

Does Context Matter? Examining The Effectiveness Of Contextual Approach On Mathematical Problem-Solving In Function Composition

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Abstract

Mathematical problem-solving ability is a crucial competency in mathematics education. This study aims to examine the effectiveness of the contextual approach on the mathematical problem-solving ability of Grade XI students at SMA Negeri 17 Makassar. The study employed a pre-experimental design with a One Group Pretest-Posttest model. The sample consisted of 26 students in class XI.2 selected through cluster random sampling. Data were collected through problem-solving tests (pretest and posttest), classroom observation sheets for learning implementation and student activity, and a student response questionnaire. Data were analyzed using descriptive statistics and nonparametric inferential statistics (Wilcoxon Signed Rank Test, One Sample Wilcoxon Signed Rank Test, and Binomial Test). Results showed that: (1) the learning implementation reached 93.75% (very good category); (2) student activity reached 93.75% (very active category); (3) the mean posttest score was 85.05 with a classical completeness rate of 96.15%, exceeding the 80% standard; (4) the normalized gain mean was 0.84 (high category); and (5) student responses reached 76.44% (tending positive category). Inferential test results confirmed that the contextual approach significantly improved students' mathematical problem-solving ability ($p < 0.05$). This study concludes that the contextual approach is effective in improving students' mathematical problem-solving ability on the topic of function composition.

Keywords: contextual approach, mathematical problem-solving ability, function composition, learning effectiveness, pre-experimental

INTRODUCTION

Mathematical problem-solving ability is one of the most important 21st-century skills that every individual must possess, enabling them to adapt and make critical decisions in

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everyday life (Cynthia & Sihotang, 2023). This ability reflects higher-order thinking skills, where individuals are required to analyze situations, devise solution strategies, and evaluate solutions taken. In the context of education, problem-solving ability is an important indicator in assessing the success of the learning process (Hermani & Nurdin, 2020). (Indarwati et al., 2014)

Mathematics is one of the subjects that directly contributes to developing students' problem-solving abilities (La'ia & Harefa, 2021). According to Permendikbud No. 22 of 2016, the objectives of mathematics learning include understanding concepts, reasoning about patterns, solving mathematical problems, and communicating arguments. However, data from PISA and TIMSS consistently show that Indonesian students' ability to solve non-routine problems remains relatively low. (Lestari et al., 2021)

Observations at SMA Negeri 17 Makassar revealed that most Grade XI students only memorized formulas when solving problems. When given different problems, students were confused about how to begin understanding and solving them independently. The dominant approaches used by teachers were the expository and scientific approaches, which tend to be teacher-centered and do not optimally facilitate students' active engagement in constructing their own understanding.

A contextual approach (Contextual Teaching and Learning/CTL) is a learning approach that connects teaching materials with relevant examples or problems in students' daily lives. According to Sugandi and Bernard (2018), contextual learning is a design that connects subject matter with the real-life experiences of students, encouraging them to link knowledge they already possess with its implementation in everyday life through seven effective components: constructivism, questioning, inquiry, learning community, modeling, reflection, and authentic assessment.

Several studies have demonstrated the effectiveness of contextual approach in improving students' problem-solving abilities. Mukhni et al. (2013) found that the application of contextual approach in mathematics was effective in improving students' problem-solving ability at the junior high school level, with higher success rates compared to students taught using the direct instruction method. Similarly, Isharyadi (2018) showed that students taught with a contextual approach demonstrated significantly better problem-solving ability than those taught using the scientific approach. Malinda (2021) also confirmed that the contextual approach was more effective in improving mathematical problem-solving ability compared to the conventional approach. Beyond classroom instructional strategies, efforts to enhance teachers' competencies through training programs—such as developing interactive mathematics learning modules using eXeLearning (Nasrullah et al., 2017) and GeoGebra training





for high school mathematics teachers (Nasrullah et al., 2025)—further demonstrate the ongoing commitment to improving the quality of mathematics instruction.

The novelty of this study lies in examining the effectiveness of the contextual approach specifically on the topic of function composition for Grade XI students at the SMA level, using a comprehensive set of effectiveness indicators including student activity, student response, and classical learning completeness, guided by the effectiveness criteria established by Kadir (2020). This study aims to determine whether the application of the contextual approach can effectively improve students' mathematical problem-solving ability and achieve classical learning completeness, as well as to examine student activity and student responses during learning.

METHOD

This study employed a pre-experimental research design with a One Group Pretest-Posttest model. The research was conducted at UPT SMA Negeri 17 Makassar during the odd semester of the 2025/2026 academic year. This design was chosen in accordance with the research objective of determining the effectiveness of the contextual approach and comparing it with the approaches commonly used by teachers at the school.

Participants

The population of this study consisted of all Grade XI students at SMA Negeri 17 Makassar in the 2025/2026 academic year. The sample was selected using cluster random sampling technique, in which one class was randomly selected from all Grade XI classes. Class XI.2, consisting of 26 students, was selected as the experimental class and received treatment using the contextual approach on the topic of function composition.

Instruments and Data Collection

Data were collected using four instruments: (1) Mathematical Problem-Solving Ability Test (Pretest and Posttest): consisting of essay questions based on problem-solving indicators according to Polya's theory, covering four aspects—understanding the problem, devising a plan, carrying out the plan, and looking back—with scoring rubric adapted from Mawaddah and Anisah (2015); (2) Learning Implementation Observation Sheet: used to assess the implementation of each of the seven effective

Procedures

The research procedure consisted of three stages: preparation, implementation, and post-research. The implementation stage included administering the pretest, two treatment sessions (first session on the basic concept of function composition, second session on the properties of function composition), and administering the posttest and response



questionnaire. Both treatment sessions were observed by an observer (the mathematics teacher at the school).

Data Analysis

Data were analyzed using two techniques. Descriptive statistical analysis was used to analyze learning implementation, student activity, problem-solving test results, and student responses. The normalized gain (N-Gain) formula by Hake (1999) was used to measure learning improvement, classified as low ($g \leq 0.3$), medium ($0.3 < g < 0.7$), and high ($g \geq 0.7$). Classical completeness was determined if $\geq 80\%$ of students achieved a score of ≥ 78 (KKM).

Inferential statistical analysis was conducted after normality testing using the Shapiro-Wilk test. Since the data did not follow a normal distribution ($p < 0.05$), nonparametric tests were employed: (1) Wilcoxon Signed Rank Test to compare pretest and posttest scores; (2) One Sample Wilcoxon Signed Rank Test to test whether the median N-Gain ≥ 0.3 ; and (3) Binomial Test to determine whether classical completeness exceeded 80%. The learning was declared effective following Kadir's (2020) criteria: student activity $\geq 75\%$, student responses $\geq 70\%$, N-Gain in medium category or above, and classical completeness $> 80\%$.

RESULT AND DISCUSSION

Learning Implementation

The learning implementation was observed over two sessions by a mathematics teacher at SMA Negeri 17 Makassar, focusing on the seven effective components of the contextual approach as described by Sugandi and Bernard (2018): constructivism, questioning, inquiry, learning community, modeling, reflection, and authentic assessment.

Table 1. Recapitulation of Learning Implementation Observation Results

Aspect of Observation	Session 1	Session 2	Mean	Category
Constructivism: Learning begins with contextual problems	4	4	4.0	Very Good
Questioning: Teacher poses guiding questions	4	4	4.0	Very Good
Inquiry: Teacher guides	3	4	3.5	Good

Aspect of Observation	Session 1	Session 2	Mean	Category
students to discover concepts				
Questioning: Teacher directs students to ask about examples	4	2	3.0	Good
Learning Community: Teacher divides students into groups	4	4	4.0	Very Good
Learning Community: Teacher directs group collaboration	4	4	4.0	Very Good
Modeling: Teacher demonstrates problem-solving steps	4	4	4.0	Very Good
Reflection: Teacher conducts reflection with students	3	4	3.5	Good
Overall Percentage	93.75%	93.75%	93.75%	Very Good

Based on Table 1, the overall learning implementation for both sessions was 93.75%, placing it in the very good category. This indicates that learning using the contextual approach was well-implemented according to all seven effective components. The high implementation score reflects the teacher's ability to manage learning activities that connect mathematical concepts with real-life contexts, which is central to contextual teaching.

Student Problem-Solving Test Results

Students' mathematical problem-solving ability was measured through pretest and posttest on the topic of function composition. The descriptive statistics of the test results are presented in Table 2.

Table 2. Descriptive Statistics of Students' Mathematical Problem-Solving Test Results

Statistics	Pretest	Posttest
Mean	4.71	85.05
Median	4.22	86.62
Mode	0	85.91
Standard Deviation	5.84	18.55
Minimum	0	0
Maximum	25.35	100
Sample Size (n)	26	26

Table 2 shows a substantial improvement from the pretest mean of 4.71 to the posttest mean of 85.05, representing significant enhancement in students' problem-solving ability. The magnitude of improvement was further analyzed using the N-Gain formula, with results presented in Tables 3 and 4.

Table 3. Descriptive Statistics of Normalized Gain (N-Gain)

Statistics	Value
Mean	0.84
Median	0.86
Mode	1
Standard Deviation	0.18
Minimum	0
Maximum	1

Table 4. N-Gain Classification of Mathematical Problem-Solving Test Results

Interval	Frequency	Percentage	Category
N-Gain < 0.3	1	3.85%	Low
$0.3 \leq \text{N-Gain} < 0.7$	0	0%	Medium
N-Gain ≥ 0.7	25	96.15%	High
Total	26	100%	

As shown in Tables 3 and 4, the mean N-Gain of 0.84 indicates a high category of improvement. 25 out of 26 students (96.15%) achieved a high N-Gain, while only 1 student (3.85%) remained in the low category. Classical completeness results showed that 25 students (96.15%) achieved scores ≥ 78 (KKM), far exceeding the 80% classical completeness standard.

Student Activity

Table 5. Student Activity Observation Results

Aspect of Observation	Session 1	Session 2	Mean	Category
Constructivism: Students express their initial understanding	4	4	4.0	Very Good
Questioning: Students ask questions when facing difficulties	4	2	3.0	Good
Learning Community: Students work in groups to investigate problems	4	4	4.0	Very Good
Inquiry: Students find patterns related to function composition	4	4	4.0	Very Good
Reflection: Students discuss	4	4	4.0	Very Good

Aspect of Observation	Session 1	Session 2	Mean	Category
findings and write conclusions				
Reflection: Students perform reflection at the end of session	3	4	3.5	Good
Overall Mean / Percentage	3.83	3.67	3.75 / 93.75%	Very Active

Table 5 shows that overall student activity reached 93.75%, categorized as very active, substantially exceeding the 75% effectiveness threshold. These results indicate that the contextual approach successfully engaged students in active learning activities, including inquiry-based exploration, collaborative group work, and reflective discussions.

Student Responses

Table 6. Student Response Scores

Statement	Score	Percentage	Category
I understand Function Composition better after learning	83	79.81%	Tending Positive
I can solve Function Composition problems more easily	89	85.58%	Positive
I have difficulty understanding Function Composition (neg.)	78	75.00%	Tending Positive
I am motivated to learn Function Composition	84	80.77%	Tending Positive
I am more enthusiastic in learning Function Composition	80	76.92%	Tending Positive
I feel bored learning Function Composition (neg.)	90	86.54%	Positive

Statement	Score	Percentage	Category
I am active in expressing opinions during group discussion	72	69.23%	Tending Negative
I actively ask questions about material not understood	69	66.35%	Tending Negative
I answer the teacher's questions well during learning	75	72.11%	Tending Positive
I feel less active in participating during learning (neg.)	75	72.11%	Tending Positive
Mean	79.5	76.44%	Tending Positive

The mean student response score was 76.44%, placing it in the tending positive category and exceeding the 70% effectiveness threshold. Most students expressed positive views regarding their improved understanding and motivation in learning mathematics through the contextual approach.

Inferential Statistical Analysis

Normality testing using the Shapiro-Wilk test showed that neither the pretest-posttest data nor the N-Gain data followed a normal distribution ($p = 0.000 < 0.05$). Therefore, nonparametric tests were applied.

Table 7. Summary of Inferential Test Results

Hypothesis Test	Statistic	p-value	Decision
Wilcoxon Signed Rank Test (Pretest vs Posttest)	$Z = -4.376$	0.000	H0 rejected
One Sample Wilcoxon (N-Gain ≥ 0.3)	$Z = 4.433$	0.000	H0 rejected
Binomial Test (Classical Completeness $> 80\%$)	—	0.023	H0 rejected



Based on Table 7, all three hypothesis tests confirmed their respective H_0 rejections at $p < 0.05$, indicating that: (1) the contextual approach significantly improved students' mathematical problem-solving ability; (2) the median N-Gain exceeded the medium category threshold; and (3) classical completeness significantly exceeded 80%.

DISCUSSION

The results of this study confirm that the contextual approach is effective in improving the mathematical problem-solving ability of Grade XI students at SMA Negeri 17 Makassar on the topic of function composition. The high student activity (93.75%) reflects how the contextual approach's components—particularly learning community, inquiry, and constructivism—successfully engaged students in active, collaborative, and exploratory learning. This finding aligns with Amalia et al. (2024), who found that contextual learning design has great potential in developing students' problem-solving skills and making mathematics learning more meaningful.

The significant improvement in test scores (from mean 4.71 to 85.05, N-Gain mean = 0.84) is consistent with Polya's problem-solving theory, which emphasizes the importance of structured and reflective processes in solving mathematical problems. The contextual approach facilitated all four stages of Polya's problem-solving: understanding the problem through real-life contexts, devising plans through collaborative inquiry, executing plans through structured group work, and reviewing solutions through reflection. This is supported by Arafani et al. (2019), who reported that students learning through the contextual approach demonstrated significantly better mathematical problem-solving ability compared to those in conventional learning.

The positive student responses (76.44%) indicate that students perceived contextual learning as engaging and relevant. The connection between function composition and real-world applications (e.g., multi-step currency conversion) helped students see the practical value of mathematics, increasing their motivation and confidence in problem-solving. Malinda (2021) similarly found that the contextual approach yielded higher student satisfaction and problem-solving effectiveness compared to the conventional approach in SMA and MA settings. The positive responses also reflect the growing receptiveness of students and educators toward varied instructional innovations, a trend further evidenced by Bachtiar and Nasrullah (2022), who documented diverse online learning applications developed by educators during the COVID-19 pandemic to maintain the quality of student engagement and learning outcomes.

However, this study has several limitations. It was conducted with only one experimental class without a control group, limiting the generalizability of findings. The analysis also did not





account for individual differences in prior ability, learning style, or motivation. Future research should include a control group design, involve larger samples, and consider individual student characteristics to provide a more comprehensive understanding of the contextual approach's effectiveness.

CONCLUSION

This study concludes that the application of the contextual approach is effective in improving the mathematical problem-solving ability of Grade XI students at SMA Negeri 17 Makassar on the topic of function composition, evidenced by three main effectiveness indicators. First, student activity during learning was very high at 93.75% (very active category), well above the 75% threshold. Second, students demonstrated positive responses at 76.44%, exceeding the 70% threshold. Third, problem-solving ability showed high improvement with a mean N-Gain of 0.84 (high category) and classical completeness of 96.15%, surpassing the 80% standard. All three hypothesis tests confirmed these results at $p < 0.05$. It is recommended that mathematics teachers adopt the contextual approach as an alternative interactive strategy to improve problem-solving ability and student engagement. Future research should explore this approach across different topics and grade levels, ideally with a control group comparison.

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