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The Influence of Realistic Mathematics Education and Learning Discipline on Students' Mathematical Critical Thinking

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Abstract
Students' critical mathematical thinking skills are still relatively low due to the Problem-Based Learning (PBL) instructional strategy. The Realistic Mathematics Education (RME) approach, supported by students' learning discipline, is expected to enhance these abilities. This study aimed to examine the effect of the RME approach and learning discipline, both individually and interactively, on the mathematical critical thinking abilities of grade V students. The research used a quantitative experimental design with a 2x2 factorial model. A total of 60 students were selected using cluster random sampling. Instruments included a critical thinking test and a learning discipline questionnaire. Data were analysed using two-way ANOVA with a significance level of 0.05. Findings show that (1) RME significantly improved critical thinking (mean = 78.45) compared to conventional methods (mean = 70.12), $F(1,56) = 6.84$, $p < 0.05$; (2) students with high discipline scored higher (mean = 80.27) than low-discipline students (mean = 69.34), $F(1,56) = 12.15$, $p < 0.01$; and (3) there was a significant interaction between RME and discipline, $F(1,56) = 4.62$, $p < 0.05$. RME and learning discipline both positively and significantly affect students' mathematical critical thinking abilities.

Keywords: Realistic Mathematics Education; discipline; critical thinking; mathematics learning

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Introduction
Mathematics education in elementary schools plays a crucial role in developing students' critical, logical, and systematic thinking abilities. Nevertheless, many studies indicate that students' critical thinking in mathematics remains relatively low. Students often struggle in connect mathematical material to real-life contexts, so they tend to rely more on memorizing formulas than on developing a deep understanding (Lestari et al., 2023; Septia et al., 2023). One of the main causes of this phenomenon is the implementation of the Problem-Based Learning (PBL) method, which emphasizes solving given problems but pays less attention to conceptual understanding and critical reasoning (Sarnoko et al., 2024).

As an alternative, the Realistic Mathematics Education (RME) approach offers a significant solution. RME encourages students to connect mathematical concepts to everyday situations so they can learn and construct their own knowledge in relevant and meaningful contexts (Utami & Pramudiani, 2024; Nashrullah et al., 2023). Research shows that the

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implementation of RME is effective in improving students' mathematical critical thinking skills (Sutama et al., 2022; Hikayat et al., 2020) . This approach not only helps students understand concepts but also builds their confidence in facing mathematical challenges (Farid et al., n.d.; Orón & Lizasoain, 2023)

In addition to instructional factors, internal factors such as learning discipline play an important role in the development of students' critical thinking skills. High learning discipline is closely related to students' regularity and focus in the learning process. Students with good discipline tend to be better able to develop their critical thinking skills than those who lack discipline in learning (Sutama et al., 2022; Bakar et al., 2024). Active involvement in the learning process, especially through collaborative learning models, can significantly enhance students' critical thinking skills (Syaiful et al., 2022).

To improve the effectiveness of mathematics learning in elementary schools, a combined effort is required through the implementation of the RME approach and the strengthening of students' learning discipline. In this way, mathematics education will not only focus on mastering formulas but also on developing students' critical and logical thinking skills, which are essential for facing future challenges (Akbar et al., 2025; Supianti et al., 2025). Given this background, this study is important to analyze the influence of the RME approach and learning discipline on the mathematical critical thinking abilities of fifth-grade students at SDN Cempaka Baru 05, Central Jakarta. The results of this study are expected to contribute to the development of more effective, context-specific mathematics learning strategies.

Based on the research background, several research problems can be formulated as the focus of this study, first, whether there is a difference in mathematical critical thinking ability between students who learn using the Realistic Mathematics Education (RME) approach and those who learn through Problem-Based Learning (PBL) second, whether there is a difference in mathematical critical thinking ability between students who have a high level of learning discipline and those who have a low level of learning discipline. Third, whether there is an interaction between the learning approaches used, namely RME and PBL, and students' learning discipline levels in influencing mathematical critical thinking ability.

In line with the formulation of the problems above, this study aims to identify and analyze several aspects. First, to determine the difference in mathematical critical thinking ability between students who learn using the RME approach and those who learn using PBL. Second, to determine the difference in mathematical critical thinking ability between students who have high learning discipline and those who have low learning discipline. Third, to examine the interaction between the RME learning approach and students' learning discipline levels in influencing the mathematical critical thinking abilities of fifth-grade students at SDN Cempaka Baru 05, Central Jakarta.

Method

This study used an experimental method with a 2×2 factorial design to examine the effect of the Realistic Mathematics Education (RME) approach and learning discipline, both independently and interactively, on students' mathematical critical thinking ability.

The population of this study comprised all fifth-grade students at SDN Cempaka Baru 05, Central Jakarta, in the 2024/2025 academic year, totaling 120 students. The research sample was selected via cluster random sampling, comprising 60 students. The sample was divided into two groups: the experimental group, which received instruction using the RME approach, and the control group, which received instruction using Problem-Based Learning (PBL).

The independent variables of this study were the learning approach (RME and PBL) and learning discipline (high and low), while the dependent variable was students' mathematical critical thinking ability. The research instruments included a mathematical critical thinking test in the form of essay questions measuring indicators such as identifying problems, analyzing arguments, providing logical reasoning, and drawing conclusions. In addition, a learning

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discipline questionnaire using a Likert scale was administered, covering aspects such as punctuality, rule compliance, learning consistency, and responsibility.

Data were collected through a post-test on mathematical critical thinking ability administered after the treatment and a learning discipline questionnaire completed before the treatment. Data analysis was conducted using a two-way ANOVA at a significance level of 0.05, with prerequisite tests including normality (Kolmogorov–Smirnov) and homogeneity (Levene's Test). If a significant interaction was found, the analysis continued with the Tukey test to identify which groups differed significantly.

Result and Discussion

This study aims to analyze the influence of the Realistic Mathematics Education (RME) approach and learning discipline on the mathematical critical thinking ability of fifth-grade students at SDN Cempaka Baru 05, Central Jakarta.

A. Data Description

To provide a more comprehensive overview of students' mathematical critical thinking ability, in addition to the average score, the standard deviation (SD) and achievement percentage are also presented. The percentage was calculated by comparing the average score with the ideal maximum score (100), as shown in Table 1.

Table 1. Description of Students' Mathematical Critical Thinking Scores

Variable	Mean	SD
RME Learning	78.45	8.12
PBL Learning	70.12	7.85
High Learning Discipline	80.27	7.64
Low Learning Discipline	69.34	8.27

(Source: Research Results)

Table 1 shows that students who learned using the Realistic Mathematics Education (RME) approach obtained an average score of 78.45, a standard deviation of 8.12, and an achievement percentage of 78.45%. This result is higher than that of the PBL group, which only achieved an average of 70.12 with a standard deviation of 7.85 and an achievement percentage of 70.12%. This indicates that RME not only improves the average score but also provides relatively balanced data variation.

In terms of learning discipline, students with high learning discipline obtained an average score of 80.27 with a standard deviation of 7.64 and an achievement percentage of 80.27%. Meanwhile, students with low learning discipline obtained an average score of 69.34, a standard deviation of 8.27, and an achievement percentage of 69.34%. This difference indicates that students with higher learning discipline tend to have better and more stable mathematical critical thinking abilities than those with lower discipline.

Overall, both the learning approach and the level of learning discipline show significant differences in students' average achievement and score variation in mathematical critical thinking. The descriptive results can be visualized in a bar chart, as shown in Figure 1.

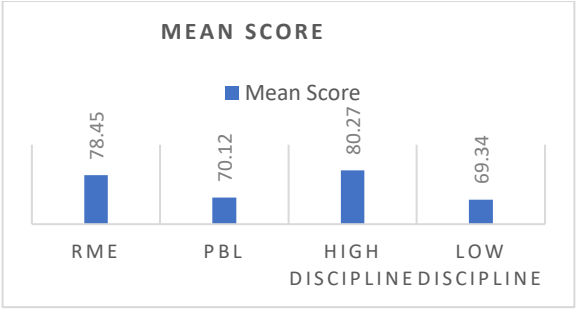

Fig.1 Comparison of Average Mathematical Critical Thinking Scores

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The graph shows a clear difference in the average scores of students' mathematical critical thinking ability in each group. Students who learned using the Realistic Mathematics Education (RME) approach achieved higher average scores than those who learned using Problem-Based Learning (PBL). This indicates that the RME approach positively contributes to improving students' critical thinking ability.

From the perspective of learning discipline, the graph shows that students with high discipline achieved the highest average score across all groups, exceeding 80 points, whereas students with low discipline achieved approximately 69 points. This difference confirms that learning discipline is a strong internal factor influencing the quality of mathematical critical thinking.

The error bars in the graph represent the standard deviation of each group; the score distribution of students with high discipline is relatively smaller than that of students with low discipline. This indicates that students with high discipline not only achieve higher average scores but also demonstrate more consistent performance. Thus, it can be concluded that the combination of RME-based learning and high learning discipline provides significant advantages for students' mathematical critical thinking ability compared with other combinations.

B. Prerequisite Analysis Test

Before conducting the two-way ANOVA, prerequisite tests were performed to ensure the data met the required statistical assumptions. These tests included the normality test using Kolmogorov–Smirnov and the homogeneity of variance test using Levene's Test, as shown in Table 2.

Table 2. Results of Prerequisite Analysis Tests

Statistical Test	Statistical Value	Sig.	Criteria	Conclusion
Kolmogorov–Smirnov	0.121–0.147	0.082–0.200	Sig. > 0.05	Data are normally distributed
Levene's Test	1.256	0.284	Sig. > 0.05	Data are homogeneous

Based on the results of the Kolmogorov–Smirnov normality test, the significance values for all data groups were greater than 0.05, ranging from 0.082 to 0.200. This indicates that the data on students' mathematical critical thinking ability are normally distributed, making them suitable for further analysis using parametric tests.

Meanwhile, the Levene's Test for homogeneity produced a p-value of 0.284 (> 0.05), indicating that the variances among groups are homogeneous. Therefore, both prerequisite assumptions were met, allowing the two-way ANOVA analysis to proceed for hypothesis testing.

C. Results of the Two-Way ANOVA Test

After the prerequisite tests were satisfied, the analysis continued using a Two-Way ANOVA to determine the effects of the learning approach, the learning discipline, and their interaction on students' mathematical critical thinking ability, as shown in Table 3.

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Table 3. Results of Two-Way ANOVA

Source of Variation	df	F	Sig.	Description
Learning Approach	1	6.84	0.012	Significant ($p < 0.05$)
Learning Discipline	1	12.15	0.001	Significant ($p < 0.01$)
Interaction (Approach × Discipline)	1	4.62	0.036	Significant ($p < 0.05$)
Error	56	–	–	
Total	59	–	–	

The two-way ANOVA at the 0.05 significance level yielded several important findings.

First, the learning approach significantly affects students' mathematical critical thinking ability, with $F(1,56) = 6.84$ and $p = 0.012 < 0.05$. This indicates that students who received instruction using the RME approach have better critical thinking skills in mathematics than those who learned through PBL

Second, the results also show a significant effect of learning discipline on mathematical critical thinking ability with $F(1,56) = 12.15$ and $p = 0.001 < 0.01$. This means that students with high learning discipline demonstrate better mathematical critical thinking ability than those with low learning discipline.

Third, there is a significant interaction between the learning approach and learning discipline on students' mathematical critical thinking ability, with $F(1,56) = 4.62$ and $p = 0.036 < 0.05$. The Tukey post hoc test revealed that students with high learning discipline who learned through the RME approach obtained the highest scores in mathematical critical thinking.

This finding confirms that an effective learning approach will yield better results when supported by a strong learning discipline among students. The interaction between the learning approach and learning discipline can be visualized in Figure 2.

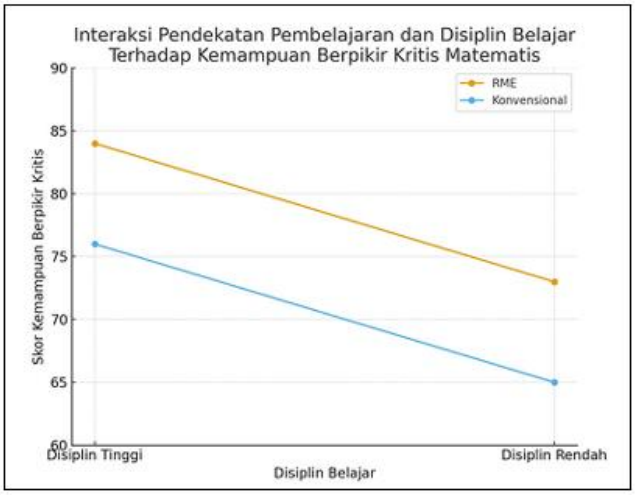

Fig.2 Interaction Between Learning Approach and Learning Discipline

The interaction graph shows different patterns of mathematical critical thinking scores across the groups. Students who learned through the RME approach achieved higher average scores than those who learned through PBL, in both the high- and low-discipline groups.

However, the difference becomes more evident among students with high discipline. In this group, the RME approach produced an average score of 84, significantly higher than the PBL group's 76. Meanwhile, in the low-discipline group, although RME still produced better results (73) than PBL (65), the difference was relatively small.

The non-parallel pattern of the RME and PBL lines confirms a significant interaction between the learning approach and the learning discipline. This means that students' level of

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learning discipline strongly influences the effectiveness of the RME approach in improving their critical thinking in mathematics. In other words, RME-based learning will yield better outcomes when students have a strong learning discipline.

D. Results of the Tukey Post Hoc Test

After confirming significant differences and interactions between the learning approach and learning discipline, the analysis was continued using the Tukey post hoc test to identify which groups differed significantly (see Table 4).

Table 4. Results of the Tukey Post Hoc Test

Comparison Group	Mean Difference	Sig.	Description
RME – PBL	8.33	0.015	Significant ($p < 0.05$)
High Discipline – Low Discipline	10.93	0.001	Significant ($p < 0.01$)
RME + High Discipline – PBL + Low Discipline	14.52	0.002	Significant ($p < 0.01$)
RME + High Discipline – RME + Low Discipline	9.71	0.018	Significant ($p < 0.05$)
PBL + High Discipline – PBL + Low Discipline	7.84	0.029	Significant ($p < 0.05$)

The Tukey test results in Table 4 show that students who used the Realistic Mathematics Education (RME) approach achieved significantly higher scores in mathematical critical thinking than those who used conventional methods. Additionally, students with high learning discipline obtained significantly higher scores than those with low learning discipline.

The interaction between the learning approach and learning discipline further confirms that the combination of RME and high learning discipline produces the highest mathematical critical thinking scores among all groups, with an average difference of 14.52 points compared to the conventional group with low discipline.

Furthermore, in both the RME and conventional groups, students with high learning discipline consistently showed better results than those with low discipline. These findings confirm that, in addition to the learning approach, internal factors such as learning discipline significantly contribute to improving students' mathematical critical thinking, especially when the two factors are optimally combined.

The results of this study indicate a significant difference in mathematical critical thinking ability between students taught using the RME approach and those taught using the PBL strategy. The RME approach focuses on real-life contexts relevant to students' daily experiences, which encourages the development of analysis, problem-solving, and reasoning abilities. Previous studies have shown that RME contributes to students' curiosity and active engagement, which in turn, enhances their critical thinking abilities (Hikayat et al., 2020; Popova et al., 2024; Sarah et al., 2022; Demo et al., 2021; Jeong & González-Gómez, 2021). According to Dai et al. (2025), the development of RME-based teaching materials can facilitate more engaging learning experiences for students, strengthening their involvement and critical thinking ability (Dai et al., 2025).

In this context, it is also important to consider the influence of learning discipline on critical thinking ability. Research indicates that students with high learning discipline tend to achieve higher scores in mathematical critical thinking. This finding is consistent with Setiana et al., who state that learning discipline reflects students' orderliness and responsibility (Setiana et al., 2021). Good learning discipline allows students to follow rules and manage their time effectively, increasing their focus on understanding mathematical concepts, which ultimately has a positive impact on their academic achievement (Hernández & Díaz, 2021; Natalia, 2017)

Furthermore, this study also revealed a significant interaction between the learning approach and learning discipline. The findings show that the combination of the RME approach and high learning discipline produces the most optimal mathematical critical thinking ability.

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This result is consistent with the findings of Rangkuti et al. (2024), who found that RME-based learning, combined with internal factors such as motivation and discipline, can improve learning outcomes (Rangkuti et al., 2024).

Further investigation is needed to explore how these factors interact and contribute to the overall success of mathematics learning. Therefore, the results of this study reinforce the view that the effectiveness of a learning approach depends not only on the instructional strategy used but also on students' characteristics, such as learning discipline. Educators need to design contextual learning experiences through the RME approach while also fostering students' discipline to maximize the development of their critical thinking skills in mathematics.

Conclusion

Based on the research findings, it can be concluded that there is a difference in mathematical critical thinking ability between students who learn using the Realistic Mathematics Education (RME) approach and those who learn using the Problem-Based Learning (PBL) strategy. Students who participated in learning through the RME approach achieved higher scores than those who learned through PBL.

In addition, there is a difference in mathematical critical thinking ability between students with high and low learning discipline, with students with higher learning discipline achieving better results. This finding confirms that both the learning approach and the learning discipline significantly influence students' mathematical critical thinking ability.

Furthermore, the results also show an interaction between the learning approach and learning discipline in influencing students' mathematical critical thinking ability. The combination of the RME approach and high learning discipline produced the highest scores, while the combination of PBL and low learning discipline resulted in the lowest scores.

Therefore, it can be concluded that the effectiveness of the RME learning approach will be more optimal when supported by a strong student learning discipline. Thus, teachers not only need to implement innovative learning approaches but also foster a culture of learning discipline among students to maximize the development of students' critical thinking skills in mathematics.

References

A. M. Utami and P. Pramudiani, "Exploring Students' Critical Thinking Skills in Geometry through the Context of Betawi Culture: Damdas 3 Batu Game," *Mathematics Education Journal*, vol. 18, no. 3, pp. 469–484, Sep. 2024, doi: 10.22342/jpm.v18i3.pp469-484.

R. Lestari, R. C. I. Prahmana, M. S. F. Chong, and M. Shahrill, "DEVELOPING REALISTIC MATHEMATICS EDUCATION-BASED WORKSHEETS FOR IMPROVING STUDENTS' CRITICAL THINKING SKILLS," *Infinity Journal*, vol. 12, no. 1, pp. 69–84, Feb. 2023, doi: 10.22460/infinity.v12i1.p69-84.

N. S. I. G. Septia, Fery Muhamad Firdaus, and Budiawan, "The Influence of Indonesian Realistic Mathematics Approach to Improve Concept Understanding and Critical Thinking Skills of Fourth Grade Elementary School Students," *International Journal of Elementary Education*, vol. 7, no. 2, pp. 273–281, May 2023, doi: 10.23887/ijee.v7i2.60530.

Sarnoko, Asrowi, Gunarhadi, and B. Usodo, "AN ANALYSIS OF THE APPLICATION OF PROBLEM BASED LEARNING (PBL) MODEL IN MATHEMATICS FOR ELEMENTARY SCHOOL STUDENTS," *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, vol. 8, no. 1, pp. 188–202, Jun. 2024, doi: 10.22437/jiituj.v8i1.32057.

F. R. Nashrullah, R. Rochmad, and A. N. Cahyono, "Mathematical Critical Thinking Abilities of Students in Terms of Self-Regulated Learning in Realistic Mathematics Education Assisted By Mobile Learning," *Mathline : Jurnal Matematika dan Pendidikan Matematika*, vol. 8, no. 3, pp. 1035–1056, Aug. 2023, doi: 10.31943/mathline.v8i3.469.

DOI: https://doi.org/10.62872/mtjcpq89

S. Sutama *et al.*, "Collaborative mathematics learning management: Critical thinking skills in problem solving," *International Journal of Evaluation and Research in Education*, vol. 11, no. 3, pp. 1015–1027, Sep. 2022, doi: 10.11591/ijere.v11i3.22193.

C. Hikayat, Suparman, Y. Hairun, and H. Suharna, "Design of realistic mathematics education approach to improve critical thinking skills," *Universal Journal of Educational Research*, vol. 8, no. 6, pp. 2232–2244, 2020, doi: 10.13189/ujer.2020.080606.

A. Farid, M. Fenech, E. Anderson, and G. Lin, "Integrating Local Spaces into Mathematics Learning: An Investigation of Place-Based Mathematics Education."

J. V. Orón and I. Lizasoain, "Achieving Transfer from Mathematics Learning," *Educ. Sci. (Basel)*, vol. 13, no. 2, Feb. 2023, doi: 10.3390/educsci13020161.

M. A. A. Bakar, A. T. A. Ghani, and M. L. Abdullah, "Discover Teacher's Knowledge on Neuroscience and Mathematics Learning Relevance via Fuzzy Conjoint Analysis: A Case Study in Southern Malaysia," *Malaysian Journal of Mathematical Sciences*, vol. 18, no. 4, pp. 711–725, Dec. 2024, doi: 10.47836/mjms.18.4.02.

Syaiful, N. Huda, A. Mukminin, and Kamid, "Using a metacognitive learning approach to enhance students' critical thinking skills through mathematics education," *SN Social Sciences*, vol. 2, no. 4, Apr. 2022, doi: 10.1007/s43545-022-00325-8.

A. Akbar *et al.*, "Integrating Augmented Reality in Mathematics Learning to Improve Critical Thinking Skills of Elementary School Students," *Emerging Science Journal*, vol. 9, no. 2, pp. 764–779, Apr. 2025, doi: 10.28991/ESJ-2025-09-02-014.

I. I. Supianti, P. Yaniawati, E. Bonyah, A. W. Hasbiah, and N. Rozalini, "STEAM approach in project-based learning to develop mathematical literacy and students' character," *Infinity Journal*, vol. 14, no. 2, pp. 283–302, May 2025, doi: 10.22460/infinity.v14i2.p283-302.

Y. Popova, M. Abdualiyeva, Y. Torebek, and P. Saidakhmetov, "Factors propelling mathematics learning: insights from a quantitative empirical study," *International Journal of Evaluation and Research in Education*, vol. 13, no. 2, pp. 1159–1172, Apr. 2024, doi: 10.11591/ijere.v13i2.27322.

R. Sarah, F. Iskandar, and D. Juandi, "Study Literature Review: Realistic Mathematics Education Learning on Students' Mathematical Creative Thinking Ability," *SJME (Supremum Journal of Mathematics Education)*, vol. 6, no. 1, pp. 35–42, 2022, doi: 10.35706/sjmev6i1.5739.

H. Demo, M. Garzetti, G. Santi, and G. Tarini, "Learning mathematics in an inclusive and open environment: An interdisciplinary approach," *Educ. Sci. (Basel)*, vol. 11, no. 5, 2021, doi: 10.3390/educsci11050199.

J. S. Jeong and D. González-Gómez, "Flipped-ocn method in mathematics learning to analyze the attitudes of pre-service teachers," *Mathematics*, vol. 9, no. 6, Mar. 2021, doi: 10.3390/math9060607.

L. Dai *et al.*, "Exploring the role of social media in mathematics learning: effects on self-efficacy, interest, and self-regulation," *BMC Psychol.*, vol. 13, no. 1, Dec. 2025, doi: 10.1186/s40359-025-03192-z.

D. S. Setiana, R. Y. Purwoko, and Sugiman, "The application of mathematics learning model to stimulate mathematical critical thinking skills of senior high school students," *European Journal of Educational Research*, vol. 10, no. 1, pp. 509–523, Jan. 2021, doi: 10.12973/EU-JER.10.1.509.

Y. P. Hernández and L. A. M. Díaz, "Learning mathematics from philosophy for/with children," *Childhood and Philosophy*, vol. 17, 2021, doi: 10.12957/CHILDPHILO.2021.58661 .

S. Natalia, "Realistic Mathematics Education: Suatu Langkah Mendidik Berpikir Matematis," *Jurnal Dinamika Pendidikan*, no. 1, pp. 81–96, 2017.

A. N. Rangkuti *et al.*, "The Effect of Realistic Mathematics Education Approach on Students' Conceptual Understanding Mariam Nasution Irwan Saleh Dalimunthe Samsuddin Dame

DOI: https://doi.org/10.62872/mtjcpq89

Siregar," 2024. [Online]. Available: https://ejournal.uinmybatusangkar.ac.id/ojs/index.php/takdib.