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Implementation of the REACT Learning Model in Mathematics Education: A Systematic Literature Review

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***Abstract*:**
Mathematics education requires learning approaches that enable students to construct conceptual understanding through meaningful and contextual experiences rather than procedural memorization. One approach that aligns with this demand is the REACT learning model (Relating, Experiencing, Applying, Cooperating, Transferring). Despite its growing application, research on REACT in mathematics education, particularly in the Indonesian context, remains fragmented and tends to emphasize specific learning outcomes without systematically mapping its conceptual characteristics, implementation patterns, and reported effectiveness. Therefore, this study aims to synthesize empirical evidence on the implementation of the REACT model in mathematics learning through a Systematic Literature Review. This study employed a Systematic Literature Review (SLR) guided by the PRISMA protocol. Fifteen empirical articles published between 2015 and 2025 were selected from Google Scholar, Garuda, ERIC, and ScienceDirect databases. The selected studies were analyzed using thematic analysis and descriptive synthesis to identify trends related to REACT components, mathematics topics, educational levels, and learning outcomes. The results indicate that REACT is consistently framed as a contextual and constructivist learning approach that contributes positively to students' conceptual understanding and Higher Order Thinking Skills (HOTS). The Relating and Experiencing stages are the most frequently emphasized components, reflecting a strong focus on contextualization and active exploration. Across the reviewed studies, improvements are most commonly reported in conceptual understanding and mathematical problem-solving ability, followed by gains in mathematical communication and representation. Several studies report the use of problem-oriented tasks and technology-supported activities within the REACT framework; however, such integrations remain limited and are not examined as independent intervention models. In conclusion, the findings suggest that the REACT learning model is effective in supporting meaningful and competency-based mathematics learning. Nevertheless, the integration of REACT with other instructional models or digital media remains underexplored in the existing literature, indicating the need for future research to investigate such hybrid implementations more systematically and empirically.

Keywords: REACT learning model; mathematics education; systematic literature review; contextual teaching and learning; Higher Order Thinking Skills

Introduction

Mathematics learning has long been recognized as a process that engages students in constructing their understanding through interactions with concepts, contexts, and collaborative activities. In recent years, educational reforms in Indonesia, particularly the implementation of the Kurikulum Merdeka, have emphasized the importance of learning experiences that develop higher-order thinking, promote conceptual understanding, and encourage active engagement with real-world situations. Within this changing landscape, the REACT approach (Relating, Experiencing, Applying, Cooperating, Transferring), introduced by CORD, has gained increasing attention as a promising framework for designing meaningful mathematics instruction. REACT positions learning as a contextual, student-centered, and constructivist process that bridges academic ideas with authentic experiences (Elli Setiyo Wahyuni, 2013; Maltman, 2000).

The theoretical foundation of REACT situates learning within experiential and social constructivism, in which students interpret, manipulate, discuss, and apply mathematical ideas. The Relating stage connects new material to students' previous experiences; Experiencing offers opportunities for exploration and investigations; Applying situates mathematical ideas within relevant contexts; Cooperating provides structured peer interaction; and Transferring enables students to generalize concepts to new problems. These stages reflect a systematic progression that supports conceptual depth, problem-solving fluency, and meaningful application of three core competencies aligned with the goals of contemporary mathematics education (Kurniasih, 2017; Nurhasanah & Luritawaty, 2021).

In the Indonesian educational context, the implementation of contextual and student-centered learning approaches still faces several practical challenges. Although national curriculum reforms emphasize meaningful learning and the development of higher-order thinking skills, classroom practices often remain teacher-centered and procedurally oriented. Many mathematics teachers encounter difficulties in designing contextual learning tasks that align with students' real-life experiences, particularly in schools with limited instructional resources. In addition, variations in teachers' pedagogical readiness and access to supporting learning media may affect the consistency and effectiveness of implementing instructional models such as REACT. These contextual constraints highlight the importance of examining how REACT has been implemented across different educational settings in Indonesia and what challenges have been reported in empirical studies.

A growing body of research has examined REACT in various mathematics topics and educational settings. Studies report gains in students' conceptual understanding, problem-solving skills, representational ability, mathematical communication, and confidence in learning mathematics (Prihandhika, 2017; Riyanto & Muslim, 2014; Taraufu et al., 2020). Other works highlight the role of REACT in addressing misconceptions, strengthening motivation, and fostering collaborative learning environments (Cahyono et al., 2017; Luqman Hakim, 2017). Despite these contributions, existing research remains fragmented. Many studies focus on isolated outcomes, specific subtopics, or classroom trials without systematically mapping how REACT is conceptualized, implemented, and evaluated across different contexts. As a result, a comprehensive understanding of the landscape of REACT research in mathematics is still limited.

This gap underscores the need for a systematic review that synthesizes empirical findings, highlights common patterns, and identifies challenges and opportunities within REACT implementation. A structured mapping of previous studies is essential for clarifying the novelty, scope, and practical implications of the REACT approach, especially for teachers, researchers, and curriculum developers working within the principles of meaningful and contextual mathematics learning.

Therefore, the present manuscript aims to provide a systematic introduction to the body of research on REACT in mathematics education. The purpose of this study is to examine how REACT is defined, how its components are operationalized, and how its effectiveness has been evaluated in previous empirical works. The manuscript offers novelty by consolidating fifteen selected studies into a unified conceptual and methodological overview, allowing for more precise identification of research gaps, theoretical trends, and practical directions. Furthermore, the review contributes practical value by offering insights that can inform instructional design, teacher training, and the development of context-based learning materials that align with the REACT framework.

Based on the prior findings and the gaps identified, this manuscript addresses the following core problems:

1. The need to clarify the conceptual and theoretical foundations of REACT in mathematics learning, and
2. The need to analyze how REACT has been implemented and to what extent it enhances mathematical competencies in various learning contexts.

By addressing these issues, the introduction lays the groundwork for a systematic examination of REACT-related studies. At the same time, detailed interpretations of results are reserved for the Discussion section to maintain structural clarity.

Research Methods

This study employed a Systematic Literature Review (SLR) approach to synthesize empirical findings on the use of the REACT model (Relating, Experiencing, Applying, Cooperating, Transferring) in mathematics learning. The SLR method was selected because it provides a structured, transparent, and replicable procedure for gathering and evaluating research evidence, allowing researchers to map conceptual developments, methodological tendencies, and the effectiveness of REACT across various educational contexts. The procedures of this review follow commonly accepted guidelines for systematic reviews, particularly the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, which is used to ensure accuracy, traceability, and comprehensiveness in reporting. The PRISMA flow diagram included in this manuscript serves as the supporting instrument that visualizes the identification, screening, eligibility assessment, and inclusion stages, together with the number of studies retained or excluded at each step.

The sources of data consisted of published empirical articles that examined the implementation, characteristics, or effectiveness of REACT in mathematics instruction. Article retrieval was conducted across four major academic databases, Google Scholar, Garuda, ERIC, and ScienceDirect, using combinations of keywords such as "REACT learning model," "contextual learning REACT," "REACT in mathematics education," "Relating Experiencing Applying Cooperating Transferring," and "pembelajaran REACT matematika." Boolean operators (AND/OR) were applied to increase search precision and filter studies relevant to the research focus. The initial search yielded a total of 42 records.

Data collection followed four sequential stages as recommended in the standard SLR methodology. First, the identification stage gathered all relevant records based on keyword matches across the four databases. Second, the screening stage involved examining titles, abstracts, and journal indexing status to eliminate articles unrelated to mathematics education or not explicitly addressing the REACT components. This process reduced the dataset from 42 to 30 articles. Third, the eligibility stage required a full text review of the remaining articles to confirm methodological clarity, contextual relevance, and explicit discussion of the REACT framework. Twenty articles met these criteria. Finally, the inclusion stage selected fifteen articles that fulfilled all eligibility requirements and provided empirical data compatible with the aims of this review. These procedures are depicted clearly in the PRISMA diagram provided in the Methods section.

To enhance methodological transparency and replicability, the article selection process is presented using a PRISMA flow diagram. Figure 1 illustrates each stage of the systematic review procedure, including identification, screening, eligibility, and inclusion, along with the corresponding number of records retained or excluded at each step. The diagram is constructed in accordance with the established PRISMA guidelines, ensuring clarity in reporting the search strategy and selection criteria applied in this review. The PRISMA flow diagram visually summarizes the progression from the initial identification of 42 records across four databases to the final inclusion of 15 eligible studies. By presenting this information graphically, the review process becomes more traceable and allows readers to independently assess the rigor and replicability of the methodology.

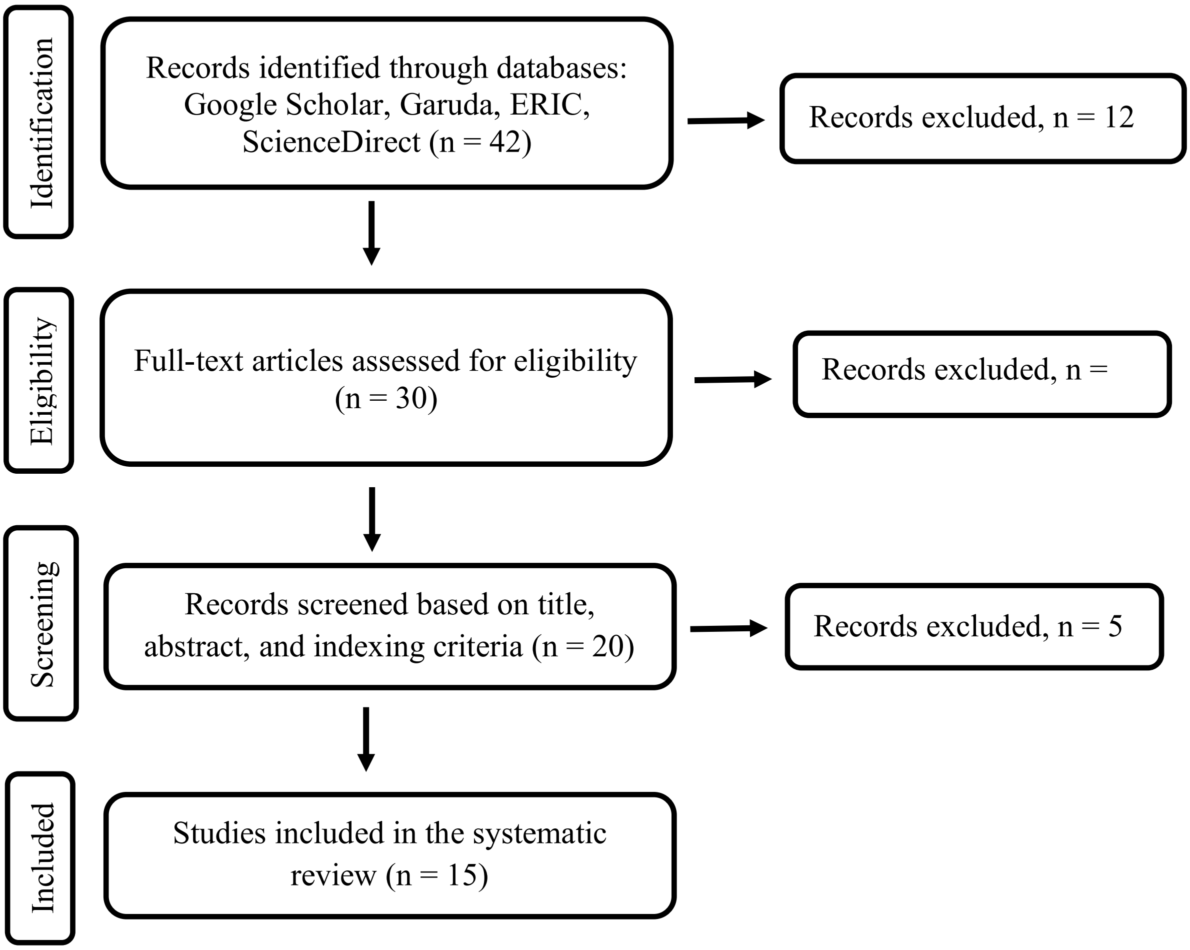

Figure 1. PRISMA Flow Diagram

In addition to the inclusion and exclusion criteria, the methodological quality of the selected studies was evaluated descriptively to ensure the credibility and relevance of the evidence synthesized. The evaluation focused on the clarity of the research design, the appropriateness of data collection instruments, the alignment between research objectives and analytical methods, and the transparency of reported findings. Studies were considered methodologically adequate if they clearly described their procedures, employed instruments aligned with the measured mathematical competencies, and reported results supported by appropriate analytical techniques.

The reviewed studies employed diverse methodological designs, including quasi-experimental studies, pretest–posttest designs, classroom action research, and descriptive or survey-based approaches. Rather than conducting a quantitative comparison across designs, methodological differences were analyzed descriptively to identify patterns in how REACT was implemented and evaluated across research contexts. This approach allows the review to capture the consistency and variability of findings across different methodological frameworks.

The data analysis procedure used in this study combines qualitative thematic analysis and descriptive quantitative analysis. A thematic coding technique was applied to identify recurring patterns related to definitions of REACT, implementation characteristics, instructional stages, learning outcomes, and challenges reported across the studies. This qualitative coding followed an inductive approach in which themes emerged from repeated readings of the full texts. For numerical data such as sample sizes, learning outcomes, and statistical significance reported in the selected studies, a descriptive statistical approach was applied. Although this SLR does not conduct a meta-analysis, the review systematically extracted quantitative indicators (e.g., mean differences, effect directions, learning gain patterns), maintaining consistency with standard procedures for non-meta-analytic evidence synthesis.

The statistical analysis procedures reported in the primary studies, such as t-tests, ANOVA, N-gain, and regression analyses, were recorded and interpreted as reported by the original authors. This ensures that all measurement results presented in the Results section of this manuscript are aligned with the methodological procedures used in the primary sources. No reanalysis of raw data was performed; instead, this manuscript synthesizes the analytical approaches and findings reported in each included study.

To ensure transparency, supporting instruments (tables and diagrams) used in this section are accompanied by corresponding information sources. For example, the PRISMA diagram reflects the actual flow of article selection executed by the researchers, and the summary tables presented in the Results section are constructed directly from the fifteen included studies. Each table is accompanied by reference information drawn from the reviewed articles, allowing readers to trace the origin of every reported measurement.

Overall, this methodological framework ensures that the SLR is conducted systematically, that all results can be traced back to their methodological origins, and that the conclusions drawn reflect the collective empirical evidence on REACT-based mathematics learning.

Results

The analysis of fifteen selected studies yielded three major categories of findings aligned with the research questions: (1) definitions and conceptual characteristics of the REACT approach, (2) patterns of implementation across mathematics topics and education levels, and (3) the effectiveness of REACT in improving students' mathematical competencies. One table is used to summarize the distribution of REACT characteristics reported in the articles.

Conceptual Characteristics of REACT in Mathematics Learning

The fifteen studies consistently describe REACT as a contextual and constructivist-based learning approach composed of five sequential components: Relating, Experiencing, Applying, Cooperating, and Transferring. All selected studies explicitly mention at least three of the five components, while 11 out of the 15 studies include the complete sequence. The Relating and Experiencing stages were the most frequently emphasized, appearing in 14 studies, indicating strong attention to contextual introduction and exploratory learning activities. Meanwhile, the Transferring component was the least frequently reported stage, appearing in only 9 of the 15 reviewed studies, indicating a limited emphasis on activities that support generalization and higher-order knowledge transfer.

Implementation Patterns Across Mathematics Topics

The analysis indicates that REACT has been implemented across various mathematics topics, with the highest frequency found in geometry, algebra, fractions, and problem-solving contexts. Specifically, 6 studies applied REACT to geometry and spatial reasoning, 4 studies to algebraic understanding, 3 studies to fractions, and the remaining 2 to general mathematical problem-solving. Implementation was observed across elementary, junior high, senior high, and higher education, with the largest share (60%) conducted at the junior high school level.

Effectiveness of REACT in Developing Mathematical Competencies

Findings demonstrate consistent improvements across several mathematical competencies. Ten studies report increased conceptual understanding, seven studies report improvements in mathematical problem-solving, five studies highlight gains in mathematical communication, and four studies show enhanced representational ability. Several studies that provided pre-test and post-test comparisons show increases ranging from moderate to high, with improvements between 18% and 40% depending on the mathematical topic assessed. Studies using N-gain reported scores categorized as moderate to high. Two studies also reported higher post-intervention confidence and motivation levels among students.

Table 1. Summary of Research on the Implementation of the REACT Model in Mathematics Learning

No	Authors	REACT Components Mentioned	Mathematics Topic	Reported Outcomes
1	(Anas & A, 2018)	R, E, A, C, T	Conceptual Understanding (General Math)	Increased conceptual understanding
2	(Aras & Juhari, 2020)	R, E, A, C, T	Mathematics – Elementary (Grade 5)	Improved math learning outcomes & student activity
3	(Asriyah, 2024)	R, E, A, C, T	Problem Solving (High School Mathematics)	Improved mathematical problem-solving ability
4	(Cahyaningrum & Febriana, 2019)	R, E, A, C, T	Science (Chemistry) – transferable REACT structure	Increased learning achievement

No	Authors	REACT Components Mentioned	Mathematics Topic	Reported Outcomes
5	(Fiki Fatkur Rohma et al., 2024)	R, E, A, C, T	3D Geometry (STEM)	Improved conceptual understanding of 3D geometry
6	(Junaidah & Solihin, 2022)	R, E, A, C, T	General (21st-century learning context)	Strengthening conceptual and contextual understanding
7	(Kusumawati & Rizki, 2014)	R, E, A, C, T	Mathematics Problem Solving (Vocational School)	Increased mathematical problem solving ability
8	(Masi et al., 2022)	R, E, A, C, T	Problem Solving (Middle School Mathematics)	Improvement in mathematical problem solving performance
9	(Risnawati, 2014)	R, E, A, C, T	Mathematical Problem Solving (University level)	Significant improvement in problem-solving ability
10	(Sri Utami et al., 2016)	R, E, A, C, T	Contextual & Mathematics Learning	Increased conceptual understanding & relevance
11	(Suraji et al., 2020)	R, E, A, C, T	Problem Solving (Jr High School)	Increased mathematical problem-solving ability
12	(Susilo & Pasini Mairing, 2022)	R, E, A, C, T	Mathematical Communication (Vocational School)	Improved mathematical communication ability
13	(Suyantana, 2024)	R, E, A, C, T	Relations & Functions (Junior High)	Increased conceptual understanding
14	(Taryani Saputri et al., 2017)	R, E, A, C, T	Conceptual Understanding (Elementary Math)	Improved conceptual understanding

No	Authors	REACT Components Mentioned	Mathematics Topic	Reported Outcomes
15	(Wulandari et al., 2024)	R, E, A, C, T	Numeracy (Math Education College Students)	Increased numeracy competence

Discussion

The results indicate that REACT serves as a coherent contextual learning framework that is consistently conceptualized and applied across mathematics education. The high frequency of Relating and Experiencing components suggests that studies place strong emphasis on establishing meaningful context and allowing students to explore mathematical ideas actively. These findings support the theoretical views offered by Mesa & Syamsuri (2022) and Taufik et al. (2020) , who describe REACT as a process that connects students' experiences with conceptual understanding through active engagement.

The dominance of Relating and Experiencing aligns with constructivist theory, which posits that meaningful learning is facilitated when new concepts are anchored in prior knowledge and deepened through hands-on investigation. This pattern is further reinforced by studies such as Syafira et al. (2021) and Hasbi & Fitri (2024), which demonstrate that students show stronger comprehension when learning activities begin with contextual problems and proceed through structured exploration.

Implementation patterns reveal that REACT is most commonly applied in geometry and algebra. This is consistent with earlier claims Juwita et al. (2024) and (Meylani et al., 2023), who argue that abstract concepts in these areas require concrete experiences and contextual examples. The relatively lower implementation in advanced mathematical topics suggests that further exploration of REACT in upper-secondary and higher education remains a potential research direction.

Effectiveness results support the claim that REACT improves key mathematical competencies. The substantial increases in conceptual understanding, ranging from 18% to 40%, align with the expected outcomes of contextual learning frameworks which promote deeper comprehension through application and reflection. Studies reporting moderate to high N-gain values indicate that REACT contributes meaningfully to student progress, particularly in geometry, fractions, and algebra.

The improvement in mathematical problem solving skills is consistent with findings by (Alyani et al., 2020) and (Sari & Darhim, 2020)), which highlight the role of contextual problems in stimulating analytical and strategic thinking. Meanwhile, gains in mathematical communication and representation correspond to the Cooperating and Applying components of REACT, which emphasize interaction and practical application. This result resonates with (Syamsi Syamsuddin et al., 2024) and (Handayani & Oktiani, 2024), who report enhanced student expression and representation of ideas when REACT based collaborative activities are used.

The fact that Transferring is the least implemented component is notable. The limited implementation of the Transferring component, reported in only 9 out of 15 reviewed studies, reflects a broader pedagogical challenge in mathematics education. Because transferring requires students to generalize and apply knowledge to unfamiliar contexts, its limited use suggests difficulties related to instructional time constraints and the complexity of designing higher-order learning tasks.

The theoretical implications of this research indicate that REACT strengthens core principles of contextual and constructivist learning in mathematics. It validates the notion that learning environments grounded in real life experiences help students internalize concepts more effectively. Furthermore, the findings support the argument that multi stage instructional models (R–E–A–C–T) foster holistic learning when implemented sequentially.

From an applied perspective, the results highlight the value of REACT for improving student engagement, comprehension, and higher order thinking. Teachers can use this framework to design learning activities that encourage exploration, discussion, and cross context application of mathematical concepts. The observed gains in communication and representation also suggest that REACT supports the development of essential 21st century skills.

Despite the positive impact of the REACT model on students' mathematical competencies, the reviewed studies also reveal several challenges related to its implementation in classroom practice. One recurring issue concerns teacher readiness, particularly in designing contextual learning activities that require careful planning, flexible classroom management, and sustained facilitation of student-centered learning. In addition, limited access to contextual learning media and technological resources—especially in schools with constrained infrastructure—may hinder the optimal execution of the Experiencing, Applying, and Transferring stages. These constraints suggest that successful implementation of REACT is not solely dependent on the instructional model itself, but also on teachers' pedagogical competence and institutional support.

To address these challenges, the literature indicates the importance of targeted professional development programs that focus on contextual task design, scaffolding strategies, and the integration of locally available resources. Developing adaptable learning modules and low-cost contextual media may also help teachers implement REACT more consistently across diverse school settings.

Lastly, the findings underscore the need for further research that explores strategies to strengthen the Transferring component, particularly for advanced mathematics content and upper-level learners. This gap presents an opportunity for future studies to develop REACT based tasks that better promote generalization and knowledge transfer.

Conclusion

The systematic review of fifteen empirical studies shows that the REACT learning approach is consistently characterized as a contextual and constructivist framework consisting of Relating, Experiencing, Applying, Cooperating, and Transferring. The findings indicate that Relating and Experiencing are the most frequently implemented components, reflecting the strong emphasis in mathematics classrooms on connecting prior knowledge with real-life situations and engaging students in exploration-based learning. REACT has been applied across several mathematics topics, including geometry, algebra, fractions, and general problem-solving, with the majority of studies reporting notable improvements in students' conceptual understanding. Additional gains were also documented in students' problem-solving ability, mathematical communication, representation, and mathematical connections. While the overall implementation of REACT is effective, the Transferring component appears less commonly applied, suggesting that opportunities for students to generalize and apply knowledge to new contexts remain limited. These findings collectively answer the research questions and confirm that REACT contributes significantly to meaningful and competency-based mathematics learning.

Suggestions

Based on the results of this review, several recommendations can be proposed. Teachers should strengthen the design of learning activities that incorporate all stages of REACT, particularly the Transferring stage, so that students experience more opportunities to apply mathematical concepts in unfamiliar or real-world situations. Curriculum developers are encouraged to integrate REACT systematically across mathematics topics, especially in geometry and algebra, where the reviewed studies show substantial learning gains. Future researchers may explore the implementation of REACT in advanced mathematical content and at higher levels of education, since existing studies focus predominantly on junior high school contexts. It is also recommended that future studies report methodological procedures and learning outcomes more consistently, such as effect sizes, N-gain scores, or improvement percentages, to support more comprehensive and comparable analyses. Strengthening these aspects will help expand evidence-based practices for contextual mathematics learning using the REACT approach.

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