathematical problem-solving and thinking skills compared to conventional learning by involving students actively in contextual experiences. Pratiwi, Suntari, and Dalion

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(2024) also highlighted the consistent positive impact of the REACT strategy across various educational levels.

Nevertheless, learning success is also influenced by student characteristics, particularly mathematical disposition. Mathematical disposition is a student's tendency to think and act positively toward mathematics, reflected in self-confidence, perseverance, curiosity, flexibility of thought, and willingness to solve problems. Students with a high mathematical disposition actively explore strategies, persist through difficulties, and confidently express ideas, whereas those with a low disposition tend to give up easily. Studies by Herutomo and Masrianingsih (2019) and Pertiwi, Mulyanti, and Balkist (2022) confirm the positive relationship between mathematical disposition and problem-solving abilities.

Based on literature reviews, most studies on REACT focus solely on its effect on problem-solving or learning outcomes without considering students' affective factors, while studies on mathematical disposition rarely integrate specific learning models as treatment variables. Furthermore, empirical evidence regarding REACT's effectiveness in elementary schools remains limited.

The novelty of this study lies in testing the effect of REACT learning on mathematical problem-solving ability while considering mathematical disposition as a moderator variable through a 2 × 2 factorial experimental design. This study aims to analyze: (1) the difference in mathematical problem-solving abilities between students under REACT and Expository learning; (2) the interaction between learning models and mathematical disposition on problem-solving ability; (3) differences in problem-solving ability among students with a high mathematical disposition; and (4) differences among students with a low mathematical disposition.

RESEARCH METHODOLOGY

This study employed a quasi-experimental method with a Posttest Only Control Group Design. This design was selected because individual randomization was not possible; randomization was only feasible for existing classes.

The research applied a 2 × 2 treatment by level factorial design involving two independent variables: the learning model (REACT [A_1] and Expository [A_2]) and mathematical disposition (high [B_1] and low [B_2]). This resulted in four treatment groups: A_1B_1, A_2B_1, A_1B_2, and A_2B_2.

The population comprised all fifth-grade elementary students in Cluster 2, Gugus VI, Ciracas, East Jakarta. Sampling was conducted using cluster random sampling, resulting in four classes: two experimental classes receiving REACT learning and two control classes receiving

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Expository learning. Prior to treatment, the groups were confirmed to have relatively equal characteristics based on academic data.

The research instruments consisted of a mathematical problem-solving ability test based on Polya's indicators (understanding the problem, devising a plan, carrying out the plan, and looking back) and a mathematical disposition questionnaire using a four-level Likert scale based on NCTM (2003) indicators. All instruments underwent expert content validity testing, followed by empirical validity and reliability testing on students with similar characteristics.

Data collection began by administering the mathematical disposition questionnaire to categorize students into high and low disposition groups. Subsequently, the experimental group received the REACT model, while the control group received Expository learning on the same material. After the treatments, both groups took the mathematical problem-solving posttest.

Data were analyzed using descriptive and inferential statistics. Prerequisite tests included the Shapiro-Wilk test for normality and Levene's test for homogeneity of variance. Hypothesis testing was conducted using Two-Way Analysis of Variance (ANOVA) at a significance level of $\alpha = 0.05$ to determine the effect of the learning model, mathematical disposition, and their interaction. Due to a significant interaction, the analysis proceeded with Tukey's post-hoc test to determine the mean differences between treatment groups.

RESEARCH RESULTS

Data analysis was conducted using Two-Way Analysis of Variance (ANOVA) to determine the effect of the learning model, mathematical disposition, and the interaction between the two variables on students' mathematical problem-solving ability. The analysis results are presented below:

Table 1. Results of Two-Way ANOVA Test

Source of Variation	Type III Sum of Squares (SS)	df	Mean Square (MS)	F	p
Corrected Model	6466	3	2155.2	59.7	0.000
A	490	1	490.1	13.6	0.000
B	5173	1	5172.7	143.2	0.000
A x B	803	1	802.7	22.2	0.000

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Based on Table 1, the learning model has a significant effect on students' mathematical problem-solving ability ($F = 13.6$; $p < 0.05$). Mathematical disposition also exerts a significant effect ($F = 143.2$; $p < 0.05$). The analysis further reveals an interaction between the learning model and mathematical disposition concerning mathematical problem-solving ability ($F = 22.2$; $p < 0.05$). Therefore, the effect of the learning model on mathematical problem-solving ability is moderated by the students' level of mathematical disposition.

The Effect of Learning on Mathematical Problem-Solving Ability

The results indicated that students engaged in REACT learning achieved higher mathematical problem-solving abilities compared to those in Expository learning. This finding suggests that REACT learning fosters a more meaningful educational process because students construct their own knowledge through contextual experiences rather than merely receiving information from the teacher.

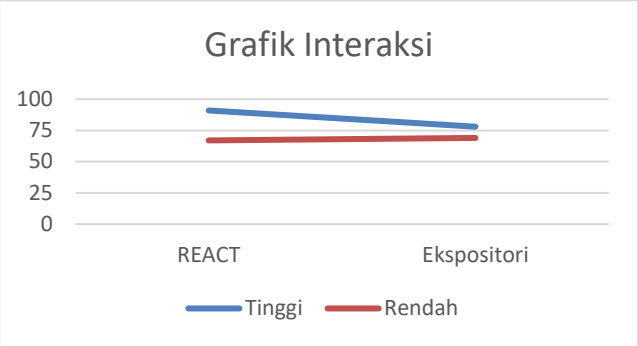
During the Relating stage, students connect mathematical concepts with real-life situations, making the concepts easier to comprehend. The Experiencing stage allows students to discover concepts through exploration activities. In the Applying stage, students implement these concepts to solve various problems. The Cooperating stage encourages discussion and the exchange of solving strategies, while the Transferring stage trains students to apply learned concepts to new situations. This sequence of activities assists students in developing their capacity to understand problems, design and execute solving strategies, and re-evaluate the outcomes.

These outcomes are consistent with Nurhasanah and Luritawaty (2021), who found that REACT learning significantly improves mathematical problem-solving ability compared to conventional methods by enabling active conceptual building through learning experiences. This is reinforced by Marlissa et al. (2015), concluding that the REACT strategy effectively enhances mathematical problem-solving through contextual, student-centered activities.

Interaction of Learning and Mathematical Disposition on Mathematical Problem-Solving Ability

The ANOVA results demonstrated a significant interaction between the learning model and mathematical disposition on mathematical problem-solving ability ($p < 0.05$). This interaction implies that the effectiveness of the learning model varies between students with high and low mathematical dispositions.

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The interaction graph illustrates that students with a high mathematical disposition experienced a more substantial increase in problem-solving ability under REACT learning compared to Expository learning. Conversely, for students with a low mathematical disposition, the average problem-solving ability remained relatively similar across both learning models.

These findings demonstrate that instructional success depends not only on the chosen learning model but also on the students' affective traits. A high mathematical disposition equips students with confidence, perseverance, and curiosity, allowing them to fully leverage all stages of REACT learning. Students with a low mathematical disposition tend to be less proactive in exploring concepts and lack the confidence to solve problems, meaning the benefits of the REACT model are not optimally realized.

This study supports Herutomo and Masrianingsih (2019), who posited that mathematical disposition is a critical factor in learning that requires higher-order thinking skills. Students with positive dispositions are generally more resilient when facing difficulties and more adept at developing problem-solving strategies than their peers with low dispositions.

Differences in Mathematical Problem-Solving Ability in Students with High Mathematical Disposition

The post-hoc test results are presented in the following table:

[Table 2. Post Hoc Calculation Results]

(I) PostHoc	(J) PostHoc	Mean Difference (I – J)	Std. Error	PTukey	95% Confidence Interval Lower	95% Confidence Interval Upper
A1B1	A2B1	11.58	1.95	0.000	1.205	2.648

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Tukey's post-hoc test reveals a significant difference between high-disposition students in the REACT group and those in the Expository group (p = 0.000). The average problem-solving ability was significantly higher for the REACT group.

This indicates that students with a high mathematical disposition can optimally utilize the characteristics of REACT learning. Their self-confidence, perseverance, cognitive flexibility, and willingness to test various strategies make them highly active during the learning process. The discussion, exploration, and problem-solving activities central to REACT provide a platform for these students to hone critical thinking and systematic problem-solving skills.

This aligns with Hasanah et al. (2019), demonstrating that contextual learning involving exploration and collaboration elevates students' mathematical thinking. Pratiwi et al. (2024) also noted that the REACT strategy is effective precisely because it provides active, meaningful learning experiences.

Differences in Mathematical Problem-Solving Ability in Students with Low Mathematical Disposition

The post-hoc test results are presented in the following table:

Table 3. Post Hoc Calculation Results

(I) PostHoc	(J) PostHoc	Mean Difference (I – J)	Std. Error	PTukey	95% Confidence Interval Lower	95% Confidence Interval Upper
A1B2	A2B2	-1.42	1.95	0.885	-0.884	0.411

Unlike the high-disposition group, Tukey's test for students with a low mathematical disposition showed no significant difference in problem-solving ability between the REACT and Expository models (p = 0.885). This suggests that applying a specific learning model is insufficient to improve problem-solving abilities if students lack an adequate mathematical disposition.

Students with a low mathematical disposition often lack confidence and perseverance, giving up easily when confronted with tasks requiring advanced reasoning. These traits hinder their ability to engage with the REACT stages optimally. Consequently, applying REACT to this demographic requires supplementary strategies, such as scaffolding, motivational reinforcement, the cultivation of reflective thinking habits, and continuous feedback.

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This is consistent with Herutomo and Masrianingsih (2019), who explained that disposition influences how students approach problems, their academic persistence, and their overall success in mathematical tasks. Developing mathematical disposition is therefore integral to any effort aimed at improving problem-solving abilities.

CONCLUSION

Overall, the findings demonstrate that REACT learning is more effective than Expository learning at enhancing mathematical problem-solving ability. However, this efficacy is strictly moderated by the students' mathematical disposition. REACT yields optimal results for students with a high mathematical disposition, whereas it produces no significant difference compared to Expository learning for students with a low mathematical disposition. This reinforces the premise that improving problem-solving skills requires not just innovative learning models, but concurrent development of the students' affective domains—fostering positive attitudes toward mathematics, boosting motivation, and providing targeted support. Educators must factor in the mathematical dispositions of their students when designing and executing lesson plans to ensure the chosen strategies yield optimal academic outcomes.

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