

The Effect of Contextual Approach on Fourth-Grade Students' Mathematics Problem-Solving Ability on Fractions at SDN Panembahan III

¹⁾Retno Fahriyani, ²⁾Hema Widiawati, ³⁾Bagus Nurul Iman

^{1,2,3)}Elementary School Teacher Education, Muhammadiyah University of Cirebon

Correspondence Author: retnofahriyani1@gmail.com

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ABSTRACT

This study aims to determine the implementation of the Contextual Teaching and Learning (CTL) approach on the mathematical problem-solving abilities of fourth-grade students on the topic of fractions. This study employed a quantitative approach with a one-group pretest-posttest design. The subjects of the study consisted of 48 fourth-grade students at SDN Panembahan 3. Data were collected using a mathematical problem-solving ability test administered before and after the implementation of the CTL approach. Mathematical problem-solving ability was measured based on the students' ability to understand the problem, plan a solution, carry out the solution, check the answer, and draw a conclusion. The data were analyzed using a paired sample t-test and N-Gain calculation. The results showed that the mean pretest score was 60.54, while the mean posttest score was 73.25. Thus, there was an increase of 12.71 points in the students' average mathematical problem-solving ability after the implementation of the CTL approach. The results of the paired sample t-test showed a t-value of 7.397 with a significant value of $p < 0.001$, indicating a significant difference between the students' mathematical problem-solving abilities before and after the implementation of the CTL approach. Furthermore, the N-Gain calculation resulted in a score of 0.281, which was categorized as low. Based on these results, it can be concluded that the implementation of the Contextual Teaching and Learning (CTL) approach resulted in a statistically significant improvement in students' mathematical problem-solving abilities, although the level of improvement was still categorized as low. These findings indicate that CTL can be used in mathematics learning, particularly in teaching fractions, to help improve students' problem-solving abilities.

Article Information

KataKunci:

Contextual Teaching and Learning, kemampuan pemecahan masalah matematika, pecahan, siswa sekolah dasar.

ABSTRACT

Penelitian ini bertujuan untuk mengetahui penerapan pendekatan Contextual Teaching and Learning (CTL) terhadap kemampuan pemecahan masalah matematika siswa kelas IV pada materi pecahan. Penelitian ini menggunakan pendekatan kuantitatif dengan desain one-group pretest-posttest. Subjek penelitian berjumlah 48 siswa kelas IV SDN Panembahan 3. Teknik pengumpulan data menggunakan tes kemampuan pemecahan masalah matematika yang diberikan sebelum dan sesudah penerapan pendekatan CTL. Kemampuan pemecahan masalah matematika diukur berdasarkan kemampuan memahami masalah, merencanakan penyelesaian, melaksanakan penyelesaian, memeriksa kembali, dan menarik kesimpulan. Data penelitian dianalisis menggunakan uji paired sample t-test dan perhitungan N-Gain. Hasil penelitian menunjukkan bahwa rata-rata nilai pretest sebesar 60,54, sedangkan rata-rata nilai posttest sebesar 73,25. Dengan demikian, terjadi peningkatan rata-rata kemampuan pemecahan masalah matematika sebesar 12,71 poin setelah penerapan pendekatan CTL. Hasil uji paired sample t-test menunjukkan nilai $t = 7,397$ dengan nilai signifikansi $p < 0,001$, sehingga terdapat perbedaan yang signifikan antara kemampuan pemecahan masalah matematika siswa sebelum dan sesudah penerapan pendekatan CTL. Selanjutnya, hasil perhitungan N-Gain memperoleh nilai sebesar 0,281 yang termasuk dalam kategori rendah. Berdasarkan hasil tersebut, dapat disimpulkan bahwa penerapan pendekatan Contextual Teaching and Learning (CTL) menunjukkan adanya peningkatan kemampuan pemecahan masalah matematika siswa secara signifikan, meskipun tingkat peningkatannya masih berada pada kategori rendah. Hasil penelitian ini menunjukkan bahwa CTL dapat digunakan dalam pembelajaran matematika pada materi pecahan untuk membantu meningkatkan kemampuan pemecahan masalah siswa.

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✉ Corresponding Author: (1) Retno Fahriyani, (2) Elementary School Teacher Education Study Program, (3) Muhammadiyah University, (4) Cirebon, Indonesia, (5) Email: retnofahriyani1@gmail.com

1.Introduction

Education is the primary foundation for developing high-quality and competitive human resources. Through education, individuals are equipped with the knowledge, skills, attitudes, and thinking skills necessary to face life's challenges. The contextual approach, or Contextual Teaching and Learning (CTL), is a learning approach based on a constructivist perspective, emphasizing that knowledge is not transferred directly from teacher to student, but rather is actively constructed by students through meaningful learning experiences. Johnson (2002) defines CTL as a learning concept that helps teachers relate the material taught to students' real-world situations and encourages students to make connections between their knowledge and its application in everyday life. Thus, learning is no longer abstract and detached from reality, but becomes relevant and functional for students. In the context of elementary education, a contextual approach is crucial because elementary school students are at the concrete operational stage, requiring learning experiences that are real and relevant to their lives. Learning that is not contextual tends to be difficult for students to understand and results in low conceptual understanding and problem-solving skills. Therefore, CTL is seen as an appropriate approach to improving the quality of mathematics learning in elementary schools. One subject that plays a strategic role in developing these thinking skills is mathematics. Mathematics serves not only as a tool for calculations, but also as a means to develop logical, systematic, analytical, critical, and creative thinking skills. Therefore, mathematics instruction in elementary school plays a crucial role as an initial foundation in developing students' rational thinking patterns.

Mathematical problem-solving ability is one of the key competencies that must be developed in elementary school mathematics learning because it reflects students' ability to use mathematical knowledge and skills effectively to solve problems. Conceptually, mathematical problem-solving ability is defined as a student's ability to understand a problem, design a solution strategy, implement the strategy appropriately, and evaluate the results logically and systematically. Polya (1957) stated that problem-solving is a complex thinking process involving a series of structured steps. Therefore, this ability requires not only mastery of mathematical concepts and procedures, but also higher-order thinking skills such as analysis, reasoning, and evaluation. In the context of elementary education, problem-solving ability is an important indicator of successful mathematics learning because it shows the extent to which students are able to apply learned concepts in new and contextual situations. Therefore, developing mathematical problem-solving ability is an essential goal in mathematics learning, particularly in fractions. However, problem-solving ability does not develop automatically. This ability needs to be trained through learning that is systematically designed, meaningful, and contextual. In practice, elementary school mathematics learning is still often oriented towards one-way material delivery, dominated by lecture methods and routine practice problems. This kind of approach tends to emphasize mastery of procedures and memorization of formulas, so that students are less

accustomed to thinking flexibly and deeply when faced with problem-based questions.

Fractions are a mathematical topic that requires significant problem-solving skills. Fractions are abstract concepts that involve understanding the relationship between parts and wholes, their symbolic representation, and their application in various contextual situations. Fourth-grade elementary school students often find fractions challenging because they require more complex thinking skills than integers. Many students are able to perform fraction calculations mechanically but do not yet understand the conceptual meaning of the numerator and denominator. Therefore, elementary school mathematics instruction should be directed toward developing higher-order thinking skills, particularly problem-solving skills, rather than simply mastering procedures or memorizing formulas. However, in practice, elementary school mathematics instruction often focuses on a mechanistic approach that emphasizes routine practice, thus under-training students in flexible and contextual thinking.

In the elementary school curriculum, mathematical problem-solving skills are a core competency that students must master. These skills include understanding problems, constructing mathematical models, determining solution strategies, and drawing accurate conclusions. Problem-solving is at the heart of mathematics learning because it encourages students to use knowledge in an integrated and meaningful way. One topic that highly demands these skills is fractions, which are abstract and require an understanding of the relationship between parts and wholes and their application in everyday life. For fourth-grade students, the concept of fractions often presents difficulties, impacting their low problem-solving abilities. Therefore, a learning approach that connects the concept of fractions to students' concrete experiences is needed to optimally develop their understanding and problem-solving skills.

The phenomenon of low mathematical problem-solving skills is not limited to specific schools but is also reflected in national and international assessment results. The Programme for International Student Assessment (PISA) results show that Indonesian students' mathematical literacy remains below the Organisation for Economic Co-operation and Development (OECD) average. These findings indicate that Indonesian students still experience difficulties in solving contextual problems that require high-level reasoning. This indicates the need for improvements in mathematics learning strategies, particularly in developing problem-solving skills.

Various national studies have also revealed that the majority of elementary school students have not achieved the expected mathematical literacy competencies. Research by Sari, Putri, and Wahyuni (2022) shows that students' difficulties in understanding the relationships between fractions and their application in everyday life are influenced by learning that is still abstract and teacher-centered. Meanwhile, the Journal of Research on School Mathematics Learning (2025) reported that the implementation of a contextual approach supported by real-life media can significantly improve students' conceptual understanding and critical thinking skills. This condition was also found in the fourth grade of SDN 3 Panembahan.

Based on observations and interviews with 48 students on December 3, 2025, with teachers, it was found that mathematics learning on fractions was still dominated by the lecture method, using textbooks and Student Worksheets (LKS) as the main sources. Learning did not fully connect the concept of fractions to the context of students' daily lives, so students tended to understand the material procedurally without understanding its meaning in depth.

The impact of these conditions is evident in student learning outcomes. Based on the results of daily tests on fractions for the odd semester of the 2025/2026 academic year, 29 out of 48 students (60%) have not achieved the Minimum Completion Criteria (KKM) of 70. The class average score of 64.3 indicates that students' mathematical problem-solving abilities are still relatively low. Students experience difficulties, especially with story problems that require contextual analysis of situations and the precise application of fraction concepts. This problem indicates a gap between mathematics learning objectives that emphasize problem-solving skills and learning practices that are still conventional. Therefore, learning innovations are needed that can bridge abstract mathematical concepts with students' concrete experiences. One relevant approach to addressing this problem is the contextual approach (Contextual Teaching and Learning). This approach emphasizes the connection between learning materials and real-world situations so that students can build conceptual understanding through direct experience. In a contextual approach, students not only receive information from the teacher but also actively construct knowledge through the process of asking questions, discussing, discovering, and reflecting on learning. In this study, the contextual approach is supported by the use of concrete media in the form of oranges. Oranges were chosen because they are readily available, relevant to students' lives, and can directly represent the concept of fractions as parts of a whole. By dividing an orange into halves, quarters, or other parts, students can understand the concept of fractions visually and manipulatively before learning it in symbolic form.

The use of orange media allows students to be actively involved in the learning process. Students not only see examples on the board, but also carry out concrete activities that help build conceptual understanding. These activities are expected to increase learning motivation, strengthen memory, and develop systematic problem-solving skills. By integrating a contextual approach and concrete media, mathematics learning on fractions is expected to be more meaningful and no longer abstract. Students are expected to be able to understand concepts in depth, relate the material to everyday life, and solve mathematical problems more effectively. Based on this description, research is needed that empirically examines the effect of a contextual approach on mathematical problem-solving abilities on fractions in grade IV. Therefore, the researcher conducted a study entitled "The Effect of a Contextual Approach on Mathematical Problem-Solving Ability on Fractions in Grade IV."

2.Method

A. Research Design

This study used a quantitative approach with a pre-experimental type of research, because it aims to determine the effect of the application of a contextual approach on students' mathematical problem-solving abilities through numerical data measurement and statistical analysis. The quantitative approach was chosen because it is in accordance with the research objectives that focus on testing the effects of a treatment objectively and measurably. According to Creswell (2018), quantitative research is very appropriate for use when researchers want to test hypotheses and cause-and-effect relationships between variables using standardized instruments and statistical analysis. In the context of this study, a quantitative approach allows researchers to systematically measure changes in students' mathematical problem-solving abilities before and after the application of a contextual approach. The research design used in this study was a pre-experimental (pre-experimental design) with a one-group pretest-posttest design. This design was chosen because the study was conducted on one group of subjects without a comparison group (control group). In this design, researchers provide treatment to the same group, then compare students' mathematical problem-solving abilities before and after being given treatment in the form of a contextual approach. The one-group pretest-posttest design allows researchers to directly determine changes in students' mathematical problem-solving abilities after the application of a contextual approach in learning fraction material. Before the treatment was administered, students were given a pretest to measure their initial mathematical problem-solving abilities. Next, students participated in the mathematics learning process using a contextual approach in accordance with the previously prepared learning plan. After the treatment was completed, students were given a posttest to measure their mathematical problem-solving abilities after participating in the learning. The use of this pre-experimental design was in accordance with field conditions and research limitations that did not allow for random class grouping or the use of a control group. According to Sugiyono, a pre-experimental design is used to determine the effect of a treatment on certain variables, even though the level of control for external variables is still limited (Sugiyono, 2019). Nevertheless, this design is still able to provide an empirical picture of changes in student abilities as a result of the treatment given.

Schematically, the one-group pretest-posttest design research design can be described as follows:

Table 3. 1 One Group Pretest-Posttest

O1 X O2

Information:

O1: Pre test before treatment

O2: Post test after treatment

Source: (Kurniawan, Rahmawati, & Dian, 2024)

Through this design, the difference between the pretest and posttest results was used as a basis to determine whether or not there was an influence of the contextual approach on students' mathematical problem-solving abilities in the

fraction material of grade IV at SDN Panembahan III. Thus, this pre-experimental design was deemed relevant and in accordance with the research objective, namely to test the influence of the contextual approach on mathematical problem-solving abilities.

B. Time and Place of Research

1. Research Time

The research timeframe is the timeframe determined by the researcher to carry out the entire research process, from preparation and data collection to data analysis, to the preparation of the research report (Sugiyono, 2021). The following is the research implementation timeframe agreed upon with the school, the partner in this research.

Table 2. Research Time

No	Activity	Execution time									
		De	Ja	Fe	Ma	Ap	Ma	Jun	Jul	Se	
1	Compilation										
	Proposal										
2	Test Seminar										
	Proposal										
3	Seminar										
	Revision										
4	Proposal Test										
	Development										
5	Instruments										
	Research into										
6	Field										
	ProcessingD										
7	ata and										
	Compilation										
8	Chapters IV										
	and V										
9	Publication										
	Thesis										
10	Thesis										
	Defence										
11	Revision of										
	the Session										
12	Thesis										

3. Research Site

This research was conducted at SDN 3 Panembahan, located on Jl. Panembahan Ratu, Plered District, Cirebon Regency, West Java.

C. Population, Sample, and Sampling Techniques

1. Population

A population is a generalized area consisting of objects or subjects possessing certain qualities and characteristics determined by the researcher. These objects or subjects will be studied by the researcher and conclusions will be drawn. Population refers not only to the number but also to all characteristics or traits possessed by the subjects or objects (Sugiyono, 2022). Based on the definition of population above, the population in this study is all fourth-grade students at SD Negeri 3 Panembahan.

Table 3. Population

Class	Amount
Class IV	48
Total	48

2. Sample

A sample is a subset of the characteristics and numbers in a population. In other words, this sample must be truly representative of the population (Sugiyono, 2021). Based on the definition above, the sample used for this study is the fourth grade students of SD Negeri 3 Panembahan, totaling 48 students.

3. Sampling Techniques

Sampling technique is a sampling technique that will be used in a study (Sugiyono, 2021). In this study, the researcher used total sampling. Total sampling is a technique for determining samples by including the entire population (Sugiyono, 2021). The reason for this is because the entire sample in grade IV of SD Negeri 3 Panembahan was used.

D. Research Variables

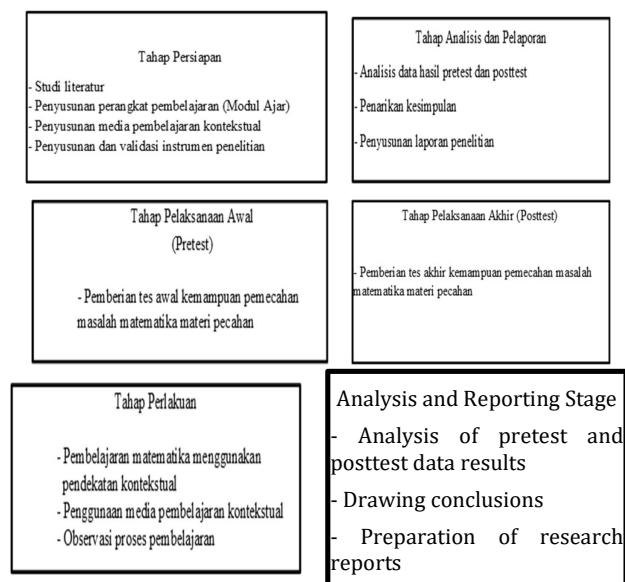
A research variable is anything that becomes the object of observation in a study and has certain variations determined by the researcher to be studied and conclusions drawn (Sugiyono, 2020). This study uses two types of variables: independent variables and dependent variables. An independent variable is a factor that influences changes in other variables. In other words, this variable functions as the cause of changes in other variables. Meanwhile, a dependent variable is a variable whose value and outcome are determined by the independent variable, so this variable can be seen as the result of the influence of the independent variable (Sahir, 2022). The independent variable in this study is X, namely a learning approach that links fraction material to students' real-life contexts. And the dependent variable in this study is Y, namely students' ability to solve fraction problems through the stages of understanding the problem, planning, solving, and re-checking answers.

E. Operational Definition

The independent variable in this study is the contextual approach (Contextual Teaching and Learning). Operationally, the contextual approach is defined as a learning approach that links mathematical material to real situations and students' daily experiences so that learning becomes more meaningful. This approach is implemented through learning activities that encourage active student involvement, such as linking fraction concepts to everyday life problems, group discussions, and solving contextual problems. Measurement of the contextual approach variable is carried out through observation sheets for the learning process with indicators including the relationship of the material to the real context, student activeness in learning, students' opportunities for critical thinking, and students' ability to link fraction concepts to real situations. Observation data are analyzed using a Likert scale to describe the level of implementation of the contextual approach in learning. The dependent variable in this study is the mathematical problem-solving ability of elementary school students, specifically on fractions. Operationally, mathematical problem-solving ability is defined as students' ability to solve mathematical problems that require a thought process, starting from understanding the problem, planning a solution strategy, implementing the solution, and drawing appropriate conclusions. This ability is measured through problem-solving tests given before and after the learning treatment with the contextual approach. The problem-solving ability indicators refer to Polya's problem-solving stages: understanding the problem, planning a solution, implementing the solution, and drawing conclusions. Test results are expressed as numerical scores and analyzed using an interval scale to determine changes in students' mathematical problem-solving abilities after treatment.

F. Research Stages

Research stages are the steps taken by a researcher in their research. The stages used in this study are the preparation stage, the implementation stage, and the final stage. The research stages are explained in the diagram below:



G. Assessment Instruments

A research instrument is a tool used to systematically and measurably collect data related to research variables. In this study, the research instrument was used to obtain data on the application of a contextual approach and elementary school students' mathematical problem-solving abilities in fractions. The instrument selection was adjusted to the characteristics of the variables studied and the objectives of the quantitative research, ensuring that the data obtained were objective and amenable to statistical analysis.

The instrument used in this study was a mathematical problem-solving ability test in the form of an essay on comparing and ordering fractions. The essay test was chosen because it provides more in-depth information about students' abilities to understand problems, plan solutions, solve problems systematically, and communicate reasons for their answers. Unlike multiple-choice tests, which only assess the final result, the essay test allows researchers to observe students' thought processes while solving mathematical problems. The structure of the mathematical problem-solving ability test is based on Polya's problem-solving indicators, which include: understanding the problem, planning a solution, implementing the solution, and drawing conclusions. Each indicator is represented by several questions so that the overall test reflects students' problem-solving abilities as a whole. Test scores are expressed in numerical form, thus using an interval scale and allowing for quantitative analysis to determine changes in students' abilities before and after treatment.

The second instrument used was an observation sheet for the implementation of the contextual approach. This observation sheet was used to observe and ensure that the contextual approach was truly implemented in the learning process according to the plan. Observations were conducted during the learning activities by observing the activities of teachers and students. Observation indicators included the relevance of the material to the context of students' daily lives, student activeness in learning, the use of contextual media, and student involvement in the problem-solving process. The observation sheet was compiled using a Likert Scale with several assessment categories, so as to systematically describe the level of implementation of the contextual approach. The procedure for developing the research instrument began with a review of previous theories and research relevant to the contextual approach and mathematical problem-solving skills. Next, the researcher formulated indicators based on the variables and research objectives. These indicators were then developed into an instrument grid that contained the suitability between the indicators, instrument format, and measurement techniques. Based on this grid, the researcher compiled test items and observation statements. The compiled instrument was then consulted and validated by experts to ensure content validity, language clarity, and suitability to the characteristics of fourth-grade elementary school students. After going through the validation and revision process, the instrument was ready for use in the research implementation.

By using problem-solving ability tests and observation sheets for the implementation of the contextual approach, this study is expected to be able to obtain accurate and

comprehensive data regarding the influence of the contextual approach on students' mathematical problem-solving abilities in fraction material.

H. Instrument Test

Research instrument testing was conducted to ensure that the instruments used had adequate levels of validity and reliability so that the resulting data were accurate and could be scientifically accounted for (Sugiono, 2020). The instrument tested in this study was a test instrument for the ability to solve mathematical problems (fraction problems) for grade IV using contextual learning.

1. Test Instrument Validity Test

Validity testing aims to determine the extent to which test items are able to measure the abilities they should, according to the learning indicators (Widoyoko, 2020). In this study, validity testing was conducted using content validity and empirical validity.

In terms of content validity, the test instrument was first consulted with experts (expert judgment), namely the supervising lecturer and fourth-grade teacher, to assess the suitability of the test items to core competencies, learning indicators, level of difficulty, and clarity of language. Test items were declared content valid if they aligned with the indicators and received approval from the experts (Sugiyono, 2020).

Next, empirical validity was tested using Pearson Product Moment correlation with the help of data processing software.

The Pearson Product Moment used is as follows:

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}$$

Information:

r_{xy} = correlation coefficient between item score and total score

X = item score

Y = total score

N = number of respondents

The decision making criteria are as follows:

If $r_{hitung} > r_{tabel}$, then the question item is declared valid

If $r_{hitung} \leq r_{tabel}$, then the question item is declared invalid

2. Test Instrument Reliability Test

Reliability testing aims to determine the level of consistency of the test instrument in measuring student learning outcomes (Sugiyono, 2020). Reliability testing in this study was conducted using the Cronbach's Alpha formula with the aid of statistical software.

The Cronbach's Alpha formula used is as follows:

$$= \frac{k}{k-1} \left(1 - \frac{\sum \sigma_i^2}{\sigma_t^2} \right)$$

Information:

α = reliability coefficient

k = number of questions

σ_i^2 = variance of scores for each question item

σ_t^2 = total score variance

The instrument reliability criteria refer to the opinion of

Widoyoko (2020), namely:

$\alpha \geq 0.80$: very high reliability $0.60 \leq \alpha < 0.80$: high reliability

$0.40 \leq \alpha < 0.60$: moderate reliability

$\alpha < 0.4$: low reliability

The results of the reliability test showed that the learning outcome test instrument obtained a Cronbach's Alpha value of . Thus, the learning outcome test instrument was declared reliable and suitable for use as a research data collection tool (Widoyoko, 2020; Creswell, 2021).

I. Data collection technique

Data collection techniques are the means by which data is obtained from the research object. Therefore, an appropriate data collection method or technique is required for the research. The data collection methods used in this study include:

a. Test

A test is a data collection technique in the form of a collection of questions or a tool that can be used to measure a person's knowledge, skills, and abilities. The tests used in this study were a pre-test, a post-test, and an initial mathematical ability test. This test was used to determine and measure the learning outcomes of fourth-grade students at SDN Panembahan 3 before and after the contextual approach was implemented.

b. Questionnaire

A questionnaire is a data collection technique that involves providing respondents with a set of written questions or statements to answer. This is an efficient data collection technique if the researcher knows precisely which variables to measure and what respondents can expect. This study will use a questionnaire to determine students' responses to a scientifically justified contextual approach (Sugiyono, 2020). The instrument tested in this study is a student learning outcome test instrument for fourth-grade fractions using contextual learning.

3. Test the Validity of the Test Instrument

Validity testing aims to determine the extent to which test items are able to measure the abilities they should, according to the learning indicators (Widoyoko, 2020). In this study, validity testing was conducted using content validity and empirical validity.

In terms of content validity, the test instrument was first consulted with experts (expert judgment), namely the supervising lecturer and fourth-grade teacher, to assess the suitability of the test items to core competencies, learning indicators, level of difficulty, and clarity of language. Test items were declared content valid if they aligned with the indicators and received approval from the experts (Sugiyono, 2020).

Next, empirical validity was tested using Pearson Product Moment correlation with the help of data processing software.

The Pearson Product Moment used is as follows:

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}$$

Information:

r_{xy} = correlation coefficient between item score and total score

X= item score

Y= total score

N= number of respondents

The decision making criteria are as follows:

If $r_{hitung} > r_{tabel}$, then the question item is declared valid

If $r_{hitung} \leq r_{tabel}$, then the question item is declared invalid

4. Reliability Test of Test Instruments

Reliability testing aims to determine the level of consistency of the test instrument in measuring student learning outcomes (Sugiyono, 2020). Reliability testing in this study was conducted using the Cronbach's Alpha formula with the aid of statistical software.

The Cronbach's Alpha formula used is as follows:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum \sigma_i^2}{\sigma_t^2} \right)$$

Information:

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σ_i^2 = variance of scores for each question item

σ_t^2 = total score variance

The instrument reliability criteria refer to the opinion of Widoyoko (2020), namely:

$\alpha \geq 0.80$:very high reliability $0.60 \leq \alpha < 0.80$: high reliability

$0.40 \leq \alpha < 0.60$: moderate reliability

$\alpha < 0.4$:low reliability

The results of the reliability test showed that the learning outcome test instrument obtained a Cronbach's Alpha value of . Thus, the learning outcome test instrument was declared reliable and suitable for use as a research data collection tool (Widoyoko, 2020; Creswell, 2021).

J. Data Collection Techniques

Data collection techniques are the means by which data is obtained from the research object. Therefore, an appropriate data collection method or technique is required for the research. The data collection methods used in this study include:

c. Test

A test is a data collection technique in the form of a set of questions or a tool used to measure a person's knowledge, skills, and abilities. The tests used in this study were a pre-test, a post-test, and an initial mathematical ability test. These tests were used to determine and measure the learning outcomes of fourth-grade students at SDN Panembahan 3 before and after learning using Canva-based interactive media.

d. Questionnaire

A questionnaire is a data collection technique that involves providing respondents with a set of written questions or statements to answer. This is an efficient data collection technique if the researcher knows exactly what variables to measure and what respondents can expect. This study will use a questionnaire to determine students' responses to learning media.

e. Documentation

Documentation is used to supplement research data in the form of documents related to the research implementation (Sugiyono, 2020). Documentation in this study includes student numbers, a list of learning outcomes, photographs of learning activities, and other supporting documents relevant to the research. Documentation techniques aim to provide empirical evidence and support the validity of data obtained through testing and observation.

K. Data Analysis Techniques

In quantitative research, there is data analysis. Data analysis is an activity carried out after the data that has been collected has been collected. In quantitative research using statistical data analysis. A number of data that has been obtained must be analyzed. For pre-test, post-test, and N-gain data before the trial, prerequisite tests will be conducted data analysis, namely normality tests and homogeneity tests. Then, for questionnaire data analysis, prerequisite tests are carried out data analysis and hypothesis testing after converting ordinal data to intervals. All of these analyses were assisted by Microsoft Office Excel 2019 with SPSS Version 26. Quantitative data were obtained in the form of instrument test results, pre-test data, post-test data, N-Gain test. Meanwhile, data from the pre-test, post-test, N-Gain test were processed using SPSS Software Version 26 for Windows. Student test results were used to examine the effect of interactive learning media on the learning outcomes of fourth-grade students of SD Negeri 3 Panembahan.

f. Data Analysis Prerequisite Test (Classical Assumption Test)

i. Performing a normality test

The normality test to be conducted in this study is the Shapiro-Wilk test. The Shapiro-Wilk test is a statistical test used to check the normality of data. This aligns with Ghozali's (2018) opinion, which states that the Shapiro-Wilk test is more appropriate for small samples ($n < 50$) due to its higher level of accuracy. The hypotheses to be tested are:

H0 :normally distributed data

H1 :non-normally distributed data

The testing criteria are:

If the significance value (p-value) < 0.05 , then reject H0.

If the significance value (p-value) > 0.05 , then accept H0

i. Conducting homogeneity test

The homogeneity test is used to determine whether the variance of the pretest and posttest data on student learning outcomes is homogeneous. According to Sudjana (2017), the homogeneity test is conducted to determine the similarity of variances between two or more data groups. In this study, the homogeneity test was conducted using the F (Fisher) test, which is by comparing the largest variance with the smallest variance of the pretest and posttest data. The F test formula is:

$$F = \frac{\text{Varians terbesar}}{\text{Varians terkecil}}$$

decision-making:

If $F_{count} < F_{table}$, then the data is declared homogeneous.

If $F_{count} \geq F_{table}$, then the data is declared non-homogeneous.

g. Research Hypothesis Testing

i. Paired-Samples T-test

The paired-samples t-test is used to compare the means of two variables.

H_0 : homogeneous variance data

H_a : non-homogeneous variance data

H_1

This test measures the difference in the values of two variables for each individual and tests whether the average of these differences is

Data	N	Sig.	Information
Pretest	48	0.064	Normal
Posttest	48	0.665	Normal

equal to zero. This t-test aims to detect significant differences between two variables, which can be two measurements on the same object or a single measurement on a pair of objects (Muhid, 2019). Decision-making is done by comparing the calculated t-value with the t-table:

If $t_{count} > t_{table}$, then H_0 is rejected. If $t_{count} < t_{table}$, then H_0 is accepted.

By comparing the significance level (P-Value) with the error:

If the significance value > 0.05 , then H_0 is accepted. If the significance value < 0.05 , then H_0 is rejected.

The steps for the paired-sample t-test are as follows:

1. Click Analyze
 2. Select Compare Means
 3. Click Paired-Samples T Test
 - a. Enter: Pretest into Variable1 and Posttest into Variable 2
 4. Click OK
- N-gain test

The steps for calculating the N-gain test are as follows:

1. Score students' answers according to the answer key and scoring guidelines that have been created.
2. Grouping students' pretest and posttest scores with tables from both the experimental and control classes.
5. Next, calculate the student's learning outcome score using the gain formula.

The formula for finding n-gain according to Meltzer

according to Oktavia, Prasasty, & Isroyati (2019):

$$N-gain = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum possible score} - \text{pretest score}}$$

After calculating the N-Gain, it is then classified using the classification according to Meltzer:

N-gain clarification

The magnitude of N-gain (g) Classification

$g \geq 0.70$	Tall
$0.30 \leq g < 0.70$	Currently
$g < 0.30$	Low

Source: (Hake 1999)

3. Results and Discussion

This study uses a quantitative approach with a pre-experimental research type and a one-group pretest-posttest design.

The study involved a group of students who received measurements of their mathematical problem-solving abilities before and after learning using a contextual approach. Data in the form of pretest and posttest scores were analyzed using descriptive and inferential statistics.

The mathematical problem-solving skills in this study refer to Polya's stages: understanding the problem, planning a solution, implementing the solution, and drawing conclusions. A contextual approach is applied by connecting mathematical concepts to students' everyday life situations, providing students with the opportunity to understand the problem more meaningfully.

The study subjects were 48 students. Prior to treatment, students were given a pretest to assess their initial abilities. Next, they underwent contextual learning on fractions. After the treatment, students were given a posttest to determine their mathematical problem-solving abilities after the learning.

1. Description of Pretest and Posttest Data

Pretest data was used to determine students' initial abilities before implementing the contextual approach, while posttest data was used to determine students' abilities after participating in the learning process. Comparing the two sets of data served as the basis for assessing changes in mathematical problem-solving abilities.

Table 2.

Statistics	Pretest	Posttest
Number of students (N)	48	48
Average (Mean)	60.54	73.25
Average difference	12.71	

Based on the table, the average pretest score was 60.54, while the average posttest score was 73.25. Thus, the average score increased by 12.71 points. Descriptively, this increase indicates that students' mathematical problem-solving abilities after the learning process were higher than before the learning process.

The descriptive average increase cannot yet be used to determine whether the change is statistically significant. Therefore, the data were further analyzed using inferential statistical tests to determine whether the difference between pretest and posttest scores was statistically strong.

B. Prerequisite Analysis Test

1. Normality Test

A normality test was conducted to determine whether the pretest and posttest data met the assumptions of a normal distribution. The test was conducted using Shapiro-Wilk software with IBM SPSS Statistics. Data were considered normal if the significance value was greater than 0.05.

The Shapiro-Wilk test results showed a significance value of 0.064 for the pretest and 0.665 for the posttest. Both values are greater than 0.05. Therefore, the pretest and posttest data are normally distributed. These results indicate that the assumption of normality is met, and parametric analysis can proceed.

2. Homogeneity Test

A homogeneity test was conducted to provide information regarding the similarity of variance between pretest and posttest scores. The test was conducted using Levene's Test. The general criterion used is a significance value greater than 0.05 indicating homogeneous variance, while a significance value less than 0.05 indicates inhomogeneous variance.

Levene Statistics	df1	df2	Sig. (p)	Information
6,664	1	94	0.011	Not homogeneous

The Levene's Test results show a value of 6.664 with $df1 = 1$, $df2 = 94$ and a significance level of 0.011. Since 0.011 is less than 0.05, the variance of the pretest and posttest scores is declared inhomogeneous.

These findings need to be interpreted according to the research design. The study used a one-group pretest-posttest, so the pretest and posttest scores came from the same students and constitute paired data. Homogeneity of variance between independent groups is not a primary assumption for the paired-sample t-test. Therefore, Levene's test results are reported as supplementary information and

should not be used as a basis for replacing the paired-sample t-test.

C. Hypothesis Testing

1. Paired-Samples t-Test

Hypothesis testing was conducted using a paired-sample t-test because the study compared two scores from the same subject: the pretest and posttest. This test was used to determine whether there was a difference in students' average mathematical problem-solving abilities before and after the application of the contextual approach.

The research hypothesis is formulated as follows. H_0 : There is no significant difference between students' mathematical problem-solving abilities before and after the application of the contextual approach. H_a : There is a significant difference between students' mathematical problem-solving abilities before and after the application of the contextual approach. The decision criterion is that H_0 is rejected if the two-way significance value is less than 0.05.

Average Difference	t	df	Sig. (2-tailed)	Information
12.71	7,397	47	< 0.001	Significant

The results of the Paired-Samples t-test showed an average score difference of 12.71, $t(47) = 7.397$, and $p < 0.001$. Because the significance value is less than 0.05, H_0 is rejected and H_a is accepted. Thus, there is a statistically significant difference between students' mathematical problem-solving abilities before and after the application of the contextual approach. The direction of change can be seen from the average score which increased from 60.54 in the pretest to 73.25 in the posttest. Thus, the results of the hypothesis test indicate that the change in scores that occurred is statistically significant.

D. N-Gain Analysis

N-Gain analysis was conducted to determine the level of improvement in students' abilities based on pretest and posttest scores. N-Gain provides additional information regarding the relative magnitude of improvement, allowing interpretation of research results beyond statistical significance.

N-Gain Value		Category
$g \geq 0.70$		Tall
$0.30 \leq g < 0.70$		Currently
$g < 0.30$		Low
Category	Number of Students	Percentage
Tall	3	6.3%
Currently	20	41.7%
Low	25	52.0%
Total	48	100%
Average N-Gain	0.281	Low

The analysis results showed an average N-Gain of 0.281, which is in the low category. Of the 48 students, 25, or 52.0%, were in the low category, 20, or 41.7%, were in the medium category, and 3, or 6.3%, were in the high category. This distribution indicates that improvement in mathematical problem-solving ability is uneven. Most students experienced low-level improvement, while others experienced moderate improvement, and only a small percentage reached the high-level.

A low N-Gain result does not necessarily mean no change in ability. A paired-sample t-test indicates a significant difference. The two analyses answer different questions: the t-test tests for the existence of a difference, while N-Gain describes the relative degree of improvement.

4. Discussion

1. Mathematical Problem Solving Ability Before Implementing the Contextual Approach

The average pretest score of 60.54 reflects the initial state of students' mathematical problem-solving abilities before treatment. Students had prior mathematical knowledge, but these abilities were not yet fully developed to be used in solving problems that require an understanding of context and strategy. Problem-solving abilities in this study included understanding the problem, planning a solution, implementing the plan, and drawing conclusions. Fractions are strongly related to everyday life, such as division, measurement, and buying and selling activities. Therefore, real-world contexts are relevant to help students connect concepts with experiences.

2. Mathematical Problem Solving Ability After Implementing a Contextual Approach

After implementing the contextual approach, the average score increased to 73.25. This 12.71-point increase indicates a change in students' abilities after gaining learning experiences that linked fractions to real-life situations. Johnson explained that contextual learning helps students connect academic material to real-life contexts, making learning more meaningful. In mathematics, this principle is relevant because students can understand concepts not just as symbols or procedures, but as knowledge used to solve problems.

3. Differences in Problem Solving Ability Based on Paired-Samples t-Test

The results of the Paired-Samples t-test showed $t(47) = 7.397$ with $p < 0.001$. These results indicate that there is a significant difference between the scores before and after learning. This finding strengthens the descriptive results that show an average increase. Theoretically, these results can be understood through the characteristics of contextual learning that direct students to connect knowledge with real contexts. However, because the research design does not use a control group, conclusions need to be formulated proportionally as changes in the studied group.

4. N-Gain Results and Ability Improvement Level

The average N-Gain of 0.281 is in the low category. This finding indicates that although the average score increased and the t-test showed a significant difference, the relative increase was not high. The low N-Gain may be related to differences in initial abilities, the need for repeated practice in problem-solving, mastery of fraction operations, and the time students have to adapt to contextual learning. The N-Gain distribution shows that 52.0% of students are in the low category, 41.7% are in the medium category, and 6.3% are in the high category.

5. Why is the t Test Significant but the N-Gain is Low?

The t-test and N-Gain have different functions. The t-test focuses on the existence of a mean difference, while the N-Gain focuses on the degree of improvement relative to the available room for improvement. In this study, the average score increased by 12.71 points, yielding a $p < 0.001$. However, after normalizing the increase against the maximum score, the average N-Gain of 0.281 is considered low. Thus, the results of the study are not contradictory: there was a significant change, but the relative improvement was still low.

6. Relation to Contextual Approach

The contextual approach places life context as a crucial part of learning. Sanjaya and Johnson emphasize that material can be understood more meaningfully when connected to students' experiences. In fractions, the context of division, measurement, and transactions can bridge students' experiences with mathematical concepts. This alignment also relates to Polya's stages because the context students understand can aid in the process of understanding problems, determining strategies, carrying out calculations, and drawing conclusions.

7. Connection with Previous Research

The results of this study align with those of Serepinah and Marini, who discussed the influence of contextual learning on mathematical problem-solving skills in elementary schools. This study demonstrated a correlation between contextual learning and problem-solving skills. This study also relates to the findings of Muhalhamah and Putrawangsa, as well as Safera, Sutiarto, and Bharata, which were used in previous studies as empirical support for the contextual approach. Although the direction of the results is consistent, the magnitude of improvement may not be the same due to

differences in student characteristics, materials, instruments, duration, and research designs.

8. Implications of Research Results

The research findings have implications for elementary school mathematics instruction. Teachers can use everyday contexts to help students understand fraction concepts and solve problems. However, the low N-Gain indicates that the approach needs to be implemented consistently and accompanied by gradual practice. Teachers can provide feedback at each stage of problem-solving to prevent students from simply focusing on the final answer.

9. Research Limitations

The study has limitations. First, the one-group pretest-posttest design did not use a control group, so score changes cannot be fully separated from other factors, such as learning experience or the effects of repeat testing. Second, the average N-Gain was low, so improvements were not optimal. Third, the study focused on fractions and specific subject characteristics, so the results need to be applied with caution to different contexts.

5. Conclusion

Based on the results of research and discussion regarding the application of a contextual approach to the mathematical problem-solving abilities of fourth-grade students on fraction material, the following conclusions were obtained.

1. Students' mathematical problem-solving abilities before applying the contextual approach are shown by the average pretest score of 60.54.
2. After implementing the contextual approach, the average posttest score increased to 73.25, resulting in an average increase of 12.71 points.
3. The results of the Paired-Samples t-test show $t(47) = 7.397$ with $p < 0.001$. Since $p < 0.05$, H_0 is rejected and H_a is accepted. This means that there is a significant difference between students' mathematical problem-solving abilities before and after the application of the contextual approach.
4. The N-Gain results show an average of 0.281, which is in the low category. A total of 25 students (52.0%) are in the low category, 20 students (41.7%) are in the medium category, and 3 students (6.3%) are in the high category.
5. Overall, the application of the contextual approach to the conditions of this study was followed by significant changes in mathematical problem-solving abilities, but the relative level of improvement based on N-Gain was still low.

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