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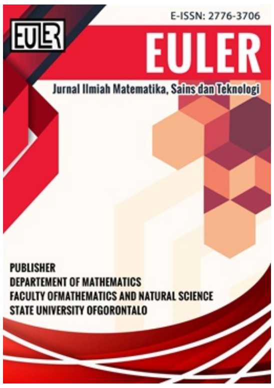

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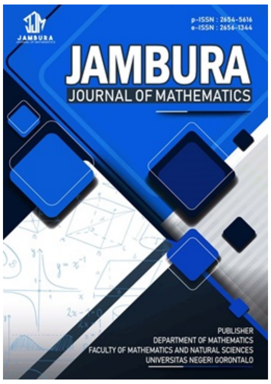

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Research Article

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Integrating Islamic Contexts into Visual Thinking Approach to Enhance Mathematical Representation Skills

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ABSTRACT. *Mathematical representation ability is an essential competency in mathematics learning because it enables students to express and communicate mathematical ideas through various forms of representation. However, students' mathematical representation ability remains relatively low, indicating the need for instructional approaches that better support its development. This study aimed to analyze differences in mathematical representation ability between students taught using the Visual Thinking approach integrated with Islamic contexts and those taught using Direct Instruction. The study employed a quantitative quasi-experimental method using a post-test-only nonequivalent group design. The sample consisted of 28 students in the experimental class and 23 students in the control class selected through cluster sampling. The research instrument was an essay test of mathematical representation ability that satisfied the required validity and reliability criteria. Data were analyzed using the Mann–Whitney U test at a 5% significance level, followed by effect size analysis. The results showed that the experimental class obtained a higher mean post-test score (84.54) than the control class (72.43). The Mann–Whitney U test indicated a statistically significant difference in the distribution of post-test scores between the two groups* ($U = 186.50$, $Z = -2.623$, $p = .009$)*. The rank-biserial correlation coefficient of 0.421 indicated a small effect. Within the context of this study, students in the experimental class obtained higher post-test mathematical representation scores than students in the control class.*

1. Introduction

Mathematical representation skills are among the key skills students need to acquire in mathematics education. The National Council of Teachers of Mathematics (NCTM) identifies representation as one of the five process standards that must be developed in mathematics education, along with problem solving, reasoning and proof, communication, and mathematical connections [1]. Through representations, students can organize, record, and communicate mathematical ideas to understand concepts and solve the problems they encounter [1]. Mathematical concepts such as symbols, equations, words, pictures, tables, graphs, manipulatives, and even mental images can be expressed, explained, and further developed through representations [2]. Therefore, mathematical representation skills play a crucial role in helping students develop conceptual understanding and express their mathematical thinking more meaningfully.

Goldin and Kaput explain that mathematical representations are various forms of configurations, such as characters, symbols, images, and concrete objects, used to represent abstract ideas in mathematics [3]. Van de Walle similarly states that representation is a way for students to express and communicate mathematical ideas through symbols, diagrams, graphs, and manipulatives [4]. Mathematical representation skills can take three main forms: visual,

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symbolic, and verbal representation. Visual representation refers to presenting information in the form of images, tables, diagrams, or graphs. Symbolic representation relates to constructing mathematical models and using symbols or mathematical expressions to solve problems. Verbal representation refers to explaining ideas and problem-solving processes in writing, using coherent, logical language [5]. These three forms complement one another in helping students understand concepts, communicate ideas, and determine appropriate problem-solving strategies.

Nevertheless, students' mathematical representation skills remain relatively low. Preliminary observations at a junior high school in Depok indicate that students still struggle to convert problems into diagrams or tables, construct appropriate mathematical models, and explain the steps for solving problems in writing. This situation suggests that students are not yet able to optimally use various forms of mathematical representation in solving the problems presented. In fact, strong mathematical representation skills are necessary so that students can not only arrive at the final answer but also understand the process and reasoning behind their solutions.

One learning approach considered capable of facilitating the development of mathematical representation skills is the Visual Thinking approach. Rivera defines visual thinking in mathematics as a person's ability to form and transform visual images in their mind [6]. Its importance is closely tied to a shift in the understanding of visualization itself, which is no longer viewed merely as an illustration but recognized as a key component of the reasoning process, one that involves deep conceptual understanding, problem-solving, and even mathematical proof [7]. In addition, visualizations help students recognize relationships between concepts, develop problem-solving strategies, and express mathematical ideas through various forms of representation [7]. In line with this, Presmeg identified seven roles of visual thinking in mathematics education, namely: (1) helping students understand problems by representing them visually so that the relationships among the elements in the problem can be identified; (2) simplifying problems through visualization, which allows students to discover a version of the problem that is easier to understand, formalize their understanding of the problem, and identify methods that can be applied to similar problems; (3) helping students see the relationships or connections between problems; (4) accommodating individual learning styles, since each student has their own way of using visual representations when solving problems; (5) replacing computational processes, where solutions to problems can be obtained directly through visual representations without involving calculations; (6) serving as a tool for verifying solutions, that is, checking the accuracy of the answers obtained; and (7) transforming problems into mathematical form through visual representation during the problem-solving process [8].

In this study, the Visual Thinking approach was implemented through four stages: looking, seeing, imagining, and showing and telling [9]. During the "looking" stage, students observe and identify the information in the given problem. The "seeing" stage helps students select and group relevant information and discover connections among it. In the "imagining" stage, students construct visual representations and develop problem-solving strategies based on their visualizations. In the "showing and telling" stage, students present and communicate their thoughts through discussion and written explanations. Through these stages, students are trained to visualize mathematical concepts and are encouraged to construct and express their understanding of mathematics more systematically.

Various previous studies have shown that the Visual Thinking approach has a positive impact on students' various mathematical skills. Abdullah found that it affects students' ability to solve math problems [10]. Khoerunnisa demonstrated that it can improve students' mathematical reasoning skills. These research findings indicate the great potential of Visual Thinking for wider application in mathematics education [11].

Mathematics instruction in madrasahs not only requires selecting appropriate approaches but also necessitates consideration of students' learning environments. One approach is to integrate Islamic contexts into the learning process. Efforts to integrate Islamic values into education are both a strategic step and a philosophical and practical foundation for building an educational system that is oriented not only to the mastery of knowledge but also to the development of students' character, so that they possess noble moral values and good character [12]. Wahyuni emphasized that science cannot be separated from Islamic values, as the two complement each other in shaping students who achieve a balance between intellectual development and spiritual awareness as both servants and vicegerents of Allah on earth [13]. Various mathematical concepts can be introduced through the context of religious activities, such as zakat and inheritance, as well as other phenomena relevant to students' daily lives in madrasahs, thereby making learning more contextual and meaningful. Numerous studies have examined the integration of Islamic contexts into mathematics education, including research on mathematical communication skills and problem-solving [10, 14]. However, research specifically examining the impact of the Visual Thinking approach, when integrated with an Islamic context, on the mathematical representation skills of MTs students remains limited. Therefore, this study addresses this gap by analyzing the effect of the Visual Thinking approach, applied within an Islamic context, on the mathematical representation skills of MTs students.

2. Methods

This study uses a quantitative, quasi-experimental design [15] to analyze the effect of the Visual Thinking approach integrated with Islamic contexts on students' mathematical representation skills. It used a quasi-experimental post-test-only nonequivalent group design with an experimental group and a control group without a pre-test. The experimental group received instruction using the Visual Thinking approach integrated with Islamic contexts, while the control group received Direct Instruction. At the end of the instruction period, both groups were administered a test. The research design is presented in Table 1.

Table 1. Research design.

Class	Treatment	Post-test
Experimental	X	O
Control	–	O

Description:

X : Classes using a Visual Thinking approach integrated with Islamic contexts.

– : Classes using a Direct Instruction model.

O : Post-test result.

The study was conducted at an MTs in Depok during the even semester of the 2025/2026 academic year. The study population consisted of all seventh-grade students, and cluster sampling was used. Class VII-A, with 28 students, was selected as the experimental class, and Class VII-C, with 23 students, was selected as the control class. Permission to conduct the study was obtained from the school administration prior to data collection. All student responses included in this study were anonymized to maintain participant confidentiality.

Instruction in the experimental class used the Visual Thinking approach integrated with

Islamic contexts, while the control class received Direct Instruction. To ensure treatment fidelity, both classes were taught by the same instructor (the researcher). Prior to the intervention, lesson plans were prepared for both groups to ensure consistency in the learning objectives, mathematical content, instructional time allocation, learning activities, assignments, and assessment procedures. Both groups studied the same mathematics topic, received the same instructional duration (four sessions of 2×40 minutes), and completed the same post-test. Thus, the two groups were comparable in terms of instructional content, duration, learning objectives, assessment procedures, and instructor. The primary planned difference between the groups was the instructional approach implemented during the intervention. All instructional sessions were conducted according to the prepared lesson plans. In the experimental class, the Visual Thinking approach was implemented through contextual mathematical problems related to students' lives at the madrasah, incorporating Islamic contexts, whereas the control class received Direct Instruction without these instructional features.

The research instrument was an essay-type test of mathematical representation skills, administered after all treatment sessions had been completed. The test covered three indicators of mathematical representation skills: visual, symbolic, and verbal. Visual representation measured students' ability to present information in pictures, tables, or diagrams. Symbolic representation measured students' ability to construct mathematical models or expressions. Verbal representation assessed students' ability to explain problem-solving processes in writing, in a logical and systematic manner.

The instructional intervention focused on the Grade VII topic of Data Representation (Statistics) in accordance with the Merdeka Curriculum. The learning materials included organizing data into tables, interpreting data, and representing data using bar charts, line graphs, and pie charts. Both the experimental and control classes studied the same mathematical topic. The test blueprint for the mathematical representation ability test is presented in Table 2.

Table 2. Test blueprint for the mathematical representation ability.

Indicator	Question Indicator	Question Number
Visual Representation	When data is presented in tabular form, students can represent mathematical ideas as pie charts, including the percentages or angle measures for each data point, and identify the largest and smallest sectors.	1, 2
Symbolic Representation	When data is presented in the form of a diagram, students can express mathematical ideas as mathematical expressions to determine unknown values using systematic arithmetic operations.	3, 4
Verbal Representation	When contextual problems are presented in the form of data, students can articulate mathematical ideas using words and descriptive text to determine the values being sought and prove the validity of a statement based on the results of their calculations.	5, 6

To provide a clearer illustration of the assessment instrument, one representative test item integrating an Islamic context, together with its summarized scoring criteria, is presented in Table 3.

Table 3 presents a representative test item illustrating how Islamic contexts were incorporated into the assessment while measuring students' visual representation skills. Although only one representative item is presented, all six essay items developed for the instrument underwent the same validation and quality evaluation procedures before being administered in the main study.

Table 3. Representative test item and summary of the scoring criteria.

Mathematical Representation Indicator	Representative Test Item	Score	Criteria
Visual Representation	**Islamic Context:** The problem is situated in the context of Prophet Muhammad SAW's exemplary values of honesty (*sidq*) and trustworthiness (*amanah*) in conducting trade.	4	Correctly determines the missing data, constructs a complete and accurate pie chart, and correctly identifies the largest sector.
	Task: Students are required to determine the number of eggs sold on Saturday, construct a pie chart representing the weekly sales data, and identify the largest sector of the chart.	3	Correctly determines most of the required information and constructs an appropriate pie chart with minor calculation or interpretation errors.
		2	Produces a partially correct solution but makes conceptual or computational errors in constructing or interpreting the pie chart.
		1	Attempts to solve the problem; however, the visual representation is largely incorrect or incomplete.
		0	No response or irrelevant answer.

Before being administered in the main study, six essay items were pilot-tested on 40 eighth-grade students at an MTs in Depok that was not included in the study sample. Prior to the pilot test, content validity was evaluated using the Content Validity Ratio (CVR) involving seven expert validators. Based on Lawshe's criterion, the minimum acceptable CVR value for seven validators was 0.99. Five items (Items 1, 3, 4, 5, and 6) obtained a CVR value of 1.00 and were therefore considered valid, whereas Item 2 obtained a CVR value of 0.71 and was excluded from further analysis.

The remaining items were then subjected to empirical validity testing using Pearson's Product–Moment correlation in IBM SPSS Statistics 25. Item validity was determined by comparing the obtained correlation coefficient (r-count) with the critical correlation value (r-table), and all retained items exceeded the required threshold, indicating satisfactory empirical validity. Reliability analysis was conducted after excluding the item that did not meet the content validity criterion. Instrument reliability was subsequently examined using Cronbach's Alpha, yielding a coefficient of 0.655, which indicates high reliability [16]. Furthermore, item analysis showed that the retained items had discriminating-power indices ranging from weak to good and difficulty indices ranging from moderate to difficult, indicating that the instrument was appropriate for measuring students' mathematical representation ability. The results of the content validity, empirical validity, reliability, discriminating-power, and difficulty-index analyses are summarized in Table 4.

Table 4. Summary of the quality of the final research instrument.

Item	CVR	Empirical Validity	Discriminating Power	Difficulty Index
1	1.00	Valid	Weak	Moderate
3	1.00	Valid	Good	Difficult
5	1.00	Valid	Good	Moderate

Based on the overall instrument analysis, one item representing each indicator of mathematical representation ability (Items 1, 3, and 5) fulfilled all instrument quality criteria and was retained for the final post-test administered to the research participants.

The research procedure was carried out in three stages: preparation, implementation, and conclusion. During the preparation stage, the research team developed instructional materials and research instruments, validated the instruments, and pilot-tested them. During the implementation stage, the experimental class was taught using the Visual Thinking approach with an Islamic context, while the control class received Direct Instruction. After all the material had been taught, both groups were given a test of mathematical representation skills. The final stage involved data processing, analysis of the research results, and drawing conclusions.

The research data were analyzed using IBM SPSS 25. The analysis began with descriptive statistics to describe students' mathematical representation skills within each group using the mean, maximum, minimum, and standard deviation. Next, normality and homogeneity tests were conducted using the Shapiro–Wilk and Levene tests, respectively, as prerequisite tests for the analysis. The results of the prerequisite tests indicated that the data did not meet the assumption of normality. Therefore, hypothesis testing was conducted using the nonparametric Mann–Whitney U test at a 5% significance level to determine differences in mathematical representation abilities between the experimental and control classes. In addition, the effect size was calculated to determine the strength of the influence of applying the Visual Thinking approach with an Islamic context on students' mathematical representation skills.

3. Results and Discussion

3.1. Description of Students' Mathematical Representation Skills

Students' mathematical representation skills were analyzed based on the results of the post-test administered to the experimental and control classes after the entire learning sequence had been completed. A descriptive analysis was conducted to obtain an overview of the students' mathematical representation skills in both classes. The results of the descriptive statistical analysis are presented in Table 5.

Table 5. Statistical description of post-test results on mathematical representation skills.

Statistic	Experimental Class	Control Class
N	28	23
Mean	84.54	72.43
Median	83.00	75.00
Mode	75	83
Std. Deviation	9.601	16.412
Min.	67	33
Max.	100	92

Based on Table 5, the average mathematical representation ability of students in the experimental class was 84.54, while that of the control class was 72.43. These results show that students who received instruction using the Visual Thinking approach integrated with Islamic contexts had higher mathematical representation ability than those who received Direct Instruction. The maximum score in the experimental class was 100, while in the control class it was 92. Overall, these descriptive findings indicate that the experimental class obtained higher post-test scores than the control class.

These results indicate that teaching methods that enable students to observe, visualize, and communicate mathematical ideas can help them gain a deeper understanding of concepts. The findings suggest that the instructional package, which combined the Visual Thinking approach with Islamic contexts, may have helped students relate mathematical concepts to situations relevant to their daily lives at the madrasah, making learning more meaningful.

3.2. *Hypothesis Test Results*

Before testing the hypotheses, normality and homogeneity tests were conducted using the Shapiro–Wilk and Levene tests in IBM SPSS 25. The normality test showed significance values of 0.002 for the experimental group and 0.047 for the control group, both below 0.05, indicating that the data were not normally distributed. In addition, Levene's Test produced a significance value of 0.016, indicating that the variances between the two groups were not homogeneous. Because the post-test scores were not normally distributed, the Mann–Whitney U test was used to compare the score distributions between the two groups.

A hypothesis test was conducted to determine whether there was a difference in mathematical representation skills between students taught using the Visual Thinking approach integrated with Islamic contexts and those taught using Direct Instruction. The hypothesis test results are presented in Table 6.

Table 6. Results of the Mann–Whitney U test.

Statistic	Results
Mann–Whitney U	186.500
Z	-2.623
Asymp. Sig. (2-tailed)	0.009
Significance Level	0.05

The experimental group obtained a higher mean rank (30.84) than the control group (20.11), with sums of ranks of 863.50 and 462.50, respectively. The Mann–Whitney U test indicated a statistically significant difference in the distribution of post-test scores between the experimental and control groups ($U = 186.50$, $Z = -2.623$, $p = .009$). These results indicate that students in the experimental class generally obtained higher post-test scores than those in the control class.

3.3. *Effect Size Analysis*

In addition to testing the significance of the differences between the two groups, this study also calculated the effect size to determine the extent of the impact of applying the Visual Thinking approach integrated with Islamic contexts on students' mathematical representation skills. The magnitude of the observed difference was quantified using the rank-biserial correlation coefficient, calculated from the Mann–Whitney U statistic [17].

Based on the calculations, an effect size of 0.421 was obtained. This value falls into the small category [18], indicating a small observed effect associated with the instructional approach implemented in this study on students' mathematical representation skills.

Nevertheless, the hypothesis test shows a significant difference between the experimental and control classes. These findings indicate that students taught using the combined instructional approach demonstrated higher post-test mathematical representation scores than those receiving Direct Instruction.

3.4. *Analysis of Mathematical Representation Skills Based on Indicators*

The following discussion presents descriptive comparisons across the three representation indicators. No separate inferential statistical tests were conducted for each indicator; therefore, the interpretation is limited to descriptive differences. The analysis of mathematical representation skills was conducted not only as a whole but also based on indicators of visual, symbolic, and verbal representation. The achievement percentages for each indicator are presented in Table 7.

Table 7. Percentage of mathematical representation skills based on indicators.

Indicator	Experimental Class (%)	Control Class (%)
Visual Representation	93.74	52.17
Symbolic Representation	74.11	81.52
Verbal Representation	85.71	83.70

Based on Table 7, the visual representation indicator achieved the highest percentage in the experimental class (93.74%), while the control class scored 52.17%. This difference shows that the experimental class outperformed the control class on visual representation. For the symbolic representation indicator, the control class's percentage was higher than that of the experimental class, at 81.52% and 74.11%, respectively. This indicates that the control class outperformed the experimental class on symbolic representation. As for the verbal representation indicator, the experimental class achieved 85.71%, while the control class achieved 83.70%. This shows a slight advantage for the experimental class in verbal representation. These differences suggest that the Visual Thinking approach within an Islamic context was associated with higher performance for visual representation, while the control class performed better in symbolic representation, and both classes showed similar results in verbal representation.

These findings suggest that students demonstrated different levels of achievement across the three mathematical representation indicators following the implementation of the Visual Thinking approach integrated with Islamic contexts. In practical terms, the approach appears to support visual representation more strongly, while its effects on symbolic and verbal representation are less consistent. A more detailed discussion of each indicator is outlined below.

To provide qualitative support for the quantitative findings, representative samples of students' written responses are presented for each mathematical representation indicator. The responses were purposively selected to illustrate the most representative characteristics of students' performance, including both high-quality solutions and responses containing representative errors commonly observed in each group.

3.5. Post-Test Results for the Visual Representation Indicator

The high level of visual representation achieved in the experimental class closely aligns with the characteristics of the Visual Thinking approach, which positions visualization as a crucial part of the learning process. This alignment is evident because the "looking" and "seeing" stages help students identify, select, and connect relevant information before constructing visual representations [9]. These findings further support Ayna and Sari's explanation that Bolton's stages help students recognize objects, construct mental images, and communicate their understanding of mathematical concepts [19].

Based on Figure 1, students accurately converted the provided information into a visual format. They identified the necessary elements for presenting data and used visual representations to solve problems, indicating that they organized information and presented it meaningfully. These findings are consistent with Abdullah's research, which shows that the Visual Thinking approach can help students identify and visualize important information, improving their understanding of mathematical problems [10]. They also support Andriani's view that mathematical representations bridge abstract and concrete thinking, helping students visualize and manipulate mathematical concepts more effectively [20].

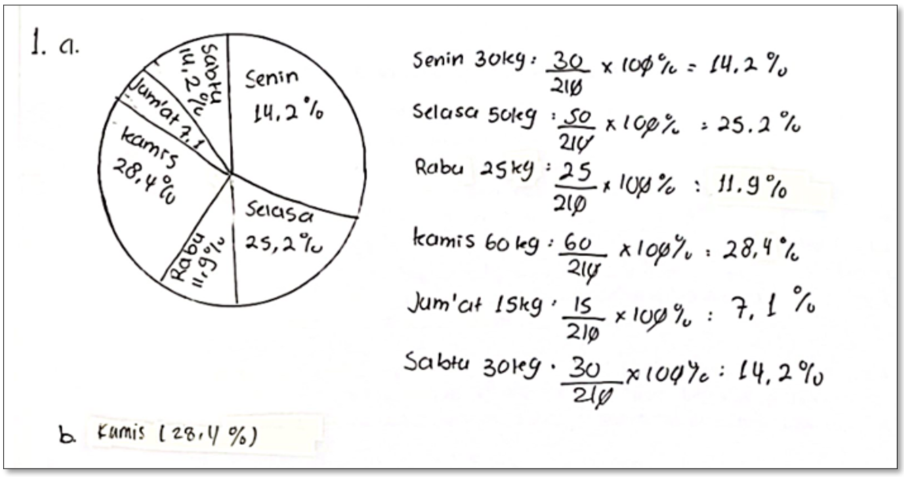

Figure 1. Answers from students in the Visual Thinking class on the visual representation indicator.

3.6. Post-Test Results for the Symbolic Representation Indicator

In contrast to visual representation indicators, the percentage of symbolic representation was higher in the control class than in the experimental class. This shows that the Visual Thinking approach did not result in higher achievement across all forms of mathematical representation.

Symbolic representation skills relate to students' ability to construct mathematical models, use mathematical symbols or expressions, and perform mathematical manipulations accurately to solve problems [21]. The results of the study show that students in the control group were more skilled at performing calculations and writing appropriate mathematical models, which supports the finding that their symbolic representation was higher.

One possible explanation for this finding is the instructional characteristics of Direct Instruction, which emphasize teacher modeling, explicit demonstrations of problem-solving procedures, and routine practice focused on the accurate use of mathematical symbols. These instructional features may provide students with more opportunities to practice symbolic manipulation systematically, thereby supporting their procedural fluency. This interpretation is consistent with Arends' view that Direct Instruction employs a step-by-step approach to strengthen students' understanding of procedural knowledge and factual information [22]. It also aligns with the findings of Rahmasafitri, Suriansyah, and Rafianti, who reported that Direct Instruction emphasizes structured teaching and systematic mastery of fundamental concepts and procedures, making it particularly appropriate for mathematics topics requiring procedural accuracy [23].

In contrast, in the experimental class, students were guided toward understanding through visualization and conceptual exploration. The "looking" and "seeing" stages helped them understand the information provided, while the "imagining" stage encouraged them to develop problem-solving strategies from the visualizations they created [9]. A stronger emphasis on conceptual understanding may help students develop appropriate problem-solving strategies; however, this emphasis may not always be accompanied by the same level of accuracy in manipulating mathematical symbols. As a result, some students still make errors in calculations or symbol use, even though their problem-solving strategies are appropriate. This situation aligns with the findings of Marlinda Sari and Ratih Handayani, who concluded that students in both the high- and moderate-performing groups on the symbolic representation indicator can create mathematical models but are less careful when substituting values into formulas, leading to incorrect answers [24].

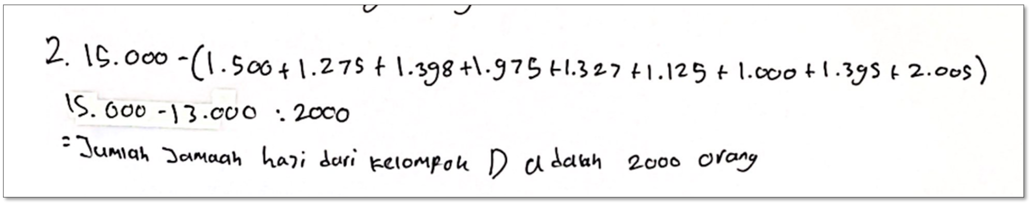

Figure 2. Answers from students in the Direct Instruction class on the symbolic representation indicator.

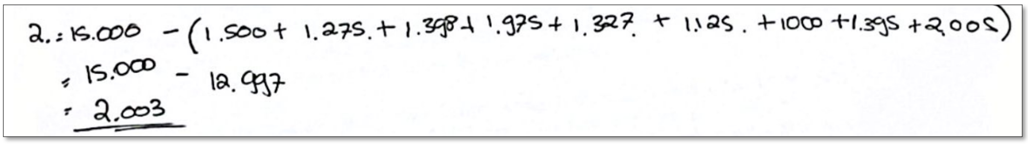

Figure 3. Answers from students in the Visual Thinking class on the symbolic representation indicator.

Based on Figure 3, students in the experimental class could determine appropriate problem-solving strategies but still made errors in manipulating mathematical symbols. In contrast, Figure 2 shows that students in the control class were more systematic in writing mathematical models and performing arithmetic operations. These findings support the quantitative results and indicate that the percentage of symbolic representations among students in the control class was higher than that in the experimental class.

Errors in symbolic representation may also stem from students' lack of understanding of the problem's meaning. This aligns with Rohman's view in Marlinda Sari and Ratih Handayani, who state that students make mistakes when writing mathematical expressions because they do not fully understand the problem's meaning, which leads to inaccurate or misperceived answers [24]. The results of this study indicate that the Visual Thinking approach is effective in helping students understand concepts and build visual representations, but it still requires reinforcement through more structured exercises to optimize symbolic representation skills. Therefore, teachers should provide symbolic manipulation exercises in stages while still allowing students opportunities to explore ideas through visualization.

Overall, these findings suggest that each learning approach has different strengths. Direct Instruction tends to better support procedural mastery, while Visual Thinking emphasizes conceptual understanding. Therefore, students' mathematical representation skills must develop in balance so they can understand concepts and use mathematical symbols appropriately.

3.7. Post-Test Results for the Verbal Representation Indicator

For the verbal representation indicator, the difference between the two groups is relatively small; however, these results suggest that students taught using the Visual Thinking approach with an Islamic context had a slightly better ability to communicate mathematical ideas in writing.

Verbal representation skills require students to explain the steps in solving a problem, justify the strategies used, and draw conclusions from the results. In the Visual Thinking approach, these skills are facilitated through the "showing and telling" stage, during which students are asked to present their thoughts either through discussion or written explanations [9]. This activity helps students organize their ideas more clearly before communicating them to others.

Through presentations and discussions, students not only practice presenting their final answers but also learn to explain the reasoning behind each step of the solution. This helps students develop coherent and logical arguments. In contrast, students in the control group tended to focus more on solving problems based on the teacher's examples, which limited their opportunities to explicitly articulate their thought processes. This finding is consistent with research comparing Problem-Based Learning and Direct Instruction, which shows that student-centered learning is more effective at fostering critical thinking, problem-solving, and independent knowledge construction, whereas Direct Instruction emphasizes the systematic mastery of concepts and procedures [23]. These learning opportunities may have provided students in the experimental class broader opportunities to communicate their mathematical ideas and reasoning, thereby fostering better development of their verbal representation skills. This is consistent with the findings of Mujahidah et al., who demonstrated that learning models that encourage exploration and active student engagement are more effective in developing higher-order cognitive skills than passive learning approaches [25].

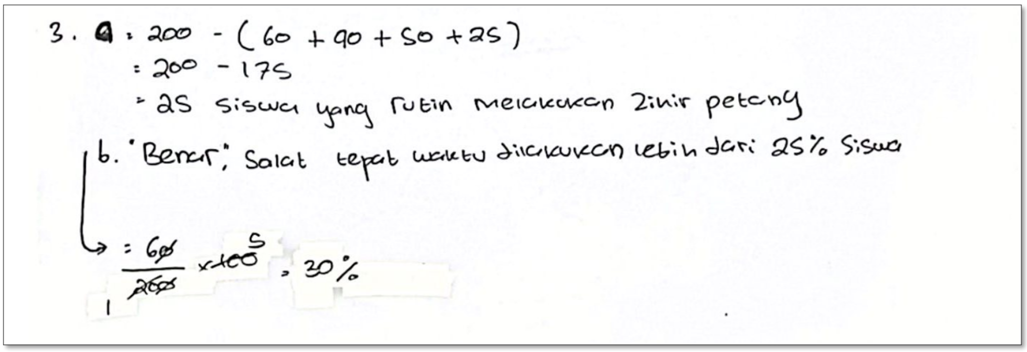

Figure 4. Answers from students in the Visual Thinking class on the verbal representation indicator.

Based on Figure 4, students could explain the problem-solving process coherently in writing. They not only wrote the final answer but also explained their steps and drew conclusions from the results. This shows the development of students' verbal representation skills in communicating mathematical ideas in writing.

The results of this study indicate that learning that gives students space to explain and discuss mathematical ideas can support the development of verbal representation skills. These findings are supported by research by Hartawan and Suparta, who concluded that the Visual Thinking approach positively affects students' mathematical abilities because student-centered learning encourages them to actively communicate their ideas and construct their own knowledge, ultimately improving their ability to express mathematical ideas verbally [26]. Therefore, teachers need to provide broader opportunities for students to communicate their thought processes through group discussions, presentations, or written explanations, so that their verbal representation skills can develop optimally.

4. Conclusion

Based on the findings of this study, students in the experimental class who were taught using the Visual Thinking approach integrated with Islamic contexts obtained higher post-test mathematical representation scores than students in the control class who received Direct Instruction. These findings suggest that implementing the Visual Thinking approach integrated with Islamic contexts may support students in understanding, organizing, and communicating mathematical ideas through various forms of representation. At the indicator level, the largest descriptive difference was observed in visual representation, whereas symbolic representation showed higher performance in the control class, and verbal representation was relatively similar between the two groups.

Within the context of this study, these findings suggest that the Visual Thinking approach integrated with Islamic contexts may serve as a promising instructional alternative for mathematics learning in settings similar to the participating classes. Therefore, teachers may incorporate visualization activities and structured opportunities for students to communicate their mathematical thinking in order to foster richer conceptual understanding and mathematical expression.

This study is limited by its relatively small sample size and the use of a post-test-only nonequivalent group design. Because no pre-test was administered, baseline equivalence between the experimental and control groups could not be directly established. Therefore, the findings should be interpreted as evidence of differences observed after the intervention rather than definitive proof of causal effects. Furthermore, because the intervention combined the Visual Thinking approach with Islamic contexts, the individual contribution of each component could not be examined separately. Consequently, the findings should be interpreted as reflecting the combined instructional approach implemented in this study.

Future research employing pre-test–post-test designs, additional baseline measures, and comparison groups that separately examine the Visual Thinking approach and Islamic contexts is recommended to strengthen causal interpretation. Furthermore, the findings should be interpreted within the context of the two participating classes and should not be generalized beyond similar educational settings without further investigation involving additional schools, classes, and larger samples.

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