INTEGRATION: Journal of Multidisciplinary Studies
ISSN 3123-6928 (online)
Vol. 1 Iss. 1 Pg. 95-104
https://ejournal.scmdigi.id/index.php/integration

Enhancing multiplication skills through the jarimatika method in elementary school students

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DOI: https://doi.org/10.65881/integration.v1i1.16

ARTICLE INFO

History:
Submit: 01-04-2026
Revision: 01-08-2026
Accepted: 01-09-2026
Published: 01-13-2026

Keywords:
jarimatika;
multiplication skills;
mathematics;
learning interest;
elementary school.

ABSTRACT

Purpose: this study aims to analyze the effectiveness of the jarimatika "fingermath" method in improving multiplication skills and learning interest in mathematics among third-grade elementary school students.
Method: this research employed a quantitative, quasi-experimental, one-group pretest–posttest design. The participants consisted of 17 third-grade students. Data were collected through pretest and posttest assessments of multiplication skills and analyzed using descriptive statistics, a paired-samples t-test, and effect size (Cohen's d).
Findings: show that the jarimatika method can improve multiplication calculation skills and foster interest and engagement in learning mathematics among third-grade elementary school students. However, the increase in learning outcomes is not yet statistically significant.
Implications: this research theoretically strengthens mathematics learning through a concrete approach, while also practically demonstrating that the jarimatika method can increase student activity, interest, and understanding, and can serve as a basis for developing innovative learning media.
Originality: lies in the application of the jarimatika method, which simultaneously examines the improvement of multiplication calculation skills and the learning interest of third-grade students in madrasah ibtidaiyah, with a concrete learning approach that is in accordance with the characteristics of the Merdeka Curriculum.

Introduction

Mathematics is a fundamental subject that plays a crucial role in developing students' logical, critical, and systematic thinking skills from elementary school onward (Wang et al., 2025). Mastery of basic mathematical concepts, particularly arithmetic operations, forms the foundation for understanding material in subsequent levels of

mathematics (Kristesia et al., 2025; Safari & Nurhida, 2024). However, in elementary school, many students still struggle to grasp basic mathematical concepts, particularly multiplication. This difficulty not only affects poor learning outcomes but also shapes students' attitudes toward mathematics, which is perceived as difficult and unappealing (Ayu et al., 2021). This phenomenon was found in third-grade students at I'naatul Khoir Mantingan elementary school (madrasah ibtidaiyah). Based on interviews with class teachers, it was found that students' arithmetic abilities remained varied: approximately 50% could perform multiplication well, while the remainder still required intensive guidance. Teachers also reported that low interest and motivation in learning mathematics were the main problems, as most students tended to be passive learners and lacked confidence when faced with multiplication problems. This condition indicates a fundamental problem in the mathematics learning process, both in students' cognitive readiness and in the strategies they use.

Low interest and motivation in learning mathematics are internal factors that often contribute to students' learning difficulties, alongside external factors such as monotonous, uninnovative teaching methods (Nurmanov et al., 2024; Ratna, 2025). At elementary school age, students are generally still in the concrete thinking stage, so they require a learning approach that is visual, contextual, and hands-on (Asril & Purwanta, 2025; Fakaruddin et al., 2024). However, classroom mathematics instruction often focuses on lectures and abstract exercises, making it difficult for students to grasp multiplication concepts that should be developed through concrete, meaningful experiences (Fikri et al., 2024; Ingkavara & Yasri, 2025). Along with the development of education in the Industrial Revolution 4.0 era and the implementation of the Independent Learning policy, teachers are required to be more creative and innovative in designing enjoyable, student-centered learning experiences (Soleh, 2025; Widiyono & Millati, 2021). Several previous studies have shown that interactive learning methods, such as games and prop-based activities, can increase student engagement and motivation (Cannavò et al., 2024; Khasanah et al., 2024; Nazarina et al., 2024; Sukandi et al., 2024). One method relevant to the characteristics of elementary school students is the jarimatika method, a counting method that utilizes the fingers as a concrete tool to help understand arithmetic operations.

Previous studies have shown that the jarimatika method has been widely researched and proven effective in improving students' numeracy skills and learning motivation. Research by Himmah et al. (2021) stated that implementing the jarimatika method can improve student learning outcomes and motivation in multiplication. Rahmayanti (2023) also reported a significant increase in learning completion in elementary school students after implementing the jarimatika method. Furthermore, research by Yanti & Nugroho (2024) confirmed that jarimatika not only improves numeracy skills but also fosters enthusiasm and active student engagement in mathematics learning. However, most previous research has focused on improving learning outcomes or general numeracy skills, without examining in more depth the relationship between improving multiplication skills and student learning interest simultaneously, particularly in third-grade elementary school students in madrasah settings. Furthermore, there is limited research examining the application of the jarimatika method in a learning context that aligns with the spirit of Merdeka Belajar (Freedom to Learn), namely active, enjoyable, and student-centered learning. Based on this research gap, the novelty of this study lies in examining the effectiveness of the jarimatika method, which focuses not only on improving multiplication skills but also on increasing students' interest in learning mathematics in third grade. This research was

also conducted in the context of an madrasah ibtidaiyah, which has different student characteristics and a learning culture from those of regular elementary schools, so it is expected to provide a more contextual empirical contribution.

The purpose of this study is to analyze the effectiveness of the jarimatika method in improving third-grade elementary school students' multiplication calculation skills and interest in learning mathematics. Specifically, this study aims to determine changes in students' calculation skills after applying the jarimatika method and to identify increases in students' interest and engagement in mathematics learning. This study is expected to make a theoretical contribution by advancing the study of concrete-based, enjoyable mathematics learning for elementary school students. In practice, the results of this study are expected to provide teachers with alternative solutions for choosing effective, innovative, and appropriate mathematics learning methods based on student characteristics, as well as to support the implementation of Merdeka Belajar in creating meaningful mathematics learning that is oriented towards student needs.

Method

This study used a quantitative, quasi-experimental, one-group pretest–posttest design. This design involved one group of research subjects who received an initial measurement (pretest) before treatment and a final measurement (posttest) after treatment. Schematically, this research design is expressed with the notation O_1 - X - O_2, where O_1 is the initial measurement of students' multiplication calculation ability and interest in learning mathematics, X is the treatment in the form of the application of the jarimatika method, and O_2 is the final measurement after the treatment was implemented. The choice of the one-group pretest–posttest design was based on the research objective of determining changes in students' multiplication calculation ability and interest in learning mathematics before and after the application of the jarimatika method. Through this design, it is possible to compare pretest and posttest results to assess the extent to which the treatment has an effect on the variables studied. This design is considered adequate for assessing the impact of a learning intervention in elementary education, primarily when the research focuses on improving students' learning abilities and attitudes (Capili & Anastasi, 2024).

The treatment in this study was the application of the jarimatika method in mathematics learning on multiplication material. This method was implemented over a period of 6–8 weeks, adjusted to the mathematics learning schedule in third-grade of elementary school. During this period, learning was systematically designed by utilizing the fingers as a concrete tool to understand the concept of multiplication, so that students could be actively involved and gain a more meaningful learning experience. The implementation of the jarimatika method was carried out in stages, starting from the introduction of the concept, structured practice, and application to contextual problems. The research instruments included a multiplication calculation ability test and a questionnaire on mathematics learning interest. The test was administered at the pretest and posttest to measure quantitative changes in students' calculation abilities. At the same time, the learning interest questionnaire was used to identify changes in students' attitudes, interests, and motivations towards mathematics learning after the implementation of the jarimatika method. The data obtained were then analyzed using appropriate statistical techniques to compare the results before and after the treatment.

A quasi-experimental design without a control group was chosen for practical, administrative, and ethical reasons. In the elementary school context, particularly in madrasah settings, dividing students into control and experimental groups is often

difficult due to limited class sizes, school policies, and considerations of learning equity for all students. Therefore, this design was deemed the most feasible to implement without disrupting the regular learning process. However, the one-group pretest–posttest design has limitations, particularly regarding the potential influence of external variables that cannot be fully controlled, such as students' learning experiences outside the classroom or natural cognitive development. To minimize these weaknesses, this study was conducted over a relatively short period of time and with structured treatments, so that changes in the research variables can be more confidently attributed to the implementation of the jarimatika method. Therefore, the use of a one-group pretest–posttest quasi-experimental design is expected to provide a sufficiently strong empirical picture of the effectiveness of the jarimatika method in improving multiplication calculation skills and mathematics learning interest of third-grade elementary school students.

Results and discussion

Description of students' multiplication calculation abilities at the initial stage (pretest)

The results of a pretest administered to 17 phase B Elementary School students showed that their multiplication calculation skills remained low to adequate. The average pretest score of 50.9, with a median of 47 and a standard deviation of 19.7, indicated that, in general, students' mastery of multiplication concepts was not optimal, and there was significant variation in ability between students. The relatively high standard deviation indicated a gap in ability, where some students already had a basic understanding, while others still experienced significant difficulties.

Most students have not yet met the Learning Objective Achievement Criteria (LOAC), especially on questions of medium to great difficulty. The most errors were found in questions 10–15, which require a deeper understanding of multiplication concepts and the application of systematic calculation strategies. This indicates that students do not yet fully understand multiplication as a relationship between numbers, but rather still rely on memorization or repeated addition without appropriate strategies. This finding aligns with the characteristics of phase B students who are still in the concrete thinking stage and thus experience difficulties with abstract mathematical concepts.

Description of students' multiplication calculation abilities after applying the jarimatika method (posttest)

After implementing the jarimatika method for 6–8 weeks, posttest results showed an improvement in students' multiplication calculation skills. The average score increased to 60.9 with a median of 60 and a standard deviation of 26.2. This 10-point increase in the average score indicates a general improvement in students' numeracy skills after learning with the jarimatika method. This improvement was more evident among students who had previously been in the low category, especially in solving fundamental multiplication problems. The jarimatika method helps students visualize the multiplication process using their fingers, thereby facilitating conceptual understanding and reducing reliance on memorization alone. However, some students still had difficulty solving problems of higher complexity, such as word problems or multiplication with larger numbers. This indicates that although jarimatika is effective in reinforcing basic concepts, further reinforcement is needed so that students can transfer this understanding to more complex contexts.

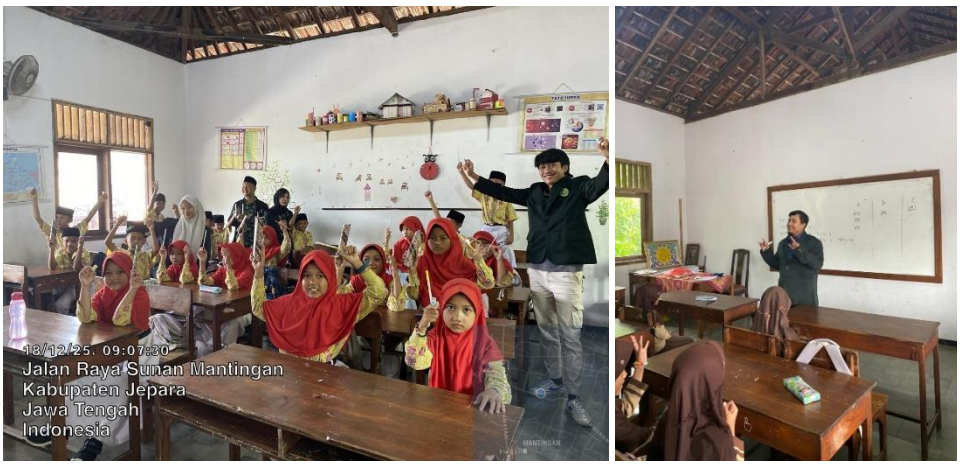

Figure 1 jarimatika learning in third-grade
Source: primary data

Figure 1 shows the implementation of mathematics learning using the jarimatika method for third-grade elementary school students. The first photo shows an active, enthusiastic classroom atmosphere, with students sitting in their chairs, raising their fingers during the jarimatika practice. The majority of students appear directly involved in the learning activities, indicating active participation and a positive response to the method. The students' cheerful, enthusiastic expressions indicate that learning takes place in a fun, stress-free atmosphere. The use of fingers as concrete aids is clearly visible in the students' activities, reflecting the characteristics of the jarimatika method as a visual and kinesthetic approach. This is very appropriate for the characteristics of phase B students who are still in the concrete thinking stage, thus requiring real media to understand the concept of multiplication. The simultaneous involvement of students also shows that this method can reduce teacher dominance and encourage student-centered learning.

In the second photo, the teacher is at the front of the class, providing explanations and directions on jarimatika. The teacher acts as a facilitator, guiding students in understanding the steps of multiplication calculations using fingers. The whiteboard serves as a support tool to clarify the concepts being studied, while students in the front seats are seen paying attention and imitating the teacher's finger movements. The two-way interaction between the teacher and students appears well-established, reflecting a communicative, interactive learning process. The jarimatika method can create an active, enjoyable, and meaningful learning environment. Learning does not only focus on the results of calculations, but also on the process of understanding the concept of multiplication through direct experience. This visual finding supports research findings of increased students' numeracy skills and learning interest. It strengthens the relevance of the jarimatika method in supporting mathematics learning aligned with the principles of the Merdeka Curriculum.

Pretest and posttest results

The results of the statistical analysis using the paired-samples t-test showed a t value of -1.67 and a p-value of 0.114 ($p > 0.05$). Statistically, these results indicate that the difference between the pretest and posttest scores is not yet significant. This failure to achieve statistical significance may be due to several factors, including a relatively small sample size, a short intervention duration, and high variation in students' initial abilities. Nevertheless, descriptively, there was an average increase of 10 points,

indicating a positive change in student learning outcomes. In addition, the effect size (Cohen's d) value of 0.406 is in the moderate category. This indicates that the jarimatika method has a significant practical effect on improving students' multiplication calculation abilities, although it is not yet statistically significant. In other words, the jarimatika method has a real impact in the classroom, especially in helping students understand the basic concepts of multiplication.

The results of this study align with those of Himmah et al. (2021), who found that the jarimatika method is efficacious in improving multiplication calculation skills through a direct, concrete approach using fingers as a concrete tool. Research by Jaelani & A'yun (2023) also confirmed that jarimatika is highly suitable for elementary school students because it can bridge understanding of abstract mathematical concepts into more concrete, easier-to-understand concepts. Furthermore, Azmi et al. (2025) showed that integrating jarimatika with the problem-based learning (PBL) model can produce more optimal learning outcomes in third-grade elementary school students.

The increase in average scores in this study indicates that finger arithmetic allows students to be more actively involved in the learning process and understand multiplication concepts visually and interactively. This supports the constructivist view that states that knowledge is built through direct experience and active student involvement in learning (Al Abri et al., 2024; Widiyono & Millati, 2021). By using fingers as a concrete medium, students not only memorize multiplication results but also understand the processes behind the calculations. In addition to improving numeracy skills, the jarimatika method also increases students' interest and motivation in learning. Rahmayanti (2023) and Rosiyana and Nurbaeti (2023) emphasized that learning mathematics in a fun way can transform students' perceptions of the subject from a difficult one to a more engaging and understandable one. This finding was also evident in this study, where students demonstrated greater enthusiasm and engagement during the jarimatika learning process (Figure 1).

In the context of the Merdeka Curriculum, the implementation of the jarimatika method is highly relevant to the characteristics of phase B learning, which emphasizes direct learning experiences, active student participation, and a pleasant learning atmosphere (Ariana et al., 2025). Although the statistical tests were not significant, the effect size is in the medium range, suggesting that this method has significant potential for further development. Therefore, increasing the duration of the intervention, strengthening practice questions with greater complexity, and using a larger sample are recommended for further research to make the effect of the jarimatika method more statistically significant. Thus, the results of this study provide empirical evidence that the jarimatika method is an effective and contextually relevant alternative for improving elementary school students' multiplication calculation skills, especially in phase B, and that it supports the implementation of meaningful learning in accordance with the spirit of the Merderka Curriculum.

Moving forward, the findings of this study should be utilized as a basis for developing mathematics learning practices in elementary schools. Although the statistical test results showed that the difference between the pretest and posttest was not yet significant, the increase in average scores and the moderate effect size indicate that the jarimatika method has a positive practical impact on students' multiplication skills. Therefore, this method remains a relevant alternative learning strategy, particularly for strengthening students' understanding of basic multiplication concepts in phase B.

The implementation of the jarimatika method should be optimized by combining it with more varied, student-centered learning models. Teachers are advised to integrate jarimatika with problem-based learning, group discussions, and numeracy games so that students can not only calculate but also understand the concept of multiplication in a more meaningful context. Reinforcing practice with questions of increasing complexity is also necessary so that students can transfer the fundamental understanding gained through jarimatika to more challenging problem-solving situations. These findings can serve as a foundation for schools to develop learning tools, such as teaching modules, student worksheets, or arithmetic-based learning media tailored to the characteristics of lower-grade students. Furthermore, training and mentoring for teachers on the application of concrete and innovative learning methods is necessary to ensure consistent and sustainable implementation of the arithmetic method in the classroom.

Conclusions

The application of the jarimatika method has a positive impact on the development of multiplication calculation skills and on interest in learning mathematics among third-grade elementary school students. Descriptively, there was an increase in the average score of student learning outcomes from the pretest to the posttest, indicating an improvement in arithmetic abilities after students participated in learning with the jarimatika method. Although the results of the paired-samples t-test did not show a statistically significant difference, the effect size was in the medium range, indicating that the jarimatika method has a significant practical impact in the context of classroom learning. In addition, the application of the jarimatika method increased students' active involvement, enthusiasm, and interest in learning mathematics. The use of fingers as a concrete tool helps students understand the concept of multiplication more visually and meaningfully, in line with the cognitive development of phase B students, who are still at the concrete thinking stage. Thus, the jarimatika method can be seen as an alternative learning strategy that is relevant, contextual, and aligned with the principles of active and enjoyable learning in the Merdeka Curriculum.

The results of this study have several important implications, both theoretically and practically. Theoretically, this study strengthens the study of mathematics learning based on concrete and constructivist approaches, which emphasize the importance of direct experience in building understanding of mathematical concepts in elementary school students. The findings also confirm that improvements in learning outcomes can be seen not only in statistical significance but also in practical impacts felt in the learning process. Practically, this study has implications for elementary school teachers, especially in Islamic elementary schools (madrasah ibtidaiyah), to utilize the jarimatika method as an alternative learning strategy in teaching multiplication concepts. This method can help teachers create more active, enjoyable, and student-centered learning experiences while increasing students' interest and motivation in learning mathematics. For schools, the results of this study can serve as a basis for developing learning tools, such as teaching modules, student worksheets, and learning media, based on concrete, innovative methods.

This study has several limitations that need to be considered. First, the research design used a quasi-experimental one-group pretest–posttest without a control group, so the results cannot be fully compared with learning using other methods. Second, the relatively small sample size and the involvement of only one class limit the generalizability of the research results. Third, the relatively short duration of the intervention (6–8 weeks) means that the effect of the jarimatika method on improving

students' numeracy skills and learning interest has not been optimally seen. Furthermore, the measurement of student learning interest still relies on questionnaires, which are heavily subject to student responses. Future research is recommended to use an experimental design with a control group to more objectively compare the effect of the jarimatika method with other learning methods. Further research is also recommended to involve a larger sample and be conducted across several schools with different characteristics, to improve the results' generalizability. Furthermore, the duration of the jarimatika method application needs to be extended and combined with other learning models, such as problem-based learning, group discussions, or numeracy games, so that students not only master basic multiplication but also apply these concepts in more complex problem-solving contexts. Further research can also develop more diverse instruments for measuring learning interests, such as observation and in-depth interviews, to obtain a more comprehensive picture of the impact of the jarimatika method on students' attitudes and motivation to learn mathematics.

References

Al Abri, M. H., Al Aamri, A. Y., & Elhaj, A. M. A. (2024). Enhancing Student Learning Experiences Through Integrated Constructivist Pedagogical Models. *European Journal of Contemporary Education and E-Learning*, *2*(1), 130–149. https://doi.org/10.59324/ejceel.2024.2(1).11

Ariana, U., Rachmah, U. F., Khasanah, U., & Hasanah, U. (2025). Implementation of Jarimatika Method in Mathematics Subjects at MI Maarif NU Bentul to Improve Learning Motivation. *Jurnal Cendekia Islam Indonesia*, *1*(1), 339–351. https://doi.org/10.62945/jcii.v1i1.87

Asril, A., & Purwanta, E. (2025). Enhancing the Ability to Recognize Fraction Numbers Through Context-Based Concrete Media in Grade V Slow Learners at a Public Elementary School. *Journal of Innovation and Research in Primary Education*, *4*(3), 1491–1500. https://doi.org/10.56916/jirpe.v4i3.1618

Ayu, S., Ardianti, S. D., & Wanabuliandari, S. (2021). Analisis Faktor Penyebab Kesulitan Belajar Matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(3), 1611. https://doi.org/10.24127/ajpm.v10i3.3824

Azmi, A., Prijambodo, R. F. N., & Meita, N. M. (2025). Efektivitas Metode Jarimatika dengan Model PBL terhadap Kemampuan Berhitung Perkalian pada Siswa Kelas 3 SD. *Katalis Pendidikan: Jurnal Ilmu Pendidikan Dan Matematika*, *2*(2), 227–238. https://doi.org/10.62383/katalis.v2i2.1676

Cannavò, A., De Lorenzis, F., Pratticò, F. G., Galante, L., & Lamberti, F. (2024). On the Quality of the Experience With Virtual Reality-Based Instructional Tools for Science Lab Activities. *Journal of Educational Computing Research*, *62*(7), 1543–1577. https://doi.org/10.1177/07356331241270658

Capili, B., & Anastasi, J. K. (2024). An Introduction to Types of Quasi-Experimental Designs. *AJN, American Journal of Nursing*, *124*(11), 50–52. https://doi.org/10.1097/01.NAJ.0001081740.74815.20

Fakaruddin, F. J., Shahali, E. H. M., & Saat, R. M. (2024). Creative thinking patterns in primary school students' hands-on science activities involving robotic as learning tools. *Asia Pacific Education Review*, *25*(1), 171–186. https://doi.org/10.1007/s12564-023-09825-5

Fikri, M. A., Fatmawati, N. F., & Riswari, L. A. (2024). Analisis Kemampuan Siswa Dalam Pemahaman Konsep Penalaran Matematis Pada Siswa Kelas V Di SDN 3 Menganti.

Journal Mathematics Education Sigma [JMES], *5*(2), 170–177. https://doi.org/10.30596/jmes.v5i2.20825

Himmah, K., Asmani, J. M., & Nuraini, L. (2021). Efektivitas Metode Jarimatika dalam Meningkatkan Kemampuan Berhitung Perkalian Siswa. *Dawuh Guru: Jurnal Pendidikan MI/SD*, *1*(1), 57–68. https://doi.org/10.35878/guru.v1i1.270

Ingkavara, T., & Yasri, P. (2025). Evaluating the Efficacy of an Integrative Instructional Framework in Mathematics Education for Students. *European Journal of Mathematics and Science Education*, *6*(1), 51–64. https://doi.org/10.12973/ejmse.6.1.51

Jaelani, H. A., & A'yun, D. Q. (2023). Efektifitas Metode Jarimatika Dalam Meningkatkan Kemampuan Perkalian Bagi Siswa Sekolah Dasar. *Jurnal Citra Pendidikan*, *3*(3), 1060–1066. https://doi.org/10.38048/jcp.v3i3.1885

Khasanah, U., Rahmawati, W., Fitrianingsih, U., Hasanah, U., & Rosyida, V. N. (2024). Efforts to Improve Mathematics Learning Outcomes on Fraction Material at MI Negeri 1 Jombang Using Concrete Object Teaching Aids. *ETNOPEDAGOGI: Jurnal Pendidikan Dan Kebudayaan*, *1*(4), 50–62. https://doi.org/10.62945/etnopedagogi.v1i4.546

Kristesia, E., Suriansyah, A., Harsono, A. M. B., Putra, E. C. S., & Mubarok, M. (2025). The Mastery of Basic Multiplication and Division Skills and Its Impact on Students' Mathematics Achievement. *AMPLITUDO : Journal of Science and Technology Innovation*, *4*(1), 26–30. https://doi.org/10.56566/amplitudo.v4i1.303

Nazarina, P., Rahmawati, Y., Arifah, N., Langgari, T., & Annisa, N. (2024). Kreativitas Guru dan Media Berbasis Proyek untuk Atasi Keterbatasan Alat Peraga. *JURNAL DIKDAS*, *12*(2), 91–104. https://doi.org/10.22487/jds.v12i2.3980

Nurmanov, A. T., Ugli, Z. J. G., Khurramovna, S. S., Zebiniso, K., Sevara, P., & Ugli, Z. K. G. (2024). Investigating increasing the level of learning and making students interested in mathematics. *Cadernos de Educação Tecnologia e Sociedade*, *17*(se4), 181–189. https://doi.org/10.14571/brajets.v17.nse4.181-189

Rahmayanti, J. D. (2023). Penggunaan Metode Jarimatika Dalam Meningkatkan Kemampuan Berhitung Perkalian Dasar. *Risda: Jurnal Pemikiran Dan Pendidikan Islam*, *7*(1), 1–13. https://doi.org/10.59355/risda.v7i1.97

Ratna, R. M. (2025). A Case Study of Students with Learning Difficulties in Mathematics at Junior High School. *Devotion: Journal of Research and Community Service*, *6*(5), 450–459. https://doi.org/10.59188/devotion.v6i5.25458

Rosiyana, M., & Nurbaeti, R. U. (2023). Pelatihan Berhitung Cepat dengan Metode Jarimatika bagi Siswa Sekolah Dasar Desa Cigadung. *JAMU: Jurnal Abdi Masyarakat UMUS*, *3*(2), 88–94. https://doi.org/10.46772/jamu.v3i02.918

Safari, Y., & Nurhida, P. (2024). Pentingnya Pemahaman Konsep Dasar Matematika dalam Pembelajaran Matematika. *Karimah Tauhid*, *3*(9), 9817–9824. https://doi.org/10.30997/karimahtauhid.v3i9.14625

Soleh, M. I. (2025). Pengembangan Kompetensi Guru dalam Menghadapi Era Revolusi Industri 4.0. *Jurnal Penelitian Dan Evaluasi Pendidikan*, *12*(2), 186–194. https://doi.org/10.64540/hk508621

Sukandi, H., Rahayu, Y. N., Safitri, N. R., & Zain, I. A. (2024). Penggunaan Alat Peraga dalam Meningkatkan Minat Belajar Matematika Siswa. *Jurnal Perspektif*, *8*(1), 70. https://doi.org/10.15575/jp.v8i1.275

Wang, M., Matore, M. E. E. M., & Rosli, R. (2025). A systematic literature review on analytical thinking development in mathematics education: trends across time and countries. *Frontiers in Psychology*, *16*.

https://doi.org/10.3389/fpsyg.2025.1523836

Widiyono, A., & Millati, I. (2021). Peran Teknologi Pendidikan dalam Perspektif Merdeka Belajar di Era 4.0. *Journal of Education and Teaching (JET)*, *2*(1), 1–9. https://jet.or.id/index.php/jet/article/view/63

Yanti, H. D., & Nugroho, P. B. (2024). Pengaruh Penerapan Metode Jarimatika Terhadap Kemampuan Berhitung Penjumlahan Siswa Kelas II Sekolah Dasar Negeri Talang Jali. *Eksponen*, *14*(2). https://doi.org/10.47637/eksponen.v14i2.1154