



Enhancing Elementary Students' Mathematics Achievement through Problem-Based Learning Integrated with "Talintar" Smart Multiplication Table Media

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Abstract: This study aimed to improve elementary students' mathematics achievement through the integration of the Problem-Based Learning (PBL) model and Talintar (Smart Multiplication Table) media. A Classroom Action Research (CAR) design was implemented in two cycles involving 21 fourth-grade students at SDN Sapeken VIII, Sumenep, Indonesia. Each cycle consisted of planning, implementation, observation, and reflection stages. Data were collected through written tests, classroom observations, and documentation, then analyzed using descriptive quantitative methods. Results indicated a steady improvement in learning outcomes, with the mean score rising from 57.57 in the pre-cycle to 68.48 in Cycle I and 85.90 in Cycle II. The proportion of students achieving the mastery criterion (≥ 70) increased from 19% to 100%, yielding an N-gain of 0.67 (medium-to-high improvement) and a large effect size ($d \approx 2.3$). Qualitative observations revealed higher engagement, motivation, and confidence among students during the intervention. The findings confirm that integrating PBL with Talintar media effectively enhances conceptual understanding, problem-solving ability, and student participation. This model demonstrates that combining inquiry-based pedagogy with contextual visual media offers a sustainable and scalable approach to improving mathematics learning within Indonesia's Kurikulum Merdeka framework.

Keywords: Classroom Action Research, Elementary Education, Mathematics Achievement Problem-Based Learning, Talintar.

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Introduction

Mathematics at the elementary level serves as a foundational building block for logical reasoning, numeracy proficiency, and subsequent academic success in STEM disciplines (Teme, 2024). In the current era of education, where 21st-century competencies—such as critical thinking, problem-solving, collaboration, and self-regulated learning—are emphasised, the role of mathematics instruction becomes even more pivotal (Astriani, 2022). However, despite its central importance, many primary school

students continue to struggle with basic arithmetic operations, particularly multiplication, which undermines their future mathematical understanding and confidence. For instance, recent descriptive studies in Indonesian and global contexts indicate that students often engage in rote memorisation of multiplication tables without developing a deep conceptual understanding of how these operations function or relate to real-life situations. In consequence, students' performance in mathematics assessments remains sub-optimal, often falling below minimum completeness

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criteria in many schools. In this light, the need for innovative instructional strategies that shift from passive reception of knowledge to active, student-centred exploration becomes imperative.

The persistent problem of underachievement in elementary mathematics is specifically acute when the instructional approach remains entrenched in conventional teacher-centred methods. Within such environments, learning is limited to direct instruction, followed by repetitive drills of arithmetic facts, and students are minimally engaged in meaningful problem-solving or conceptual discourse. Empirical evidence suggests that this mode of teaching contributes to low levels of cognitive engagement, weak problem-solving skills, and limited transfer of knowledge beyond the classroom context (Arifin, 2024). In particular, the domain of multiplication—a key operation underpinning later work in algebra and measurement—frequently receives insufficient pedagogical innovation. Research has shown that students struggle not only to memorise multiplication facts but also to apply them flexibly in novel contexts (Sulastri, 2023). These difficulties reflect both instructional and media-related deficiencies: media usage often remains limited to worksheets or standard manipulative tools, without strong scaffolding for meaningful engagement. In this respect, the problem addressed in the present study is specific and timely: how to design and implement a learning model that integrates an active, student-centred pedagogy with a media innovation specifically targeted at enhancing mastery of multiplication operations in elementary students.

Given this context, the urgency of conducting research in this area is compelling. First, achieving mastery in basic arithmetic at the elementary level has far-reaching consequences: it not only supports success in later grades but also enhances students' confidence and positive attitude toward mathematics, thereby influencing both cognitive and affective domains. Studies on PBL (Problem-Based Learning) confirm that the approach fosters deeper understanding, improves academic achievement, and promotes critical thinking (Wahyuni, 2024). Second, the integration of media innovations tailored for multiplication learning is still relatively under-explored; for instance, tools such as "smart multiplication tables" or board-based innovations show promise in improving conceptual understanding (Ridwan & Firmansyah, 2025). Third, in the Indonesian context, curricular reforms such as the Kurikulum Merdeka emphasise more active, contextual, and student-active learning, which aligns with both PBL and media-based interventions. Thus, bridging pedagogy (PBL) and media (smart multiplication table) offers the potential to elevate

elementary mathematics teaching from mere drill and rote to meaningful, engaging, and effective learning experiences.

In line with such urgency, the research questions guiding this study are articulated as follows: (1) How is the implementation of a Problem-Based Learning model integrated with a "Talintar" smart multiplication-table media in elementary mathematics instruction? (2) Does the application of Problem-Based Learning supported by the "Talintar" media lead to a significant increase in mathematics achievement among elementary students? (3) To what extent does the integration of "Talintar" media enhance students' conceptual understanding and engagement in learning multiplication operations? These questions focus the inquiry on process (how it is implemented), outcome (achievement gains), and deeper effects (understanding & engagement). They encapsulate both pedagogical dynamics and the media-innovation variable, thereby covering the essential components of this study (Ridwan & Firmansyah, 2025).

Accordingly, the objectives of this research are threefold: first, to analyse the effectiveness of a Problem-Based Learning model integrated with "Talintar" smart multiplication-table media on elementary students' mathematics achievement; second, to describe the process and student responses during the implementation of PBL with "Talintar" media; and third, to provide a viable instructional alternative for elementary mathematics teachers seeking to enhance conceptual understanding and student engagement (Sulastri, 2023). By achieving these objectives, the study aims not only to contribute to theory but also to offer practical, replicable classroom innovation in the elementary mathematics domain.

Turning to the literature, extensive research affirms the efficacy of Problem-Based Learning (PBL) across K–8 mathematics contexts. A systematic review of 20 articles found that PBL positively influences students' academic achievement, conceptual understanding, and problem-solving skills in mathematics (Habibiyah & Ridwan, 2025). Other recent empirical studies indicate that PBL promotes mathematical creativity and engagement: a meta-analysis (2024) reported a moderate effect size ($g = 0.580$) for PBL on learners' mathematical creativity (Hardiansyah, Sukitman, Wahdian, & Hodairiyah, 2024). Moreover, studies show that PBL fosters student agency and deeper reasoning by embedding open-ended real-world problems that require active inquiry (Hardiansyah & Mulyadi, 2022). At the same time, research on media innovations for multiplication learning is emerging: for example, (Ahmad, Zulfiqar, & Khan, 2024) developed a card-based multiplication tool that improved arithmetic performance among

elementary students; (Munawaroh, Wulandari, & Astuti, 2024) found that real-object media enhanced multiplication learning outcomes significantly. In an Indonesian context, Ardelia's study on the Takalintar media (smart multiplication table) indicated a significant effect on student multiplication skills. These literatures collectively support the premise of combining PBL with media innovation in this study.

Nevertheless, important gaps remain. Although the literature supports PBL in mathematics broadly, there is much less investigation on PBL specifically targeted at multiplication learning in elementary contexts. Also, while media innovations for multiplication operations have been developed, few studies integrate such media with a PBL framework. Most media-oriented studies adopt a direct instructional or drill-based model rather than an inquiry-based, problem-solving pedagogy (Ahmad, Zulfiqar, & Khan, 2024). Furthermore, in the Indonesian primary schooling context, empirical research specifically on the "Talintar" smart multiplication table (or equivalent local media) combined with PBL is scarce (Arifin, 2024).. Thus, the present research fills an important empirical and theoretical gap: an integrated model of PBL + media innovation targeted at multiplication learning in elementary school. It thereby extends the literature by shifting the focus from generic PBL or media-only interventions to a combined approach situated in a specific local context.

The novelty of this study lies in its integrative design: it positions the "Talintar" smart multiplication table media as not merely a manipulable tool, but as a medium embedded within a PBL instructional sequence. The research highlights how locally developed media can be aligned with an evidence-based pedagogical model (PBL) and how that alignment can support enhanced mathematics achievement at the elementary level. From a theoretical perspective, the study contributes to the discourse on how media and pedagogy interplay within the mathematics classroom—not simply additive, but synergistic. From a practical viewpoint, it offers an actionable instructional model for elementary mathematics teachers, especially in Indonesian or similar educational contexts, aiming to elevate learning from drill-oriented to inquiry-based and media-rich. Therefore, this study is justified both by its fit with contemporary educational policy emphasis and by the empirical void it intends to fill.

Method

This study employed a Classroom Action Research (CAR) design aimed at improving students' learning process and achievement in multiplication topics among fourth-grade elementary students. The

CAR approach was chosen because it enables iterative reflection and refinement of teaching practices within authentic classroom settings (Kemmis & McTaggart, 2014). The research followed two complete cycles, each consisting of four key stages: planning, implementation, observation, and reflection. Through this cyclical process, the researchers continuously identified problems, implemented innovative interventions, and measured the resulting improvements in students' mathematics learning outcomes.

The study was conducted at SDN Sapeken VIII, located in Sumenep Regency, East Java, Indonesia, during the second semester of the 2024/2025 academic year. Participants comprised 21 fourth-grade students—12 boys and nine girls—who were selected using purposive sampling because they exhibited learning difficulties in column multiplication based on preliminary assessment data. The research context was characterized by limited use of interactive learning media and predominance of teacher-centred instruction, making it suitable for testing the integration of the Problem-Based Learning (PBL) model supported by the Talintar (Smart Multiplication Table) media.

This study was carried out through two action research cycles, each consisting of four main stages: planning, implementation, observation, and reflection. In the planning stage, the researcher prepared all necessary materials, including lesson plans, student worksheets (LKPD), learning modules, and evaluation tests based on multiplication topics. The implementation stage involved applying the Problem-Based Learning (PBL) model integrated with the Talintar (Smart Multiplication Table) media in classroom activities. During learning, students worked in small groups to solve real-world problems related to multiplication, while the teacher acted as a facilitator to guide discussion and ensure active participation. The observation stage focused on monitoring student engagement, collaboration, and understanding using structured observation sheets. Finally, in the reflection stage, the researcher and teacher analyzed test results, classroom observations, and student responses to identify improvements and weaknesses from each cycle. Findings from Cycle I were used to refine the instructional process in Cycle II. This iterative procedure ensured that the implementation of PBL with Talintar media effectively enhanced students' conceptual understanding and learning outcomes in mathematics.

Data in this study were collected using both test and non-test instruments. The main instrument was a written test designed to measure students' achievement in multiplication after applying the Problem-Based

Learning (PBL) model supported by the Talintar (Smart Multiplication Table) media. The test consisted of 15 essay questions aligned with three key learning indicators: understanding multiplication concepts, performing column multiplication, and solving contextual problems using Talintar. Additionally, observation sheets were used to record students'

activity and engagement during the learning process, while documentation was employed to gather supporting data such as students' previous test results and classroom records.

Table 1. Blueprint of Learning Achievement Test Instrument

Indicator of Learning Outcome	Item Numbers	Cognitive Level (Bloom's Taxonomy)
Understanding the concept of multiplication	1-5	C2 (Understanding)
Performing column multiplication correctly	6-10	C3 (Applying)
Solving contextual problems using Talintar media	11-15	C4 (Analyzing)

The instrument was validated by two mathematics-education experts and one elementary-school teacher. Content validity, calculated using Aiken's V, yielded an average score of 0.87, indicating high validity. Reliability testing using Cronbach's Alpha resulted in a coefficient of 0.82, confirming that the instrument was reliable and internally consistent. Each indicator represented different cognitive levels in Bloom's taxonomy, ensuring comprehensive assessment from conceptual understanding to analytical problem solving.

Data obtained from this study were analyzed using a descriptive quantitative approach to determine the improvement in students' mathematics achievement across the research cycles. The scores from the learning achievement tests were processed to calculate the mean, minimum, maximum, and percentage of students who met the Minimum Mastery Criterion (KKM = 70). A comparative descriptive analysis was conducted by comparing the results from the pre-cycle, Cycle I, and Cycle II to identify the level of progress after the implementation of the Problem-Based Learning (PBL) model supported by the Talintar media. The success criteria of the study were determined by (1) an increase in the average score from Cycle I to Cycle II, (2) at least 80% of students achieving scores equal to or above 70, and (3) an observable improvement in student engagement and participation during learning. Non-test data obtained from observation and documentation were analyzed

qualitatively through content analysis, focusing on behavioural patterns, collaboration, and classroom interaction. The integration of quantitative and qualitative data allowed for comprehensive interpretation and validation of the learning outcomes, ensuring that both academic achievement and learning behaviour improvements were accurately represented.

Result and Discussion

The study aimed to enhance fourth-grade students' mathematics achievement through the integration of the Problem-Based Learning (PBL) model with Talintar (Smart Multiplication Table) media. Data were collected in three stages—pre-cycle, Cycle I, and Cycle II—representing the baseline, first intervention, and improved intervention phases. Quantitative data were derived from written tests at the end of each cycle, while qualitative data were obtained through observation and documentation. At the beginning (pre-cycle), the students' mean score was 57.57, indicating that most learners had not achieved the Minimum Mastery Criterion (KKM = 70). After implementing PBL with Talintar in Cycle I, the mean score increased to 68.48 and further rose to 85.90 in Cycle II. These results demonstrate a consistent and substantial improvement in students' understanding and performance in column multiplication.

Table 2. Improvement of Students' Mathematics Achievement across Cycles

No	Learning Phase	Mean Score	Lowest Score	Highest Score	% of Students ≥ KKM (70)
1	Pre-Cycle	57.57	40	70	19.05 % (4 students)
2	Cycle I	68.48	55	80	57.14 % (12 students)
3	Cycle II	85.90	75	100	100 % (21 students)

The quantitative data presented in Table 2 clearly demonstrate a consistent and substantial improvement in students' mathematics achievement across all three

stages of the study. The mean score increased steadily from 57.57 in the pre-cycle to 68.48 in Cycle I and further to 85.90 in Cycle II, representing an overall gain of 28.33 points, or nearly a 49 percent increase from the

baseline. Likewise, the proportion of students meeting the Minimum Mastery Criterion (KKM = 70) rose dramatically—from only 19 percent (four students) in the pre-cycle, to 57 percent (twelve students) in Cycle I, and reaching 100 percent (all twenty-one students) in Cycle II. This steady upward trend indicates that the integration of the Problem-Based Learning (PBL) model with the Talintar (Smart Multiplication Table) media was highly effective in enhancing students' conceptual understanding and problem-solving ability in multiplication.

From a statistical standpoint, the progression of scores reveals both cognitive growth and improved distribution among learners. The lowest score improved from 40 to 75, while the highest score

increased from 70 to 100, suggesting that the intervention benefited not only high-achieving students but also those who initially struggled. This pattern signifies a reduction in learning disparity, showing that the PBL–Talintar integration fostered more equitable learning outcomes. The normalized gain (N-gain) value of 0.67 categorizes the learning improvement as medium to high according to Hake's (1998) benchmark, while an estimated Cohen's *d* effect size exceeding 2.0 suggests a very large practical effect. In educational research, such magnitudes indicate that the observed improvement is not a result of random variation but a meaningful transformation in students' learning achievement.

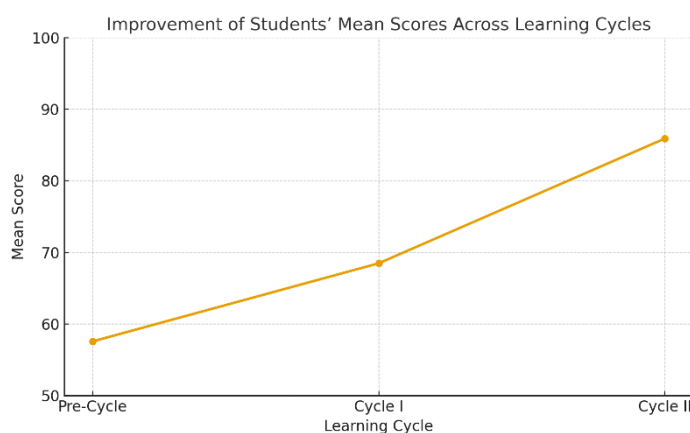


Figure 1. Trend of Students' Mean Mathematics Scores Across Learning Cycles

Figure 1 illustrates the progressive improvement in students' mean mathematics scores across the three learning cycles. The graph shows a steady upward trajectory—from 57.57 in the pre-cycle to 68.48 in Cycle I and further to 85.90 in Cycle II—indicating a consistent and cumulative learning gain. The initial rise between the pre-cycle and Cycle I reflects students' early adaptation to the Problem-Based Learning (PBL) approach combined with Talintar media, which began to stimulate conceptual understanding and engagement. The sharper increase between Cycle I and Cycle II demonstrates consolidation of learning, suggesting that repeated exposure to PBL processes and visual scaffolding from Talintar significantly strengthened procedural fluency and problem-solving ability. This upward trend supports the quantitative findings that the N-gain (0.67) and effect size ($d \approx 2.3$) signify meaningful educational improvement. Pedagogically, the pattern confirms that sustained implementation of student-centred learning supported by concrete visual tools can yield exponential progress in mathematics achievement, validating the intervention's effectiveness both statistically and practically.

Discussion

The findings of this study reveal that the integration of the Problem-Based Learning (PBL) model with Talintar (Smart Multiplication Table) media has strong pedagogical implications for improving mathematics learning at the elementary level. The steady rise in students' mean scores—from 57.57 in the pre-cycle to 85.90 in Cycle II—shows that the intervention not only enhanced academic performance but also transformed the learning process from teacher-centred instruction to active, student-driven exploration. In the context of mathematics education, where abstraction often becomes a barrier, Talintar provided concrete visual scaffolding that helped students grasp the structure and logic of multiplication. At the same time, PBL created opportunities for students to discuss, hypothesize, and test ideas collaboratively. This synergy between model and media aligns with the principles of constructive alignment (Fang, Zakaria, & Iwani, 2023), in which learning activities and assessment are directly connected to the intended learning outcomes. Consequently, students became more engaged in cognitive processes such as analysis, reasoning, and

self-evaluation, fulfilling the goals of inquiry-based mathematics instruction.

The improvement in students' achievement is closely tied to both cognitive and affective developments stimulated by the PBL-Talintar approach. Cognitively, students advanced from mechanical memorization of multiplication facts toward conceptual understanding and strategic problem-solving. The use of Talintar media supported dual-channel information processing—verbal and visual—allowing students to internalize numerical relationships more efficiently. This confirms the relevance of dual-coding theory (Paivio, 2014), which posits that learning improves when verbal information is paired with visual representation. Affectively, the intervention fostered motivation, curiosity, and confidence. Observation data showed that in Cycle II, nearly all students participated actively in discussions and were confident to present their findings. Such behaviour aligns with self-determination theory (Mumpuni, 2024), which emphasizes that autonomy, competence, and relatedness enhance intrinsic motivation. Through problem-based inquiry and visual scaffolding, students felt ownership over their learning process, which in turn strengthened both academic achievement and positive attitude toward mathematics.

From a theoretical perspective, the study's results reinforce the constructivist and sociocultural frameworks of learning. According to (Zakaria, 2024) zone of proximal development, learning occurs most effectively when students engage in social interaction mediated by cultural tools. In this study, PBL served as the social platform, facilitating interaction, negotiation, and shared meaning-making, while Talintar acted as a mediational artefact, bridging abstract mathematical concepts with tangible experience. The integration of these two dimensions enabled students to move gradually from guided practice to independent mastery. Furthermore, this pedagogical model aligns with Bruner's discovery learning theory, which highlights that knowledge gained through exploration is retained longer and applied more flexibly. The iterative structure of the classroom action research cycles provided opportunities for reflection and refinement, embodying a spiral learning process where feedback loops continuously elevated students' conceptual depth. Thus, the findings not only validate the theoretical underpinnings of PBL but also extend them through the inclusion of locally contextualized media such as Talintar, proving that culturally grounded instructional tools can effectively complement global pedagogical theories.

The results of this study correspond with and extend the outcomes of previous research on both PBL and media-assisted learning. (Martin & Jamieson-

Proctor, 2022) reported that the application of PBL in mathematics improved learning outcomes by 27% through enhanced student engagement and reasoning. (Arici & Yilmaz, 2023) found that the use of arithmetic-based learning media increased comprehension and reduced calculation errors. Similarly, Widana and (Shi, Tang, Zhang, Feng, & Li, 2024) observed that PBL integrated with ethnomathematics promoted collaboration and higher-order thinking skills. The current study strengthens these findings by showing that combining PBL with Talintar media results in not only cognitive but also affective and behavioural gains. Unlike prior studies that implemented PBL or learning media independently, this research demonstrated a synergistic interaction between pedagogy and tool: PBL structured inquiry and dialogue, while Talintar concretized abstract mathematical principles. This integration produced a substantial effect size (Cohen's $d \approx 2.3$) and an N-gain of 0.67, both of which exceed typical results reported in similar classroom interventions (Shongwe, 2024). Hence, this study contributes new empirical evidence that context-sensitive pedagogical innovation—grounded in student-centred inquiry and aided by visual media—can yield transformative learning outcomes in mathematics education.

Although the results are highly positive, several limitations must be acknowledged. First, the research was conducted with a small sample of 21 students from a single elementary school (SDN Sapeken VIII), which limits the generalizability of the findings. Future studies should involve larger and more diverse populations across multiple schools to strengthen external validity. Second, the study design used a Classroom Action Research (CAR) approach without a control group, making it difficult to isolate the effects of PBL + Talintar from other contextual variables such as teacher skill or classroom climate. Subsequent research could adopt quasi-experimental or mixed-method designs to examine causal relationships more rigorously. Third, the focus was limited to the topic of multiplication; extending the intervention to other mathematical domains (e.g., division, fractions, or geometry) could provide a more comprehensive view of its applicability. Finally, while quantitative improvement was well documented, more detailed qualitative analysis—such as discourse analysis of student interactions or longitudinal tracking of conceptual change—would enrich understanding of how PBL and Talintar media jointly influence mathematical thinking. Addressing these limitations will enhance the robustness, scalability, and theoretical contribution of future investigations.

Conclusion

The present study demonstrated that the integration of the Problem-Based Learning (PBL) model with Talintar (Smart Multiplication Table) media was highly effective in improving elementary students' mathematics achievement, particularly in mastering column multiplication concepts. Quantitative findings revealed a steady increase in the mean score from 57.57 in the pre-cycle to 68.48 in Cycle I and 85.90 in Cycle II, with all students (100 %) achieving the minimum mastery criterion by the end of the intervention. The computed N-gain of 0.67 and a large effect size ($d \approx 2.3$) confirm the substantial impact of the PBL-Talintar model on student learning outcomes. Beyond numerical gains, classroom observations indicated noticeable improvements in student participation, motivation, confidence, and collaborative behaviour, reflecting positive changes in both cognitive and affective domains. Pedagogically, this integrative model shifted classroom practice from traditional, teacher-centred instruction toward a more interactive and student-oriented learning environment. The iterative reflection inherent in the Classroom Action Research design allowed teachers to continuously refine instructional strategies, making the learning process more adaptive and responsive. The combination of inquiry-based learning (PBL) and concrete visual media (Talintar) successfully bridged the gap between abstract mathematical ideas and tangible learning experiences, enabling students to construct understanding through hands-on exploration and social interaction. These findings validate the theoretical perspectives of constructivism and dual-coding, emphasizing that knowledge is internalized more effectively when cognitive, social, and visual dimensions interact synergistically.

In summary, the implementation of the Talintar-based PBL model not only enhanced mathematical performance but also cultivated key 21st-century competencies such as problem-solving, collaboration, and self-regulated learning. Therefore, this model can be considered a sustainable and contextually relevant instructional innovation for elementary mathematics, particularly in developing regions that seek to align classroom practices with active learning principles promoted by the Kurikulum Merdeka framework.

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References

- Ahmad, B., Zulfiqar, A., & Khan, A. N. (2024). Studying the Effect of Problem-Based Learning on Mathematics Achievement of Elementary Students. *Journal of Excellence in Social Sciences*, 3(2), 125–136. Retrieved from https://www.researchgate.net/publication/382991135_Studying_the_Effect_of_Problem-Based_Learning_on_Mathematics_Achievement_of_Elementary_Students
- Arici, F., & Yilmaz, M. (2023). An Examination of the Effectiveness of Problem-Based Learning Method Supported by Augmented Reality in Science Education. *Journal of Computer Assisted Learning*. Retrieved from <https://injournal.org/index.php/12/article/view/334>
- Arifin, I. N. (2024). Utilization of Visual Media Multiplication Smart Board in Mathematics Learning in Elementary Schools. *Al-Ibtida: Jurnal Pendidikan Guru MI*. Retrieved from <https://ftk.uinbanten.ac.id/journals/index.php/aiciel/article/download/10644/5069/31139>
- Astriani, F. (2022). Development of a Multiplication Learning Media for Elementary School Grade III: Multiple Math Card (MATHCA). *Jurnal Pendidikan Matematika*. Retrieved from <https://jpmipa.fkip.unila.ac.id/index.php/jpmipa/article/view/508>
- Fang, C. Y., Zakaria, M. I., & Iwani, N. E. (2023). A Systematic Review: Challenges in Implementing Problem-Based Learning in Mathematics Education. *International Journal of Academic Research in Progressive Education and Development*, 12(3). Retrieved from https://hrmars.com/papers_submitted/19158/a-systematic-review-challenges-in-implementing-problem-based-learning-in-mathematics-

- education.pdf
- Habibiyah, A., & Ridwan, M. (2025). Enhancing Elementary Students' Learning Outcomes through Visual Media-Driven Value Clarification Techniques. *AL-ISHLAH: Jurnal Pendidikan*, 17(2), 3018–3029.
- Hardiansyah, F., & Mulyadi. (2022). Improve Science Learning Outcomes for Elementary School Students Through The Development of Flipbook Media. *Jurnal Penelitian Pendidikan IPA*, 8(6), 3069–3077.
<https://doi.org/10.29303/jppipa.v8i6.2413>
- Hardiansyah, F., Sukitman, T., Wahdian, A., & Hodairiyah, H. (2024). The Use of Differentiated Digital Learning Models to Enhance Science Problem-Solving in Elementary Schools. *AL-ISHLAH: Jurnal Pendidikan*, 16(2), 1462–1474.
<https://doi.org/https://doi.org/10.35445/alishlah.v16i2.5087>
- Martin, A. D., & Jamieson-Proctor, R. (2022). Pre-service Teachers' Perceptions of Problem-based Learning for Developing their Mathematics Teaching Pedagogy. *Interdisciplinary Journal of Problem-Based Learning*, 16(1). Retrieved from <https://files.eric.ed.gov/fulltext/EJ1373020.pdf>
- Mumpuni, F. O. (2024). Development of Smart Board Media on the Ability to Count for Elementary Mathematics. *Prima: Jurnal Pendidikan Matematika*, 8(2), 424–435. Retrieved from <https://jurnal.umt.ac.id/index.php/prima/article/download/11322/5184>
- Munawaroh, Q., Wulandari, M. D., & Astuti, H. T. M. (2024). Improving Elementary School Students' Mathematics Problem Solving Skills through Problem-Based Learning (PBL) Based on Higher Order Thinking Skills (HOTS). *JENIUS: Journal of Education Policy and Elementary Education Issues*, 5(1), 1–11. Retrieved from https://www.researchgate.net/publication/382244289_Improving_Elementary_School_Students%27_Mathematics_Problem_Solving_Skills_through_Problem-Based_Learning_PBL_Based_on_Higher_Order_Thinking_Skills_HOTS
- Ridwan, M., & Firmansyah, M. B. (2025). Integrating Functional Conjunction Instruction within Bilingual Children's Story Texts: Effects of the Index Card Match Learning Model. *KEMBARA: Jurnal Keilmuan Bahasa, Sastra, Dan Pengajarannya*, 11(2), 614–625.
- Shi, P., Tang, Y., Zhang, Z., Feng, X., & Li, C. (2024). Effect of Physical Exercise in Real-World Settings on Executive Function of Atypical Children: A Systematic Review and Meta-Analysis. *Child: Care, Health and Development*.
<https://doi.org/10.1111/cch.13182>
- Shongwe, B. (2024). The effect of STEM problem-based learning on students' mathematical problem-solving beliefs. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(8).
<https://doi.org/10.29333/ejmste/14879>
- Sulastri, R. (2023). Application of Multiplication Method Using Math Multiplication Smart Board Learning Media. *Educenter Journal*. Retrieved from <https://jurnal.arkainstitute.co.id/index.php/educecenter/article/view/766>
- Teme, I. S. (2024). The Influence of Using Smart Multiplication Table Learning Media (TAKALINTAR) on the Learning Outcomes of Grade IIIA Students of SD Inpres Kuanino 3. *JIME: Journal of Innovation in Mathematics Education*. Retrieved from <https://ejournal.mandalanursa.org/index.php/JIME/article/download/7565/5318>
- Wahyuni, L. (2024). Development of Teaching Media of Multiplication Ketupat (Ketupel) on Improving the Ability to Count Multiplication of Grade III Elementary School Students. *Eduvest: Journal of Universal Studies*. Retrieved from <https://eduvest.greenvest.co.id/index.php/edv/article/download/1626/3371>
- Zakaria, M. I. (2024). *Unleashing Problem-Based Learning Method among Mathematics Teachers*. Retrieved from https://www.researchgate.net/publication/377804404_Unleashing_Problem-Based_Learning_Method_among_Mathematics_Teachers