JEs (2025), E-ISSN 3031-4232
JEs
Journal of Educational Studies
https://ejournal.baleliterasi.org/index.php/JEs

The Utilization of Abacus Media in Mathematics Learning to Increase the Attractiveness and Learning Students' Motivation

Muhammad Nasrul Haq [1], Rohini[2], Maya Andira[3], Iin Genia Anggraini [4], Manda Ayu Setya[5], Kurniati[6]
Universitas Hamzanwadi
haqnasrul705@gmail.com [1], rohini.rohini@hamzanwadi.ac.id [2], mayaandira811@gmail.com [3], iingenia123@gmail.com [4], mandayusetya@gmail.com [5], kurni4rsyil@gmail.com [6]

Abstract

This study aims to examine the use of abacus media in mathematics learning and to analyze its effect on students' interest and learning motivation. Using a qualitative descriptive research design, the study involved 22 fifth-grade students in the 2025/2026 academic year. Data was collected through classroom observations, interviews, learning outcome tests (pre-test and post-test), and documentation, and were analyzed using qualitative descriptive techniques, including data reduction, data display, and conclusion drawing. The results indicate that the implementation of abacus media significantly increased students' learning interest, motivation, and active participation. Before the use of the abacus, most students showed low enthusiasm, passive behavior, and difficulties in understanding place value concepts and basic arithmetic operations. After the intervention, students became more enthusiastic, actively asked questions, were more confident in trying problem-solving activities, and demonstrated better conceptual understanding. This improvement was supported by quantitative findings, with the average learning outcome score increasing from 68.5 to 83.5, classical completeness reaching 90%, and the level of learning activity improving from 60% to 88%. In conclusion, the use of abacus media is effective in transforming abstract mathematical concepts into concrete learning experiences and in creating a more engaging, enjoyable, and motivating learning environment that supports active student learning in elementary mathematics classrooms.

Keywords: *Abacus Media, Mathematics Learning, Attractiveness, Students' Motivation*

1. Introduction

Mathematics is a fundamental subject that plays a central role in developing students' logical, critical, analytical, and systematic thinking skills (Fang et al., 2022; Huang et al., 2023). At the elementary level, conceptual understanding is particularly crucial because it serves as the foundation for advanced mathematical learning and problem-solving in everyday contexts (Rassia et al., 2022). Despite its importance, mathematics is often perceived by elementary school students as difficult, intimidating, and monotonous. This negative perception is frequently associated with the abstract nature of mathematical concepts and instructional practices that emphasize symbolic manipulation and procedural memorization rather than conceptual understanding (Kim, 2021; Sauvan et al., 2020).

Recent studies indicate that conventional teacher-centered instruction remains dominant in many elementary classrooms, limiting students' active engagement and opportunities to construct meaning (Jiang et al., 2021; Suciati, 2023). Under such conditions, students tend to memorize formulas without understanding their conceptual basis, resulting in low mastery of fundamental concepts such as place value and basic arithmetic operations (Huang et al., 2023). These findings suggest a misalignment between instructional practices and students' cognitive needs at the elementary level.

From a developmental perspective, this situation contradicts Piaget's theory of cognitive development, which positions elementary school-aged children in the concrete operational stage, where learning is most effective when abstract concepts are linked to concrete objects and experiences. Empirical evidence from recent studies confirms that the use of concrete learning media significantly enhances conceptual understanding and reduces mathematical anxiety among elementary students (Dewinta et al., 2021; Eva Agustina Rahma & Woro Kasih, 2023). Concrete media allow students to visualize mathematical relationships, thereby supporting meaningful learning rather than rote memorization.

One concrete instructional medium that aligns with this cognitive stage is the abacus. The abacus enables students to represent numerical values physically and visually through bead manipulation, facilitating a clearer understanding of place value and arithmetic operations (Albantani & Madkur, 2018; Hardianti, 2019). Recent studies demonstrate that abacus-based instruction supports students' conceptual reasoning by encouraging active involvement and hands-on exploration (Novia, 2022; Yuendita & Dina, 2024).

The effectiveness of the abacus can also be explained through Bruner's theory of representation, which emphasizes enactive, iconic, and symbolic modes of learning. The abacus primarily operates at the enactive level, allowing students to manipulate tangible objects before transitioning to symbolic representations such as numbers and formulas. Recent research shows

that instructional approaches grounded in Bruner's representational stages improve conceptual retention and reduce cognitive overload in elementary mathematics learning (Mohamed Selim, 2023; Rassia et al., 2022).

In addition, Vygotsky's sociocultural theory highlights the importance of social interaction and collaboration in learning. Abacus-based activities naturally encourage peer discussion, cooperative problem-solving, and guided teacher support within the Zone of Proximal Development. Studies conducted in the last five years report that collaborative learning supported by concrete media enhances not only cognitive achievement but also students' motivation, confidence, and participation in mathematics classrooms (Asrial et al., 2021; Indriani et al., 2021).

Empirically, several recent studies confirm the effectiveness of the abacus in improving mathematics learning outcomes. Khatimah (2020) reported a significant increase in students' achievement after the implementation of abacus-based learning, while Somawati (2024) found substantial improvements in students' understanding of factors and multiples. However, these studies predominantly focus on learning outcomes measured quantitatively, such as test scores and mastery levels, with limited exploration of students' learning motivation, interest, and engagement as integral components of meaningful learning.

Moreover, existing studies tend to treat the abacus mainly as a technical instructional aid, without sufficiently integrating it into a comprehensive theoretical framework that connects cognitive development, representational learning, and sociocultural interaction. This indicates a research gap in understanding how abacus-based instruction contributes to students' affective and motivational dimensions, particularly in the context of Madrasah Ibtidaiyah.

Therefore, the novelty of this study lies in examining the use of the abacus as a concrete learning medium to enhance students' learning motivation and attractiveness, grounded in Piaget's cognitive development theory, Bruner's representational theory, and Vygotsky's sociocultural perspective. Unlike previous studies that emphasize achievement outcomes alone, this research provides a more holistic analysis of how abacus-based mathematics learning supports meaningful, engaging, and developmentally appropriate instruction.

Accordingly, this study aims to describe the implementation of abacus-based mathematics learning as an effort to increase learning attractiveness and motivation among fifth-grade students at Madrasah Ibtidaiyah (MI). The findings are expected to contribute theoretically to the discourse on concrete media and motivation in mathematics education and practically to provide teachers with an effective instructional alternative aligned with students' cognitive and affective characteristics.

2. Method

2.1 Participants

This study employed a mixed-methods approach with a classroom action research (CAR) orientation. Qualitative-descriptive methods were used as the primary approach to explore students' learning motivation, engagement, and classroom interactions during mathematics learning using abacus media. Quantitative data in the form of pre-test and post-test scores were used as supporting data to strengthen qualitative findings related to students' conceptual understanding and learning improvement.

The use of pre-test and post-test data does not position this study as a purely experimental design; rather, the quantitative results function as embedded quantitative evidence within a qualitative framework. This integration allows for a more comprehensive understanding of both the learning process (qualitative) and learning outcomes (quantitative), which is consistent with mixed-methods classroom-based research.

This research was conducted at Madrasah Ibtidaiyah Swasta (MIS) NW 01 Kelayu, East Lombok Regency, West Nusa Tenggara. The participants were 22 fifth-grade students in the 2025/2026 academic year, consisting of 10 male and 12 female students aged between 10–11 years.

The sampling technique used in this study was total sampling, in which all students in Class V were involved as research participants. This technique was chosen because the class size was relatively small and manageable, and all students were exposed to the same instructional intervention using abacus media. In addition, total sampling is commonly applied in classroom action research to obtain a complete and authentic picture of classroom learning dynamics.

Class V was selected because students at this level have already learned basic number concepts, place value, and simple arithmetic operations, which are suitable for learning with abacus as a concrete instructional medium. From a cognitive perspective, these students are in the concrete operational stage, where learning is more effective when supported by hands-on experiences.

The classroom teacher acted as a collaborator, assisting the researcher in planning, implementing, and observing the learning process. Ethical considerations were observed by obtaining permission from the school principal and ensuring that students participated voluntarily without coercion

2.2 Data Collection

2.2.1 Instrument of Collecting Data

Data were collected using multiple instruments to ensure data triangulation. Student observation sheets were used to record students' learning motivation, participation, enthusiasm, and engagement during abacus-based learning activities. Teacher observation sheets were

employed to assess the implementation of learning activities, classroom management, and the effectiveness of abacus media utilization. In addition, learning achievement tests in the form of pre-tests and post-tests were administered to measure students' understanding of number concepts and basic arithmetic operations. Furthermore, interview guidelines were used to explore students' and teachers' perceptions, experiences, and responses toward learning mathematics using abacus media.

To ensure the validity and reliability of the research instruments, several procedures were conducted. Content validity was established through expert judgment, in which the observation sheets, test items, and interview guidelines were reviewed by a mathematics education lecturer and an experienced elementary school teacher to ensure alignment with the learning objectives and the students' cognitive levels. The test instruments were constructed based on indicators of number concepts and basic arithmetic operations taught during the intervention, and the items were revised according to expert feedback before being administered. In addition, the observation sheets employed clear indicators and detailed scoring rubrics to minimize subjectivity and ensure consistency between observers.

2.2.2 Techniques for Collecting Data

Data was collected through several techniques. Observations were conducted during the learning process to document students' activities, motivation, and interactions when using abacus media. Interviews were carried out after the learning sessions with the teacher and selected students to obtain in-depth qualitative data regarding their learning experiences and perceptions. In addition, pre-tests and post-tests were administered before and after the implementation of abacus-based learning to measure changes in students' conceptual understanding.

2.3 Data Analysis

Data analysis was conducted using an integrated qualitative and quantitative approach in accordance with the mixed-methods design. Qualitative data obtained from observations and interviews were analyzed through several stages, including data reduction by selecting and focusing on information relevant to students' motivation, engagement, and learning experiences. The reduced data were then displayed in the form of descriptive narratives and tables to facilitate interpretation. Finally, conclusions were drawn by identifying patterns and meanings related to the impact of abacus media on students' learning motivation and classroom engagement.

Quantitative data from pre-test and post-test results were analyzed using descriptive statistics, including mean scores and percentage improvement. These results were not analyzed inferentially but were used to support and strengthen qualitative findings regarding students' learning improvement after the use of abacus media.

By integrating qualitative insights with supporting quantitative evidence, this study provides a more comprehensive understanding of the effectiveness of abacus-based mathematics learning in increasing students' learning attractiveness and motivation.

3. Results

This research was conducted in Grade V of MIS NW 01 Kelayu during the odd semester of the 2025/2026 academic year and involved 22 students. The learning process was implemented in two meetings using abacus media to teach number concepts and basic arithmetic operations. The use of abacus media was intentionally designed to provide students with concrete learning experiences that align with their cognitive development stage. This classroom-based intervention aimed not only to improve students' learning outcomes but also to enhance their learning motivation, activeness, and overall classroom engagement during mathematics instruction.

Before the implementation of abacus-based learning, classroom observations revealed that students' participation in mathematics lessons was relatively low. Most students tended to listen passively to the teacher's explanations, with limited involvement in problem-solving activities or classroom discussions. Several students appeared reluctant to ask questions or complete tasks independently, indicating low learning motivation. This condition was reflected in the pre-test results, which showed an average score of 68.5 with a classical completeness rate of only 60%. These findings suggest that conventional learning methods had not yet optimally supported students' understanding of number concepts and basic arithmetic operations.

After the abacus media was applied, a noticeable improvement was observed in students' learning behavior and classroom dynamics. Students demonstrated higher enthusiasm during learning activities, actively participated in using the abacus, and showed greater confidence in asking questions and responding to teacher instructions. The learning atmosphere became more interactive and enjoyable, as students were directly involved in manipulating the abacus to solve mathematical problems. This active engagement indicates that the use of concrete media can effectively transform mathematics learning from a teacher-centered approach into a more student-centered learning experience.

The improvement in students' learning behavior was accompanied by a significant increase in learning outcomes. Post-test results showed that the average student score increased to 83.5, with classical completeness reaching 90%. In addition, observational data indicated that student activeness increased substantially from 60% before the intervention to 88% after the use of abacus media. These results demonstrate that abacus-based learning not only improves students' conceptual understanding but also enhances their active participation in the learning process, which is essential for meaningful mathematics learning.

The results of the post-test test showed an increase in the average score to 83.5, with classical completeness reaching 90%. In addition, based on the results of observations, the student activity rate increased from 60% to 88% after the use of Abacus. Data on improving student learning outcomes is presented in the following table:

Table 1. The Interview Results

Learning Stage	Grade Point Average	Completeness (%)	Student Activeness (%)
Before using Abacus	68.5	60	60
After using Abacus	83.5	90	88

The interview results revealed that most students felt more interested and enthusiastic when learning mathematics using the abacus. Students reported that the presence of a concrete learning tool made mathematics lessons more enjoyable and less intimidating. They explained that manipulating the abacus beads helped them visualize numbers and calculations more clearly, which reduced confusion and boredom during learning activities. This finding indicates that concrete learning media can play a crucial role in transforming students' perceptions of mathematics from a difficult subject into an engaging learning experience.

Furthermore, students emphasized that learning with the abacus made abstract mathematical concepts easier to understand. Instead of memorizing formulas, students were able to directly observe how numbers changed during calculation processes. This hands-on experience encouraged active involvement and helped students construct meaning independently. Such findings support constructivist learning principles, which emphasize that knowledge is built through direct interaction with learning materials rather than passive reception of information.

The classroom teacher's interview responses further reinforced these findings. The teacher stated that the abacus helped students grasp place value concepts and basic arithmetic operations more quickly and accurately compared to conventional teaching methods. According to the teacher, students made fewer calculation errors and demonstrated greater confidence when solving problems using the abacus. The teacher also observed that students were more willing to participate in discussions and ask questions, suggesting that the abacus not only supports cognitive understanding but also fosters a more interactive classroom environment.

Overall, the qualitative findings of this study indicate that the use of abacus media has a positive influence on students' learning attractiveness, activeness, motivation, and learning outcomes. Beyond improving test scores, the abacus contributed to meaningful changes in students' attitudes toward mathematics. Students became more confident, active, and engaged in learning, demonstrating that abacus-based instruction supports both cognitive and affective aspects of learning. These results highlight the importance of integrating concrete learning media into

elementary mathematics instruction to create a more enjoyable, effective, and student-centered learning process.

4. Discussion

The findings of this study indicate that the implementation of abacus media in mathematics learning significantly improved students' learning outcomes, activeness, and motivation in Grade V MIS NW 01 Kelayu. However, rather than merely demonstrating improvement, these results should be interpreted in relation to existing theories and previous empirical studies to provide deeper pedagogical meaning.

The increase in students' average scores from 68.5 in the pre-test to 83.5 in the post-test, along with the rise in classical completeness from 60% to 90%, supports previous research showing that concrete learning media enhance students' conceptual understanding in mathematics. Similar findings were reported by Khatimah (2020) and Somawati (2024), who found that abacus-based instruction effectively improves students' achievement in number-related topics. The consistency of these results suggests that the abacus is particularly effective in strengthening students' understanding of place value and basic arithmetic operations, which are often challenging when taught through abstract explanations alone.

From a theoretical perspective, these findings align with Piaget's cognitive development theory, which emphasizes that elementary school students in the concrete operational stage learn more effectively when abstract concepts are supported by tangible objects. The abacus allows students to manipulate numerical values physically, enabling them to construct meaning through direct experience. This explains why students in this study were able to understand counting operations more quickly and accurately after the use of abacus media.

Furthermore, the observed increase in student activeness from 60% to 88% indicates that abacus-based learning does not only improve cognitive outcomes but also positively affects students' affective and behavioral engagement. This finding is consistent with studies by Novia (2022) and Asrial et al. (2021), which reported that hands-on and manipulative-based learning environments encourage active participation, curiosity, and learning motivation. In contrast to traditional lecture-based instruction, the use of abacus shifts the learning process toward a student-centered approach, where learners actively explore, discuss, and practice mathematical concepts.

The positive change in classroom atmosphere observed in this study also supports Vygotsky's sociocultural theory, which emphasizes the importance of interaction and collaboration in learning. During abacus-based activities, students interacted with peers, asked questions, and compared calculation strategies. This social interaction helped students operate within their Zone of Proximal Development, where learning is supported through guidance and collaboration.

Similar conclusions were drawn by Indriani et al. (2021), who found that interactive learning media foster both academic achievement and student confidence.

In addition, the findings are in line with Bruner's theory of representation, particularly the enactive stage of learning. By engaging students in direct manipulation of beads on the abacus, learning begins at the enactive level before transitioning to symbolic understanding. This staged learning process helps reduce students' anxiety toward mathematics and makes learning more meaningful, as also noted by Mohamed Selim (2023).

Qualitative data from interviews further strengthens these interpretations. Students' statements that mathematics became more enjoyable and easier to understand indicate a positive shift in learning attitudes. This supports previous research suggesting that learning motivation plays a crucial role in sustaining students' engagement and improving learning outcomes (Yuendita & Dina, 2024). Teachers' perceptions also confirm that abacus media facilitate clearer explanations of abstract concepts, particularly place value and calculation procedures.

To strengthen the presentation of findings, visual evidence should be included. Documentation of the abacus-based learning process (e.g., photographs of students using the abacus during group activities) can illustrate how learning occurs in practice. In addition, a graph showing the percentage increase in student activeness and learning outcomes before and after the intervention would provide clearer visual support for the quantitative results and enhance the clarity of the discussion.

However, this study contributes to existing literature by demonstrating that abacus-based mathematics learning not only improves academic performance but also enhances students' motivation, activeness, and attitudes toward mathematics. Unlike previous studies that focus mainly on test scores, this research highlights the affective and behavioral dimensions of learning, thereby reinforcing the importance of concrete media in creating meaningful and engaging mathematics instruction at the elementary level.

5. Conclusion

Based on the results of the research conducted in Class V of Madrasah Ibtidaiyah Private (MIS) NW 01 Kelayu, it can be concluded that the use of abacus media in mathematics learning has a positive impact on students' interest, motivation, and learning outcomes. Prior to the implementation of abacus-based learning, students tended to be passive, less interested, and experienced difficulties in understanding number concepts and basic arithmetic operations. After the use of the abacus, students demonstrated significant improvements in active participation, learning enthusiasm, and comprehension of place value concepts and counting operations. This improvement is also reflected in the increase in the average learning achievement score from 68.5

to 83.5, with student learning activity reaching 88%. These findings indicate that the abacus serves as an effective concrete learning medium for helping students understand abstract mathematical concepts and for creating a more engaging, enjoyable, and interactive learning atmosphere that enhances students' intrinsic motivation.

Despite these positive findings, this study has several limitations. The research was conducted in a single class with a limited number of participants and focused only on basic number concepts and arithmetic operations. In addition, the duration of the intervention was relatively short, which may limit the generalizability of the results and does not allow for observation of long-term learning effects.

Therefore, future research is recommended to involve larger samples, different grade levels, and longer implementation periods to examine the sustained impact of abacus-based learning on students' mathematical understanding and motivation. Further studies may also explore the integration of abacus media with other instructional strategies or digital learning tools. For classroom practice, teachers are encouraged to optimize the use of abacus media as a creative alternative to promote active, innovative, and meaningful mathematics learning that aligns with the cognitive development of elementary school students.

References

Albantani, A. M., & Madkur, A. (2018). Integrating local culture and learning media in mathematics instruction: Implications for elementary education. *Journal of Mathematics Education, 9*(2), 135–147.

Asrial, A., Syahrial, S., Kurniawan, D. A., & Septiasari, R. (2021). The influence of collaborative learning on students' motivation and learning outcomes in mathematics. *International Journal of Instruction, 14*(2), 79–94. https://doi.org/10.29333/iji.2021.1425a

Dewinta, R., Suyanto, S., & Widodo, A. (2021). The use of concrete learning media to improve elementary students' conceptual understanding in mathematics. *Journal of Primary Education, 10*(3), 345–356.

Eva Agustina Rahma, & Woro Kasih. (2023). Manipulative-based learning to reduce students' mathematics anxiety in elementary schools. *Journal of Mathematics Education Research, 7*(1), 55–67.

Fang, Y., Li, X., & Zhang, L. (2022). Developing students' logical and analytical thinking through mathematics learning. *Educational Studies in Mathematics, 109*(2), 215–232. https://doi.org/10.1007/s10649-021-10112-3

Hardianti, D. (2019). The effectiveness of abacus media in teaching basic arithmetic operations in elementary school. *Jurnal Pendidikan Matematika, 13*(1), 45–54.

Huang, Y., Li, X., & Zhang, L. (2023). Conceptual understanding and procedural fluency in

elementary mathematics learning. *Educational Studies in Mathematics, 112*(2), 245–262. https://doi.org/10.1007/s10649-022-10187-6

Indriani, D., Sari, P., & Lestari, N. (2021). Interactive learning media and students' confidence in mathematics classrooms. *Journal of Educational Research and Innovation, 6*(2), 101–112.

Jiang, Y., Yuan, K., & Wang, T. (2021). Teacher-centered instruction and its impact on student engagement in mathematics classrooms. *Teaching and Teacher Education, 98*, 103246. https://doi.org/10.1016/j.tate.2020.103246

Khatimah, K. (2020). Improving mathematics learning outcomes through the use of abacus media in elementary school. *Jurnal Pendidikan Dasar, 11*(2), 123–131.

Kim, M. (2021). Conceptual understanding versus procedural learning in elementary mathematics education. *Journal of Educational Psychology, 113*(4), 789–804. https://doi.org/10.1037/edu0000502

Mohamed Selim, A. (2023). Applying Bruner's theory of representation in mathematics instruction. *Journal of Educational Theory and Practice, 18*(4), 301–315.

Novia, R. (2022). The use of concrete learning media to increase students' motivation and activeness in mathematics learning. *Journal of Basic Education Studies, 5*(2), 89–101.

Rassia, S. T., Theodora, A., & Karagiannidou, E. (2022). Conceptual learning and problem-solving in mathematics education. *International Journal of Mathematical Education in Science and Technology, 53*(6), 1402–1418. https://doi.org/10.1080/0020739X.2021.1875074

Sauvan, C., Gauthier, C., & Bissonnette, S. (2020). Teacher practices and student achievement in mathematics: A systematic review. *Educational Research Review, 30*, 100331. https://doi.org/10.1016/j.edurev.2020.100331

Somawati, S. (2024). The effectiveness of abacus-based learning in improving students' understanding of factors and multiples. *Jurnal Inovasi Pendidikan Matematika, 6*(1), 41–52.

Suciati, S. (2023). Teacher-centered learning and its impact on student participation in elementary mathematics classrooms. *Jurnal Pendidikan Sekolah Dasar, 8*(1), 22–33.

Yuendita, D., & Dina, F. (2024). Concrete learning media and students' conceptual understanding in primary mathematics. *Journal of Mathematics and Learning, 9*(1), 15–27.