p-ISSN: 2086-4280
e-ISSN: 2527-8827

The Effectiveness of The Mathematics in Context Approach on Students' Problem-Solving Ability

Irianto Aras[1*], Turmudi[2], Tatang Herman[3], Ejen Jenal Mutaqin[4], Asdar Muhammad Nur[5]

[1*,2,3,4]Elementary School Teacher Education Program, Universitas Pendidikan Indonesia
Jalan Dr. Setiabudhi No. 229, Kota Bandung, West Java, Indonesia
[1*]aras_irianto@upi.edu; [2]turmudi@upi.edu; [3]tatangherman@upi.edu; [4]jenal86mutaqin@upi.edu

[5]English Education Department, University of Galway
University Road, Galway, Irlandia
[5]a.nur2@universityofgalway.ie

Article received: 19-12-2025, revision: 16-01-2026, published: 31-01-2026

Abstrak
Pembelajaran matematika memerlukan pendekatan relevan untuk mengembangkan kemampuan pemecahan masalah kompleks. Penelitian ini bertujuan mengevaluasi efektivitas pendekatan Mathematics in Context (MiC) terhadap kemampuan pemecahan masalah matematika siswa kelas V di tiga sekolah dasar Kabupaten Pinrang. Penelitian dilakukan sebanyak 17 pertemuan menggunakan bahan ajar dan panduan guru yang telah divalidasi ahli. Data dikumpulkan melalui instrumen pretes dan postes yang mengukur lima aspek pemecahan masalah: analisis, desain, eksplorasi, implementasi, dan verifikasi. Hasil analisis menunjukkan adanya perbedaan rata-rata kemampuan siswa yang signifikan sebelum dan sesudah perlakuan di ketiga sekolah. Berdasarkan skor N-Gain, pendekatan MiC terbukti cukup efektif meningkatkan kemampuan pemecahan masalah siswa; aspek analisis, desain, dan eksplorasi berada pada kategori sedang, sementara aspek implementasi dan verifikasi berada pada kategori rendah. Temuan ini menyimpulkan bahwa pendekatan MiC efektif dalam membantu siswa memahami dan merancang strategi penyelesaian, namun kurang optimal dalam meningkatkan kemampuan prosedur penyelesaian (implementasi) dan verifikasi jawaban.
***Kata Kunci**: Pemecahan Masalah Matematis; Matematika dalam Konteks; Sekolah Dasar.*

Abstract
Mathematics education aims to cultivate students' ability to solve complex mathematical problems, necessitating the use of relevant pedagogical approaches. This study evaluates the effectiveness of the Mathematics in Context (MiC) approach on the mathematical problem-solving skills of fifth-grade students across three elementary schools in Pinrang Regency. The intervention was conducted over seventeen sessions using MiC-based instructional materials and teacher guides validated by experts. Data were collected via pre-test and post-test instruments measuring five dimensions of problem-solving: analysis, design, exploration, implementation, and verification. Analysis revealed a significant difference in mean problem-solving scores before and after the MiC intervention across all schools. N-Gain analysis results indicate that the MiC approach is moderately effective in enhancing student performance; specifically, the analysis, design, and exploration aspects reached the "medium" category, while implementation and verification remained in the "low" category. These findings suggest that while the MiC approach effectively supports students in understanding and designing problem-solving strategies, it is less optimal in improving procedural execution and solution verification.
Keywords: Mathematical Problem-Solving; Mathematics in Context; Elementary School.

I. INTRODUCTION

Mathematics education in the global era is undergoing a paradigm shift from merely mastering procedures toward developing higher-order thinking competencies, in which mathematical problem-solving ability holds a central position (Lewis, 2020). This ability is not only an indicator of success in international assessments such as PISA (Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study) but also forms the foundation for preparing students to face 21st-century challenges. However, the 2022 PISA report consistently reveals that Indonesian students, including those at the elementary school level, remain weak in one aspect of creative thinking, namely social problem solving and scientific problem solving (OECD, 2022).

Initial test results from several elementary schools in Pinrang Regency during the 2023-2024 period show a similar trend. In this case, the researcher used problem-solving questions from Ford (1994), which consist of questions solvable in a single step, two or more steps, and reasoning questions. The results indicate that 87% of students could only answer single-step questions. This shows that students' abilities are oriented only toward questions with direct answers, while they struggle or are unable to answer problem-solving oriented questions.

The problem-solving procedure is related to students' ability to analyze information and questions in a problem, design a solution strategy, explore possible solution strategies, implement the designed problem-solving plan, and verify the answer (Schoenfeld, 1982). In response to this challenge, various innovative learning approaches have been developed. One promising approach is Mathematics in Context (MiC). The differences between Mathematics in Context and traditional teaching lie in its philosophy, the mathematical content it encompasses, and its instructional methods (Meyer, 1997). The MiC design incorporates a "bottom-up" approach using visual models, allowing students to connect their informal understanding of familiar contexts to powerful mathematical concepts through formal mathematical representations (Pligge et al., 2000).

MiC is a mathematics learning approach developed by the Freudenthal Institute, based on the theory of Realistic Mathematics Education (RME). The core of MiC is positioning mathematics as a human activity, where mathematical concepts emerge and develop from meaningful real-world situations (contextual problems) for students (De Corte et al., 2000). Through MiC, students are encouraged to construct their own knowledge through the process of mathematization, both horizontal mathematization (transforming real-world problems into mathematical models) and vertical mathematization (developing these models into more formal mathematical concepts) (Gravemeijer et al., 2002). Furthermore, through the MiC approach, which involves contextual problems in learning, students can become accustomed to problem solving, as MiC is developed not to teach technical skills, but to teach students to solve non-routine problems (T A Romberg & Shafer, 2005; Thomas A. Romberg et al., 2005; Thomas A Romberg &

p-ISSN: 2086-4280
e-ISSN: 2527-8827

Meyer, 2001; Thomas A Romberg & Shafer, 2004)

In addition to familiarizing students with the problem-solving process, the MiC approach can also address teachers' difficulties in teaching problem solving. One major difficulty for teachers is how to implement problem-solving strategies in the classroom (Siswono et al., 2017). Although teachers are aware of the benefits of problem solving for students (Yavuz & Erbay, 2015), they often still emphasize memorizing facts and concepts in their teaching. This may occur because teachers do not know how to teach problem solving (Palraj et al., 2017). Through MiC learning, which provides contextual problems for students to discuss, teachers can be helped in guiding students to become accustomed to solving problems—from understanding the problem, planning a solution strategy, exploring possible solutions, carrying out the solution procedure, and verifying the answer.

Numerous studies in Indonesia show that the MiC approach contributes to creative thinking ability (Dwidayati et al., 2020), mathematical communication (Riawati et al., 2020), mathematical representation (Saputra et al., 2020), and problem-solving ability (Nanang, 2018). Nevertheless, the specific focus of the MiC approach on problem-solving ability, particularly regarding non-routine and open-ended problems, still requires deeper exploration. Therefore, research examining the effectiveness of the Mathematics in Context (MiC) approach on elementary school students' mathematical problem-solving ability is highly relevant and urgent. This research is expected to provide valid empirical evidence on the extent to which this approach can serve as an alternative solution to overcome students' weaknesses in problem solving. The findings of this study can provide valuable input for curriculum developers, teachers, and educational policymakers in efforts to reform elementary mathematics education to be more meaningful, relevant, and capable of equipping students with 21st-century skills.

II. METHOD

This study is a quasi-experimental research that involves administering a treatment to three groups of students across three elementary schools in Pinrang Regency. The research design employed is a three-group experiment (see Table 1), where all groups receive the same treatment. A control group was not utilized due to the fact that each school had only one class cohort per grade level, making a control group impractical for this setting.

The research was conducted across three different schools to investigate whether the MiC approach demonstrates consistent influence and effectiveness in improving students' mathematical problem-solving abilities, even when implemented by different teachers, with different student populations, and in schools with varying characteristics.

Table 1.
Research Design

Group	*Pretest*	*Treatment*	*Posttest*
Kelas V SDN 133	O_1	X	O_2
Kelas V SDN 266	O_1	X	O_2
Kelas V SDN 175	O_1	X	O_2

The research was conducted over 17 sessions, covering topics on integers, prime numbers, factors and multiples, and decimals. Prior to implementing the Mathematics in Context (MiC) learning intervention, student MiC books and corresponding teacher guides were developed. These materials were subsequently validated by experts to ensure their suitability for use in learning. Five validators, comprising both experts and practitioners, concluded that both the student books and teacher guides were suitable for use, with an average validity score of 4.7 (indicating *very valid*).

To ensure consistent treatment across the three sample schools, the researcher conducted a perception alignment session via a Focus Group Discussion (FGD) with the three teachers who would implement the instruction prior to the application of the MiC approach. The FGD covered discussions on the mapping of content for each session, lesson plans, and the procedures for guiding students in discussions related to the tasks assigned during MiC-based learning.

The population of this study comprises all fifth-grade elementary school students in Pinrang Regency. To ensure sample relevance to the research objectives, a purposive sampling method was employed. An initial test of students' problem-solving abilities was conducted using Ford (1994) problem-solving ability test. The results of this preliminary test identified several schools with low average problem-solving abilities. Based on these test results, along with consideration and input from the local education office, three schools were selected: SD Negeri 175 Pinrang, SD Negeri 133 Pinrang, and SD Negeri 266 Pinrang. Each school provided one class group, resulting in a total of 50 students from the three schools.

Data was collected using pretest and posttest instruments designed to measure problem-solving ability based on Schoenfeld's (1982) problem-solving aspects: analysis, design, exploration, implementation, and verification. Each test item was meticulously developed according to specified indicators to ensure comprehensive assessment. The pretest and posttest each consisted of four mathematical problem-solving items.

These items were then verified by experts and piloted to examine their item validity and reliability. The pilot test, conducted with 25 students, showed that all items were valid with r values greater than the r-table value (0.396). The instruments also demonstrated high reliability, with a Cronbach's alpha of 0.883 for the pretest and 0.768 for the posttest.

Below is an example of a problem presented in the problem-solving instrument:

"Mrs. Rani wants to make snack packages to distribute at her child's birthday party. She has 60 packs of crackers and 90 packs of candy. Mrs. Rani wants all packages to contain the same number of each snack item, with no leftovers. What is the maximum number of packages Mrs. Rani can make? If Mrs. Rani wants to make fewer packages than the maximum, can the snacks still be divided equally? Explain other possible numbers of packages that could be used without any leftovers."

Student responses to the problem-solving questions were scored according to the problem-solving stages of analysis, design, exploration, implementation, and verification, using the following criteria:

Analysis

- *3 Points*: Correctly and completely writes down the known information from the problem and correctly states what is being asked.
- *2 Points*: Correctly writes down the known information but it is incomplete, or states what is being asked but with minor inaccuracies.
- *1 Point*: Writes down the known information incorrectly or not at all, and/or is unable to identify the problem being asked.

Design

- *3 Points*: The planned problem-solving strategy is written completely, clearly, logically, and appropriately.
- *2 Points*: A problem-solving strategy is proposed but is somewhat inappropriate or incomplete.
- 1 Point: A problem-solving strategy is written but is unsuitable for solving the problem.

Exploration

- *3 Points*: Explores the planned strategy and correctly determines whether it is valid or not.
- *2 Points*: Explores the planned strategy but is less precise in determining whether their proposed strategy is correct.
- *1 Point*: Explores the planned strategy but cannot determine whether it is correct or not.

Implementation

- *3 Points*: Performs calculations according to the solution plan; the procedure and calculations are correct and complete, and the final answer is correct.
- *2 Points*: Performs calculations according to the solution plan; the procedure and calculations are incomplete or contain errors, but the final answer is correct.
- *1 Point*: Calculations do not follow the solution plan; the procedure and calculations are incomplete, incorrect, and the final answer is wrong.

Verification

- *3 Points*: Verifies the final result and provides a conclusion about the process and outcome; the final statement directly answers the question posed in the problem.
- *2 Points*: Verifies the answer but provides an incomplete conclusion about the process and outcome; the final statement addresses the question but is incomplete.
- *1 Point*: Attempts to verify the answer but cannot conclude whether their procedure and result are correct. Does not provide a final statement

The problem-solving ability data obtained from the pretest and posttest results were analyzed using a paired sample t-test. Prior to conducting this test, data prerequisites were first confirmed through prerequisite tests (normality test). The hypotheses to be tested are as follows:

H_0: There is no difference in the average scores of students' mathematical problem-solving ability tests before and after the implementation of the MiC approach.

H_1: There is a difference in the average scores of students' problem-solving ability tests before and after the implementation of the MiC approach.

The decision rule for the hypothesis test is: if the sig. (2-tailed) value is less than the predetermined significance level (0.05), then H_0 is rejected and H_1 is accepted. Conversely, if the significance value is greater than or equal to 0.05, then H_0 is accepted and H_1 is rejected.

To determine the effectiveness of the MiC approach on problem-solving ability, an analysis of normalized gain was conducted. The method for obtaining the normalized gain according to Hake (1999) is as follows:

$$<g>=\frac{\bar{x}_{post}-\bar{x}_{pre}}{100\%-\bar{x}_{pres}}$$

$<g>$: N-Gain

$\bar{x}_{post}$: Average Posttest Score

$\bar{x}_{pre}$: Average Pretest Score

The results of the N-gain calculation were then categorized into several criteria as shown in Table 2 (Hake, 2002).

Table 2.
N-Gain Categories

Average *N-Gain*	Categoty
$(<g>)\geq 0,7$	High
$0,3\leq(<g>)<0,7$	Medium
$(<g>)<0,3$	Low

To determine whether there is a difference in the effectiveness of the MiC approach across the three schools, a one-way ANOVA test was conducted on the student gain data from the three schools. If the test result shows a significance value > 0.05, then the effectiveness of the MiC approach is the same across the three schools. However, if the test result shows a significance value < 0.05, then the effectiveness differs among the three schools.

III. Result and Discussion

The pretest and posttest results were used to measure students' problem-solving abilities. Before implementing learning with the MiC approach, students' problem-solving abilities were first measured using a pretest. Subsequently, the MiC approach was implemented over 17 learning sessions in each school. At the end of these sessions, problem-solving ability was measured again using a posttest. The average problem-solving ability results from both the pretest and posttest for each school are presented in the following Table 3.

Table 3.
Pretest and Posttest Results of Problem-Solving Ability

Scholl	*N*	*Test*	*Average*	*Std. Dev*
SDN 133	14	*Pretest*	34,05	12,25
		Posttest	58,33	11,53
SDN 266	16	*Pretest*	29,58	11,27
		Posttest	60,21	12,29
SDN 175	20	*Pretest*	36,83	14,50
		Posttest	62,08	14,32

Based on the pretest and posttest results from the three elementary schools, the findings reveal an improvement in mathematical problem-solving ability following the implementation of the MiC approach. The pretest and posttest data show a consistent pattern of increase in average scores across all research groups. Initial pretest scores ranged from 29.58 to 36.83, then increased significantly to a range of 58.33 to 62.08 in the posttest period, representing an increase of 24.28 to 30.63 points. Specifically, the results for problem-solving in the pretest and posttest

p-ISSN: 2086-4280
e-ISSN: 2527-8827

are detailed across various problem-solving aspects as follows in Table 4.

Table 4.
Pretest and Posttest Results for Each Problem-Solving Aspect

School		Problem Solving Aspects				
		Analysis	*Design*	*Exploration*	*Implementation*	*Verification*
SDN 133	*Pre*	57,14	43,33	22,86	9,05	3,81
	Post	74,29	72,38	45,71	26,67	14,29
SDN 266	*Pre*	51,67	33,75	22,08	7,92	2,92
	Post	74,58	71,67	47,50	28,33	18,75
SDN 175	*Pre*	54,67	41,67	28,67	14,33	7,67
	Post	75,33	73,33	51,67	28,67	19,33

The pretest and posttest data measuring the five aspects of problem-solving analysis, design, exploration, implementation, and verification show a consistent pattern of improvement across all research groups. Overall, an increase was observed in all problem-solving aspects across the three schools.

The aspects of analysis and design showed the highest posttest achievement, reaching a range of 74-75 for analysis and 71-73 for design. Meanwhile, the exploration aspect showed a fairly significant increase from a range of 22-29 to 46-52. However, the most notable improvements were in the implementation and verification aspects, although their absolute scores remain relatively low compared to the others. The implementation aspect increased from 7-14 to 26-29, while verification rose from 3-8 to 14-19.

Analysis revealed a consistent pattern across the three schools, where the order of ability from highest to lowest remained the same between the pretest and posttest. This indicates that while the intervention successfully improved all aspects of problem-solving ability, the greatest challenge still lies in developing students' skills in implementing procedures and verification.

To ensure that the improvement in students' mathematical problem-solving ability was genuinely caused by the learning intervention using the MiC approach, a paired sample t-test was conducted for each student group, preceded by a normality test as a prerequisite.

Table 5.
Normality Test Results

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest SDN 133	.155	14	.200*	.934	14	.347
Posttest SDN 133	.200	14	.133	.940	14	.420
Pretest SDN 266	.208	14	.102	.887	14	.073
Posttest SDN 266	.203	14	.121	.925	14	.262
Pretest SDN 175	.165	14	.200*	.959	14	.713
Posttest SDN 175	.219	14	.068	.913	14	.172

Based on Table 5, the results of the normality test conducted using two statistical methods, namely Kolmogorov-Smirnov and Shapiro-Wilk, on the pretest and posttest data from the three schools (SDN 133, SDN 266, and SDN 175), it can be concluded that all data are normally distributed, thus allowing for the continuation with the t-test (paired sample t-test). This conclusion is based on the significance values (Sig.) obtained from both tests, where all significance values are greater than α = 0.05.

Table 6.
Paired Sample T-Test Results

Sekolah	Stand. Error Mean	t	df	Sig. (2-tailed)
SDN 133	2.9633	8.195	13	0,000
SDN 266	2.508848	12.208	15	0,000
SDN 175	1.91385	13.237	19	0,000

Referring to Table 6, the results of the paired sample t-test analysis conducted on the pretest and posttest data from the three schools, it can be concluded that there is a statistically significant difference between the pretest and posttest scores in each school. The t-test results show a significance value (p-value) of 0.000 for all three schools, which is below the significance level of α = 0.05.

This finding indicates that the MiC approach has a significant influence on improving students' problem-solving abilities in all three elementary schools. The consistently high t-statistic values across all schools suggest a substantial effect size, while the uniform p-value of 0.000 confirms the statistical significance of these findings. Therefore, it can be concluded that the observed improvement in students' problem-solving ability is not due to chance, but is genuinely a result of the intervention provided.

From the paired sample t-test results, it was obtained that the MiC approach significantly influences the improvement of students' problem-solving abilities. To understand the extent of its effectiveness, an N-Gain analysis was performed on the pretest and posttest results of problem-solving ability, both overall and for each specific aspect.

Table 7.
Effectiveness of the MiC Approach for Each Problem-Solving Aspect

School		Problem Solving Aspects				
		Anlys	Dsgn	Exp	Impl	Ver
SDN 133	N-Gain (<g>)	0,40	0,51	0,31	0,19	0,11
	Category	Medium	Medium	Medium	Low	Low
SDN 266	N-Gain (<g>)	0,47	0,57	0,33	0,22	0,16
	Category	Medium	Medium	Medium	Low	Low
SDN 175	N-Gain (<g>)	0,46	0,54	0,32	0,17	0,13
	Category	Medium	Medium	Medium	Low	Low

The analysis of Table 7, Normalized Gain (<g>) across the five aspects of problem-solving ability reveals interesting variations in intervention effectiveness across the three elementary schools. The data shows a consistent pattern where the design aspect recorded the highest achievement, with N-Gain values ranging between 0.51-0.57, falling into the moderate category.

The analysis aspect followed with values of 0.40-0.47, while the exploration aspect ranged from 0.31-0.33—both also in the moderate category.

However, findings that require special attention pertain to the two final aspects of problem-solving.
The implementation aspect only reached N-Gain values of 0.17 - 0.22, and the verification aspect recorded the lowest values of 0.11 - 0.16, with both classified in the low category.

This pattern was consistent across all three schools, with SDN 266 consistently showing the highest values for almost all aspects, followed by SDN 175 and SDN 133.

These analytical results indicate that while the MiC approach is generally effective in improving problem-solving ability, there is a significant disparity in achievement across different aspects. Mid-level cognitive aspects such as information analysis involved in formulating, designing, and exploring problem-solving plans showed a good response to the intervention. In contrast, applied aspects like implementation and verification require further attention in the instructional process.

Subsequently, to determine whether the effectiveness of the MiC approach on students' mathematical problem-solving ability is consistent across the three schools, a one-way ANOVA test was conducted. This test examines whether there is a difference in the average effectiveness among the three schools. The results of this test are presented in the following Table 8.

Table 8.
One-Way ANOVA Test Results for the Effectiveness of the MiC Approach Across Schools

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	441.685	2	220.843	.817	.448
Within Groups	12711.295	47	270.453		
Total	13152.980	49			

Based on the results of the One-Way ANOVA analysis conducted to compare the effectiveness of the intervention among the three school groups, an F-value of 0.817 with a significance of 0.448 was obtained. This significance value, which is well above $\alpha = 0.05$, indicates that there is no statistically significant difference in the effectiveness of the intervention among the three elementary schools.

This finding suggests that the variation occurring within the groups is far more dominant than the variation between the groups. In other words, the differences in student ability within each school are more prominent than the differences in average ability between the schools. This result strengthens the consistency of the implemented intervention's effectiveness, demonstrating that the intervention proved to work with equivalent effectiveness across all three schools—namely, a moderate level—despite variations in student characteristics at each school.

Overall, the findings of this study confirm that the implementation of the Mathematics in Context (MiC) approach had a significant and consistent impact (in the moderate category) on improving mathematical problem-solving abilities across the three schools studied. This consistency in effectiveness reinforces the theoretical premise of MiC, grounded in Realistic Mathematics Education, which posits that mathematics should be taught as a human activity rooted in authentic contexts, where students gradually build models from informal to formal reasoning (Doorman et al., 2007).

An in-depth analysis revealed that effectiveness was highest in the aspects of Analysis and Design. The moderate achievement in these two aspects indicates that students successfully engaged in the stage of horizontal mathematization—namely, analyzing contextual problems and formulating strategies for solving (modeling) them (Supriatna et al., 2019). Students' ability to engage in planning (design) often shows faster improvement after intervention compared to their execution ability. This is because interventions focused on providing initial strategies (heuristics) are easier for elementary-level students to understand and apply (Sagita et al., 2023). This is supported by literature confirming that authentic contexts facilitate students' identification of variables and formulation of solution steps.

The effectiveness of the MiC approach in problem-solving began to decline in the Exploration aspect, reflecting fundamental difficulties in the process of formalizing the solution strategies they devised. This decline aligns with the presence of a cognitive gap, where students struggle to transition from intuitive, contextual reasoning to abstract, procedural mathematical reasoning (Bradshaw & Hazell, 2017). Consequently, students are often able to design a plan but fail to extensively explore various possible solutions and monitor the process mathematically (Blum & Leiß, 2007).

The most significant disparity in ability was observed in the Implementation and Verification aspects, which consistently fell into the "low" category across all schools. This pattern is a critical indicator often highlighted in problem-solving studies (Schoenfeld, 2016). Low performance in Implementation is linked to weaknesses in conceptual understanding and the procedural mathematical skills essential for processing data (Rittle-Johnson, 2017; Santia et al., 2021). This indicates that students have difficulty executing correct mathematical operations or applying formulas accurately, not due to a lack of ideas for solving the problem (Csáky et al., 2015). Furthermore, low performance in Verification reinforces the finding that critical reflection, validation of conclusions, and evaluation of one's own solutions are higher-order thinking skills (Gradini et al., 2025) often overlooked in pedagogy. Students tend to consider a task complete once they obtain a result and are often disinclined to verify their answers (Yeni et al., 2020).

From the implementation aspect of problem-solving, the Mathematics in Context (MiC) approach conducted has not yet fully evolved into applying mathematics to complex, authentic real-world situations. The learning implemented was still limited to solving context-oriented word problems. Therefore, greater student involvement in long-term investigative projects or open-ended problem-solving is necessary (Nanang, 2018). The lack of an implementation stage involving design, model creation, or simulation prevented students' knowledge transfer abilities in problem-solving from being optimally honed. This represents a shortcoming in the application process of the implemented MiC approach.

Meanwhile, from the verification aspect, there was a weakness in the process of encouraging students to critically check and validate their solutions. The MiC-based learning conducted often merely involved matching final answers with an answer key. To address this, the MiC learning process could incorporate methods such as reflecting on possible alternative solutions, assessing the reasonableness of results based on context, or using digital tools to check for consistency. If the verification process stops only at confirming right or wrong answers without metacognitive discussion, students miss the opportunity to

p-ISSN: 2086-4280
e-ISSN: 2527-8827

develop scientific skepticism and self-evaluation skills crucial for mathematical literacy. Consequently, their conceptual understanding remains shallow, as the focus shifts more toward the final procedural correctness rather than the resilience and reliability of their own thought processes in solving problems.

Furthermore, the low effectiveness in this aspect reflects that teacher interventions during learning tended to limit time or did not provide specific scaffolding for the review and checking process (Kusmaryono et al., 2020). Ultimately, these findings suggest that improvements in MiC implementation must focus on a pedagogical shift from merely seeking answers toward systematically strengthening the processes of interpretation and verification (Schukajlow et al., 2018). This improvement can be achieved by allocating substantial time and providing greater authoritative space for students to discuss, compare diverse solutions, and verify their work—a critical stage that is often still dominated or even neglected by teachers in mathematics instruction.

IV. CONCLUSION

Based on the overall analysis results, it can be concluded that the implemented MiC approach has proven effective in significantly improving students' problem-solving abilities across all three elementary schools. This improvement occurred consistently across all problem-solving aspects, with the highest achievement in the aspects of design and analysis, while the implementation and verification aspects showed more limited improvement.

Statistical tests confirm that the observed improvement is statistically significant, and the data meet the normality assumption. Importantly, there was no significant difference in effectiveness among the three schools, indicating that this MiC approach can function effectively across different student populations, teachers, and school contexts. Overall, the MiC approach successfully enhanced students' mathematical problem-solving abilities with a moderate level of effectiveness, although further reinforcement is needed regarding the implementation and verification aspects.

Based on the research findings, it is recommended to target the strengthening of the implementation and verification aspects within MiC instruction, given that these two aspects demonstrated the most limited improvement—a gap the researcher acknowledges is often minimally addressed by teachers during the learning process. Nonetheless, the consistent effectiveness of the intervention across all three schools supports the replication of the program with appropriate contextual modifications. To address the still considerable variation in individual abilities within each school, the tasks assigned in MiC-based learning should take this factor into account.

The limitations of this study pertain to its location and sample, which were confined to a single district. Although the results demonstrated consistency across schools, its effectiveness cannot be generalized to broader contexts. Another limitation is the absence of a control group, which means there was no direct comparison to illustrate how the MiC approach differs in detail and impact.

Furthermore, the research findings indicated low effectiveness in the aspects of implementation and verification. Upon reflection, the MiC-based learning process as applied did not allocate sufficient time for students to verify each other's answers or the solutions to the assigned tasks, due to constraints in instructional time.

Based on these limitations and shortcomings, the researcher suggests that future studies could be conducted within a broader scope, incorporate a control group, and place greater emphasis on the implementation and verification aspects in mathematical problem-solving processes.

REFERENCES

Blum, W., & Leiß, D. (2007). How do Students and Teachers Deal with Modelling Problems? *Mathematical Modelling*, *1 997*, 222–231. https://doi.org/10.1533/9780857099419.5.221

Bradshaw, Z., & Hazell, A. (2017). Developing problem-solving skills in mathematics: a lesson study. *International Journal for Lesson and Learning Studies*, *6*(1), 32–44. https://doi.org/10.1108/IJLLS-09-2016-0032

Csáky, A., Szabová, E., & Naštická, Z. (2015). Analysis of Errors in Student Solutions of Context-Based Mathematical Tasks. *Acta Mathematica Nitriensia*, *1*(1), 68–75. https://doi.org/10.17846/amn.2015.1.1.68-75

De Corte, E., Verschaffel, L., & Greer, B. (2000). Connecting Mathematics Problem Solving to the Real World. *International Conference on Mathematics Education into the 21st Century: Mathematics for Living*, 66–73.

Doorman, M., Drijvers, P., Dekker, T., van den Heuvel-Panhuizen, M., de Lange, J., & Wijers, M. (2007). Problem solving as a challenge for mathematics education in The Netherlands. *ZDM - International Journal on Mathematics Education*, *39*(5–6), 405–418. https://doi.org/10.1007/s11858-007-0043-2

Dwidayati, N., Junaedi, I., & Rahmawati, N. (2020). *Mathematical Literacy Based on Metacognition on MIC Assisted PBL and Geogebra with Local Culture*. *MiC*. https://doi.org/10.4108/eai.29-6-2019.2290396

Ford, M. I. (1994). Teachers' Beliefs About Mathematical Problem Solving in the Elementary School. *School Science and Mathematics*, *94*(6), 314–322. https://doi.org/10.1111/j.1949-8594.1994.tb15683.x

Gradini, E., Firmansyah B, F. B., Noviani, J., & Ulya, K. (2025). Fostering Higher-Order Thinking Skills in Mathematics Education: Strategies, Challenges, and Classroom Practices. *Prisma Sains : Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *13*(2), 135. https://doi.org/10.33394/j-ps.v13i2.15099

Gravemeijer, K., Lehrer, R., Oers, B. Van, & Verschaffell, L. (2002). Symbolizing, Modeling and Tool Use in Mathematics Education. In *Symbolizing, Modeling* *and Tool Use in Mathematics Education*. Springer. https://doi.org/10.1007/978-94-017-3194-2

Hake, R. R. (1999). Analyzing change/gain scores. *Unpublished. [Online]*

Hake, R. R. (2002). Relationship of individual student normalized learning gains in mechanics with gender, high-school physics, and pretest scores on Mathematics and Spatial Visualization. *Physics Education Research Conference*, *8*(August 2002), 1–14.

Kusmaryono, I., Ubaidah, N., & Basir, M. (2020). The role of scaffolding in the deconstructing of thinking structure: a case study of pseudo-thinking process. *Jurnal Infinity*, *9*(2), 347–262.

Lewis, S. (2020). PISA, Policy and the OECD. In *PISA, Policy and the OECD*. https://doi.org/10.1007/978-981-15-8285-1

Meyer, M. R. (1997). Mathematics in context: Opening the gates to mathematics for all t the middle level. *NASSP Bulletin*, *81*(586), 53–59. https://doi.org/10.1177/019263659708158606

Nanang. (2018). Kemampuan Pemecahan Masalah Matematika Mahasiswa Melalui Pembelajaran Mathematics In Context. *Jurnal Siliwangi: Seri Pendidikan*, *4*(1), 10–16.

OECD. (2022). *PISA 2022 Results Volume III : Creative Minds , Creative Schools*. *III*.

Palraj, S., DeWitt, D., & Alias, N. (2017). Teachers Beliefs in Problem Solving in Rural. *Malaysian Online Journal of Educational Technology*, *5*(4), 45–57. https://doi.org/10.1093/nq/176.16.279-a

Pligge, M. A., Kent, L. B., & Spence, M. S. (2000). *Examining Teacher Change within the Context of Mathematics Curriculum Reform: Views from Middle School Teachers*. 32.

Riawati, B., Dwidayati, N. K., & Rosyida, I. (2020). *Mathematical Communication Ability Reviewed from Student ' s Self-Esteem on MiC Learning Process with Nuance of Jepara Culture*. *9*(1), 1–10.

Rittle-Johnson, B. (2017). Developing Mathematics Knowledge. *Child Development Perspectives*, *11*(3), 184–190. https://doi.org/10.1111/cdep.12229

Romberg, T A, & Shafer, M. (2005). The longitudinal/cross-sectional study of the impact of teaching mathematics using Mathematics in context on student achievement: Implications and …. *Madison, WI: Wisconsin Center for Education Research*.

Romberg, Thomas A., Webb, D. C., Folgert, L., & Shafer, M. C. (2005). Differences in Performance between Mathematics in Context and Conventional Students. *Wisconsin Center for Education Research School of Education -*.

Romberg, Thomas A, & Meyer, M. (2001). Mathematics In Context (MIC). *Madison: Educational Development Center, Inc*.

Romberg, Thomas A, & Shafer, M. C. (2004). *Purpose , Plans , Goals , and Conduct of the Study*. 1–101.

Sagita, D. K., Ermawati, D., & Riswari, L. A. (2023). Kemampuan Pemecahan Masalah Matematis Siswa Sekolah Dasar. *Jurnal Educatio FKIP UNMA*, *9*(2), 431–439. https://doi.org/10.31949/educatio.v9i2.4609

Santia, I., Purwanto, Subanji, Sudirman, & Sutawidjadja, A. (2021). Characteristics of Prospective Student Teacher's Representation in Solving Ill-Well Algebraic Problems. *Journal of Physics: Conference Series*, *1779*(1). https://doi.org/10.1088/1742-6596/1779/1/012001

Saputra, R. A. K., Sukestiyarno, & Dwidayati, N. K. (2020). Self Regelated Through Mathematics in Contexts (Mic) Approach Based on Local Culture Module to Improve Math Representation. *Unnes Journal of Mathematics Education Research*, *11*(1), 55–61. https://journal.unnes.ac.id/sju/index.php/ujmer/article/view/38364

Schoenfeld, A. H. (1982). Expert and Novice Mathematical Problem Solving. *Journal for Research in Mathematics Education*, *13*(1), 31–49. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.879.4394&rep=rep1&type=pdf#page=81

Schoenfeld, A. H. (2016). Learning to Think Mathematically: Problem Solving, Metacognition, and Sense Making in Mathematics (Reprint). *Journal of Education*, *196*(2), 1–38. https://doi.org/10.1177/002205741619600202

Schukajlow, S., Kaiser, G., & Stillman, G. (2018). Empirical research on teaching and learning of mathematical modelling: a survey on the current state-of-the-art. *ZDM Mathematics Education*, *50*(April), 5–18. https://doi.org/10.1007/s11858-018-0933-5

Siswono, T. Y. E., Kohar, A. W., Rosyidi, A. H., & Hartono, S. (2017). Primary school teachers' beliefs and knowledge about mathematical problem-solving and their performance in a problem-solving task. *World Transactions on Engineering and Technology Education*, *15*(2), 126–131.

Supriatna, I., Asmahasanah, S., Rachmadtullah, R., Khair Asdar, A., Fahrudin, & Rasmitadila. (2019). The effect of learning methods and self regulation on problem-solving ability of mathematics in elementary school. *Journal of Physics: Conference Series*, *1175*(1). https://doi.org/10.1088/1742-6596/1175/1/012139

Yavuz, G., & Erbay, H. N. (2015). The Analysis of Pre-service Teachers' Beliefs about Mathematical Problem Solving. *Procedia - Social and Behavioral Sciences*, *174*, 2687–2692. https://doi.org/10.1016/j.sbspro.2015.01.953

Yeni, E. M., Wahyudin, & Herman, T. (2020). Difficulty analysis of elementary school students in mathematical problem solving in solutions. *International Journal of Scientific and Technology Research*, *9*(3), 44–47.

p-ISSN: 2086-4280
e-ISSN: 2527-8827

AUTHOR'S BIOGRAPHY

Irianto Aras, M.Pd.

Born in Pinrang, January 10, 1990. Lecturer at the Elementary School Teacher Education Study Program, Borneo University of Tarakan. The author's education comes from the S1 Mathematics Education level at Muhammadiyah Unversity of Parepare, graduated in 2011, and the S2 Mathematics Education level at State University of Makassar, graduated in 2014, and is currently continuing his doctoral studies at the Indonesian Education University.

Prof. Turmudi, M. Ed., M. Sc., Ph.D.

Born in Ciamis January 12, 1961. Professor at the Indonesian University of Education. Study S-1 Mathematics Education, IKIP Bandung, graduated in 1982; S-2 Mathematics Education, La Trobe University Australia, graduated in 1997; S-2 Instructional Design, Twente University Netherlands, graduate in 1999 and S-3 Mathematics Education, La Trobe University Australia, graduate in 2007.

Prof. Dr. Tatang Herman, M.Ed.

Born in Garut October 11, 1962. Professor at the Indonesian University of Education. Study S-1 Mathematics Education, IKIP Bandung, graduated in 1989; S-2 Mathematics Education, Deakin University Melbourne Australia, graduated in 1996; and S-3 Mathematics Education, Indonesian University of Education, graduated in 2006.

Ejen Jenal Mutaqin, M.Pd.

Born in Garut, July 16, 1986. Lecturer at the Elementary School Teacher Education Study Program, Indonesian Education Institute Garut. The author's education comes from the S1 Elementary School Teacher Education level at the Indonesian Education University Bandung, graduated in 2010, and the S2 Elementary Education level at UPI, graduated in 2013, and is currently continuing his doctoral studies at the Indonesian Education University.

Asdar Muhammad Nur

Born in Maros on September 28, 1989. He is an English lecturer in Universitas Sulawesi Barat. He earned hIS Bachelor's degree in English Education Department from UIN Alauddin Makassar in 2011, and completed his Master's degree in Indonesia University of Education in 2019. He is currently pursuing his PhD in Education at University of Galway.