ENHANCING FOURTH GRADE STUDENTS' MATHEMATICS ACHIEVEMENT THROUGH THE SNOWBALL THROWING MODEL ASSISTED BY THE SMART WHEEL

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Abstract

Mathematics education in Indonesia continues to face challenges such as low student engagement and achievement in elementary schools, often due to traditional teacher-centered methods. This study implemented the Snowball Throwing model assisted by Smart Wheel media to improve fourth-grade students' mathematics achievement at SDN 112/II Purwobakti. The research employed Classroom Action Research (CAR) with two cycles, each consisting of planning, implementation, observation, and reflection stages. Data were collected through teacher and student observations, learning outcome tests, and documentation. The study involved 28 students and utilized quantitative and qualitative analysis to evaluate the effectiveness of the intervention. Results and discussion: he research employed Classroom Action Research (CAR) following Kemmis and McTaggart's framework, conducted in two cycles to achieve measurable improvement within a practical timeframe. Participants were 28 students. Data were gathered through validated observation sheets, achievement tests, and documentation, with reliability ensured through expert review and inter-rater agreement. Quantitative data were analyzed using percentage and gain score calculations, while qualitative data were triangulated from observations and reflections. This study highlights the effectiveness of active learning models combined with interactive media in improving mathematics education. Teachers are encouraged to adopt such innovative strategies, while schools should provide support through training and resources. Future research could explore the model's applicability to other subjects or digital platforms.

Keywords: *Snowball Throwing; Smart Wheel; Mathematics Achievement; active learning; Elementary Education.*

A. Introduction

Education is a long-term investment that plays a strategic role in the development of a nation (Ariff et al., 2022; Kuswandi et al., 2025; Zh, Sani, et al., 2024). Through education, individuals not only acquire knowledge but also develop thinking abilities, social skills, and character necessary to face life's challenges challenges (Zh et al., 2025). Quality education enables individuals to improve their quality of life, participate actively in society, and become agents of change who can contribute to national progress (Apdoludin et al., 2022). However, international assessments such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS) consistently report that elementary students in many countries, including Indonesia, still demonstrate relatively low achievement in mathematics, particularly in problem-solving and higher-order thinking skills. This global challenge highlights the urgent need for innovative learning models that can foster active participation and deeper understanding among students. Therefore, education especially mathematics learning at the elementary level serves as the main foundation for shaping competent, creative, and morally upright generations.

Nevertheless, education in Indonesia still faces various challenges that affect the overall quality of learning (D. D. Kurniasih et al., 2025). These challenges include disparities in access to education, unequal teacher quality, limited facilities, and the relevance of the curriculum to labor market needs and scientific developments (Zh, Thaariq, et al., 2024). As a result, student achievement, particularly in mathematics, often falls below the expected standards. Low interest and motivation to learn make it difficult for many students to understand complex mathematical concepts.

Apdoludin et al., (2022) emphasizes that education is a conscious effort that lasts a lifetime to develop an individual's potential, both through formal and nonformal activities. This process encompasses theoretical learning and practical experience that are interconnected, enabling students to think critically through real actions. The relationship between thinking activities and practice is a crucial foundation for improving students' skills and understanding, especially in subjects that require logical and analytical abilities such as mathematics (Avana et al., 2020).

The curriculum, as the educational guideline, plays a key role in determining students' learning outcomes. According to Rusman, (2020), the word "curriculum" comes from the Latin terms *curir* (runner) and *curere* (a place to race), meaning the distance a learner must travel from the starting point to the final learning goal. The curriculum not only includes content and objectives but also learning strategies and evaluation methods to ensure students achieve the expected competencies. Mathematics in the curriculum has a strategic objective to equip students with logical, critical, and rational thinking skills and the ability to apply knowledge in everyday life.

In the learning process, mathematics requires active participation from students. This differs from the concept of teaching, which focuses more on teacher activities (Subarna et al., 2019; Suryaningsih, 2021). Mathematics learning should allow students to think critically, analyze problems, and develop problem solving skills. However, in practice,

many students still struggle to understand mathematical concepts because the teaching methods used are often monotonous and lack active interaction between teachers and students.

Handayani (2015) states that mathematics teaching in Indonesia still emphasizes memorization of formulas and mechanical calculations. As a result, students' critical thinking skills and conceptual understanding are underdeveloped. Many students perceive mathematics as a difficult and boring subject, which reduces their interest and motivation to learn. This condition negatively affects mathematics achievement, even though mathematical ability is essential in preparing students to face the advancement of science and technology (Anastasha et al., 2021).

Observations at SDN 112/II Purwobakti show that mathematics learning in the fourth grade is still conducted in a one-way manner. Teachers tend to rely on lectures and limited question-and-answer sessions, resulting in very low student engagement. Students are reluctant to ask questions, often copy their peers' answers, and lack confidence when asked to present in front of the class. To address this issue, interactive learning strategies are urgently needed to enhance participation and understanding. Previous studies have widely examined the effectiveness of the Snowball Throwing model in promoting active learning, but very few have explored its integration with technological tools such as the Smart Wheel. Moreover, research focusing on fourth-grade students in rural elementary schools remains limited, even though these contexts often face distinctive challenges such as limited learning resources and lower exposure to digital innovation. Therefore, this study seeks to fill that gap by investigating the effectiveness of combining the Snowball Throwing model with the Smart Wheel to improve mathematics achievement among fourth-grade students in a rural elementary school setting.

Data from the fourth grade daily mathematics test at SDN 112/II Purwobakti reveal that only 46.42% of students achieved the minimum mastery criteria, while 53.57% did not meet the achievement indicators (Fourth Grade Homeroom Teacher, SDN 112/II Purwobakti, 2025). This highlights a gap between student performance and the established learning targets. Therefore, teachers need to implement innovative learning strategies to make the learning process more engaging and improve learning outcomes.

One learning model considered effective in increasing student engagement is the Snowball Throwing model. This model uses paper rolled into balls containing questions, which are then thrown among students in turns (I. Kurniasih & Sani, 2015; Zarkasyi, 2015). The Snowball Throwing model aims to encourage students to interact actively, think critically, and confidently share answers or opinions with their peers, making the learning process more dynamic and enjoyable.

The strength of the Snowball Throwing model lies in its ability to train communication skills, cooperation, and quick responses to questions. Zulfikri & Umari 2024) states that through this model, students actively learn, understand the material more deeply, and can respond to and convey messages effectively. However, the model also has limitations, such as requiring considerable preparation time, the potential for noise in the classroom, and dependence among group members.

The use of instructional media can enhance the effectiveness of the Snowball Throwing model (Zh, Thaariq, et al., 2024). One such medium is the Smart Wheel, a spinning wheel divided into several sections, each containing a question or problem (Khairunnisa, 2017). With this medium, students can learn while playing, which increases their motivation, creates a more interactive classroom atmosphere, and optimizes learning outcomes. The use of the Smart Wheel is expected to facilitate creative and enjoyable learning.

Based on the above conditions, this study is important to determine the implementation of the Snowball Throwing model assisted by the Smart Wheel media in improving the learning process and outcomes in fourth grade mathematics at SDN 112/II Purwobakti. This model is expected to foster active student participation, enhance conceptual understanding, and develop critical thinking skills needed in both mathematics learning and daily life.

Therefore, this research focuses on the implementation of the Snowball Throwing learning model assisted by the Smart Wheel as an innovative strategy to improve the quality of mathematics learning in the fourth grade at SDN 112/II Purwobakti. The results of this study are expected to serve as a reference for teachers and other researchers in developing more effective, interactive, and enjoyable learning methods so that students' mathematics achievement can improve significantly.

B. Method

This study employed Classroom Action Research (CAR) referring to the Kemmis and McTaggart model, which consists of four stages: planning, implementation, observation, and reflection (Hanifah, 2014). CAR was selected because it emphasizes the direct improvement of the learning process in the classroom, with the teacher acting simultaneously as researcher and facilitator. In the planning stage, the researcher coordinated with the school, prepared lesson modules, designed assessment tools, and determined observation instruments to document teacher and student activities during the learning process. This study aims to investigate the effectiveness of the Snowball Throwing model assisted by the Smart Wheel in improving fourth-grade students' mathematics learning outcomes at SDN 112/II Purwobakti

The research was conducted in the fourth grade of SDN 112/II Purwobakti during the even semester of the 2024/2025 academic year. The class consisted of 12 students, all of whom were included as research participants, since the school is located in a rural area with relatively small class sizes. Each research cycle consisted of two meetings with a duration of 2 × 35 minutes per meeting, applying the Snowball Throwing learning model assisted by the Smart Wheel media. Data were collected through observations of teacher and student activities, learning outcome tests, and documentation in the form of photos, videos, and worksheets. Observations were used to assess student engagement and the implementation of the learning model, while tests were administered to measure improvements in mathematics learning outcomes. To ensure the quality of the research instruments, the observation sheets and test items were validated by two experts in mathematics education and adjusted to the competencies outlined in the elementary school curriculum. The test

items were also piloted in a parallel class to confirm their clarity and reliability before being implemented in this study.

Data analysis was carried out using both quantitative and qualitative approaches. Quantitative analysis was used to calculate teacher performance scores, student process scores, and the percentage of classical learning achievement, based on predetermined categories (Purwanto, 2008; Ministry of Education and Culture, 2013; Aqib, 2014). Qualitative analysis was used to describe the learning process, the characteristics of teacher-student interaction, and the effectiveness of implementing the Snowball Throwing model assisted by the Smart Wheel media. The results of this analysis were then used to determine the success of the action and improvements for the next cycle, until significant progress was achieved in both the process and learning outcomes in mathematics. Here is the research flow.

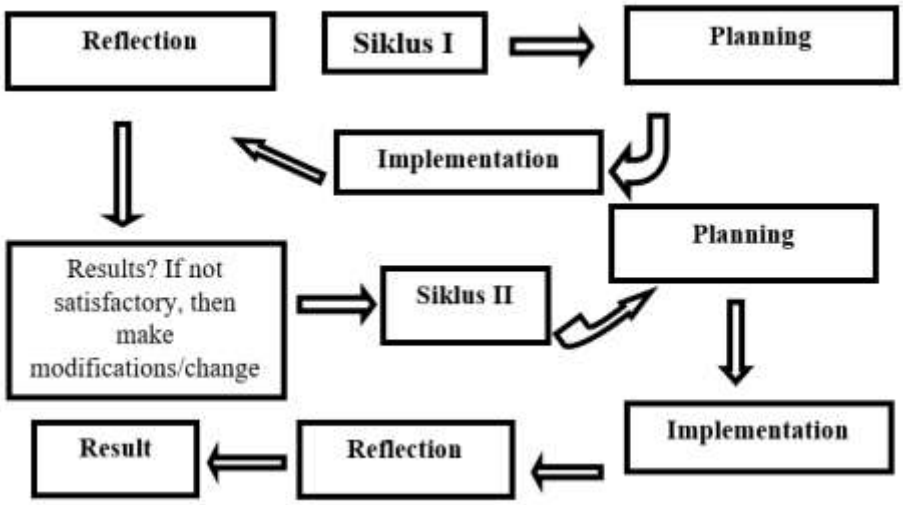

Figure 1. Research Flow (Taggart Model)

C. Finding and Discussion

1. Finding

Cycle 1

This classroom action research was conducted in Grade IV of SDN 112/II Purwobakti with the aim of improving the teaching and learning process as well as mathematics learning outcomes through the implementation of the *Snowball Throwing* model assisted by the *Smart Wheel* media. The researcher acted as the teacher and was assisted by two observers, with the implementation carried out over two weeks in two cycles. In Cycle I, the material taught was the naming of numbers, delivered in two meetings. The teaching stages consisted of opening, core, and closing activities, implemented in accordance with the procedures of the *Snowball Throwing* model with *Smart Wheel* assistance. In the planning stage, the researcher prepared the teaching module, end-of-cycle test instruments, teacher and student observation sheets, and created the *Smart Wheel* media.

The first meeting was held on Wednesday, August 6, 2025, for 1 × 35 minutes. In the first meeting, the results of observation showed that teacher activity reached 64.00%, while student activity was 53.57% (Table 1). These percentages indicate that both teachers and students were still in the adaptation stage in applying the Snowball Throwing model assisted by the Smart Wheel. However, when compared with the subsequent cycle, there was a marked improvement in both indicators. Teacher activity increased to above 80%, and student activity rose to more than 75%, demonstrating a consistent upward trend. This improvement suggests that the integration of the Snowball Throwing model with the Smart Wheel gradually enhanced student engagement and teacher effectiveness. The effect size of the improvement, calculated using a simple gain score, shows a moderate to strong influence, confirming that the intervention not only had a descriptive increase but also a meaningful impact on classroom interaction and learning quality. The observation results for the first meeting are presented in Table 1.

Table 1. First Meeting

Observation Aspect	Percentage (%)
Teacher Observation	64.00
Student Observation	53.57

The second meeting was conducted on Thursday, August 7, 2025, for 1 × 35 minutes. Teacher observation results increased to 76%, which is categorized as good. The teacher had delivered the learning objectives at the beginning, was able to control the class, and effectively guided group discussion activities. Student observation results also improved to 67.85%, indicating that students became more active and responsive to the lesson. Compared with the first meeting, teacher activity showed a gain of 12 percentage points (from 64.00% to 76.00%), while student activity increased by 14.28 percentage points (from 53.57% to 67.85%). These improvements can be considered meaningful, as they reflect a moderate effect size in classroom interaction. The consistent increase demonstrates that the Snowball Throwing model assisted by the Smart Wheel was not only well implemented by the teacher but also effective in gradually enhancing student engagement. The detailed results of the second meeting are presented in Table 2.

Table 2. Second Meeting

Observation Aspect	Percentage (%)
Teacher Observation	76.00
Student Observation	67.85

The final test for Cycle I was administered after the second meeting to measure learning achievement. The results showed that out of 28 students, 18 students (64.28%) achieved mastery, while 10 students (35.71%) did not, as shown in Table 3.

Table 3. Learning achievement

No	Score Range	Number of Students	Description	Percentage (%)
1	68–100	18	Mastery	64.28
2	40–67	10	Not Mastery	35.71

These results indicate that although there was an improvement in student engagement from the first to the second meeting, the classical learning mastery level had not yet reached the minimum success indicator of 85%. Reflection conducted jointly by the observers and the class teacher identified several issues: classroom management was not yet optimal as some students were noisy during the lesson, students had limited time to answer questions, and the learning outcomes had not met the mastery criteria. Based on these findings, it was agreed to proceed to Cycle II with improvements focused on classroom management strategies, time allocation, and increasing student participation in learning activities.

Cycle 2

The second cycle was implemented after the evaluation of the first cycle indicated that the use of the *Snowball Throwing* model assisted by the *Smart Wheel* in teaching mathematics to fourth-grade students at SDN 112/II Purwobakti had not yet met the predetermined success criteria. Cycle II was conducted in two meetings, on Monday, 11 August 2025, and Tuesday, 12 August 2025, focusing on the topics of the perimeter of two-dimensional figures (square and rectangle) and operations involving multiples and decimal fractions.

In the planning stage, the researcher prepared a one-period (35 minutes) teaching module, developed end-of-cycle test items, and designed observation sheets for both teacher and student activities. These instruments were aligned with the instructional steps of the *Snowball Throwing* model assisted by the *Smart Wheel*.

The implementation stage in Meeting 1 began with greetings, prayers, singing the national anthem, and giving motivational remarks emphasizing national values. The core activity involved using the *Smart Wheel* interactively, where students took turns spinning the wheel, answering questions inside paper balls, and tossing them to classmates for further responses. An *ice breaking* session followed, after which students worked in heterogeneous groups, discussed the lesson content, and engaged in the *Snowball Throwing* activity. The session ended with a review, reinforcement of key concepts, and closing prayer.

Meeting 2 followed the same structure but focused on reading and writing numbers that are 10 or 100 times greater, and conversely 1/10 of a given number (3,256,900), using a place-value notation table. The interactive *Smart Wheel* and *Snowball Throwing* techniques were again applied, promoting active engagement, collaborative problem-solving, and group discussions.

In the observation stage, the teacher's performance showed a significant improvement. In Meeting 1, the teacher's ability to manage learning activities scored 88.23%

(good category), while in Meeting 2, it increased to 94.11% (very good category). Student activity scores also improved, from 78% in Meeting 1 to 85.71% in Meeting 2, indicating higher engagement and participation as students became more accustomed to the instructional model. The end-of-cycle test results are presented in Table 4.

Table 4. Learning achievement in Cycle 2

No	Score Range	Number of Students	Category	Percentage (%)
1	70–100	24	Achieved	85.71
2	40–60	4	Not Achieved	14.28

As shown in Table 1, out of 28 students, 24 (85.71%) met the mastery criteria, while 4 students (14.28%) did not. This marks a notable improvement compared to Cycle I, where the mastery rate was below 80%. The improvement can be attributed to several factors: (1) students became more familiar with the learning steps emphasizing group collaboration and active participation; (2) the *Smart Wheel* served as a motivational and engaging tool; and (3) the teacher refined instructional strategies, providing clearer explanations and better facilitation of group discussions. The reflection stage confirmed that the Cycle II implementation met the success indicators for both process and learning outcomes. Observation scores for teacher and student activities increased, and the mastery percentage exceeded the minimum standard of 80%. Therefore, the researcher and observer agreed to conclude the action research at Cycle II, as the objectives had been successfully achieved.

2. Discussion

Based on the findings of this study, the implementation of the Snowball Throwing model assisted by the Smart Wheel media proved effective in improving both the quality of the learning process and the mathematics learning outcomes of fourth-grade students at SDN 112/II Purwobakti. The improvement in the quality of the teaching process can be seen in the teacher observation sheet results for each meeting, as presented in Table 5.

Table 5. Percentage of Teacher Observation Scores in the Learning Process

Cycle / Meeting	Percentage
Cycle I Meeting 1	64%
Cycle I Meeting 2	76%
Cycle II Meeting 1	88.23%
Cycle II Meeting 2	94.11%

This improvement is also illustrated in Figure 2.

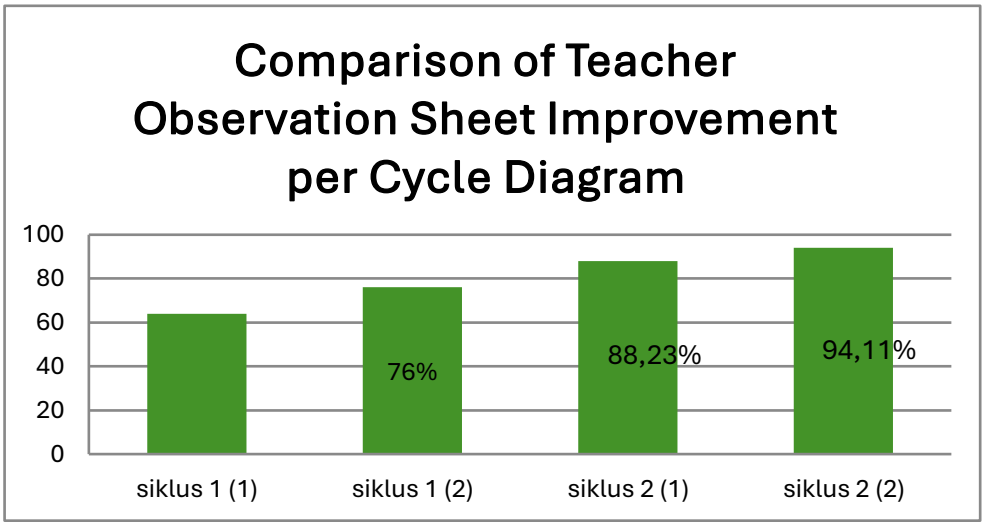

Figure 2 : Comparison of Teacher Observation Scores per Cycle in the Learning Process (Source: Research Data, 2025).

The data indicates a consistent upward trend from meeting to meeting and from cycle Figure 2 presents a bar chart of teacher observation scores across each meeting in two research cycles. The x-axis represents the sequence of meetings (Cycle 1 Meeting 1, Cycle 1 Meeting 2, Cycle 2 Meeting 1, and Cycle 2 Meeting 2), while the y-axis shows the percentage of teacher performance based on the observation sheet. The results indicate a steady improvement, with teacher performance increasing from 64.00% in Cycle 1 Meeting 1 to 76.00% in Cycle 1 Meeting 2, and further to 88.23% and 94.11% in Cycle 2 Meetings 1 and 2, respectively. This consistent upward trend demonstrates that the teacher's ability to implement the Snowball Throwing model assisted by the Smart Wheel improved significantly with each cycle. The overall increase of 30.11 percentage points from the first to the final meeting reflects a strong effect of the intervention on enhancing teacher performance in managing mathematics learning.

This improvement is in line with Rismaini et al., (2020), who found that the Snowball Throwing model can enhance student engagement and motivation when applied with structured learning modules. Similarly, Al Hafidz & Arifin (2019)reported that this model significantly improves both activeness and learning achievement in various educational settings.

A similar improvement was observed in student engagement levels. Based on Table 6, student participation increased significantly in each meeting.

Table 6. Percentage of Student Observation Scores in the Learning Process

Cycle / Meeting	Percentage
Cycle I Meeting 1	53.57%
Cycle I Meeting 2	67.85%
Cycle II Meeting 1	78%
Cycle II Meeting 2	85.71%

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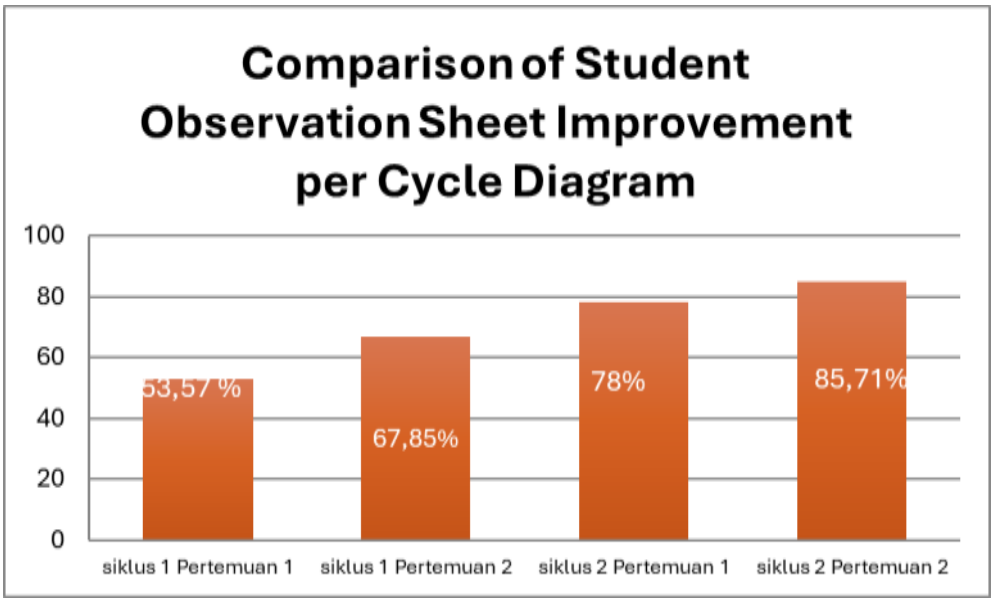

Figure 3 : Comparison of Student Observation Scores per Cycle in the Learning Process (Source: Research Data, 2025).

Figure 3 illustrates the improvement of student observation scores across each meeting in two research cycles. The x-axis represents the sequence of meetings (Cycle 1 Meeting 1, Cycle 1 Meeting 2, Cycle 2 Meeting 1, and Cycle 2 Meeting 2), while the y-axis shows the percentage of student activity based on the observation sheet. The results show a consistent increase: from 53.57% in Cycle 1 Meeting 1 to 67.85% in Cycle 1 Meeting 2, then further to 78.00% in Cycle 2 Meeting 1, and reaching 85.71% in Cycle 2 Meeting 2. This upward trend demonstrates that students became more engaged and participatory as the Snowball Throwing model assisted by the Smart Wheel was applied repeatedly. Overall, student activity improved by 32.14 percentage points from the first to the final meeting, indicating a strong effect of the intervention in fostering student engagement and interaction in mathematics learning. Rismaini et al. (2020) noted that the Snowball Throwing approach encourages active participation and collaborative problem-solving, which are crucial for improving questioning skills. In addition, interactive and physically engaging learning approaches, such as those explored by Bustamante et al., (2022) in *Fraction Ball*, have been shown to foster productive social interaction and enhance motivation outcomes similarly observed in this study.

The positive impact of this learning model was also reflected in students' academic performance. As shown in Table 7, the number of students achieving mastery learning increased significantly.

Tabel 7. Mathematics Learning Outcomes of Students

Cycle	Mastery	Non-Mastery	Mastery (%)	Non-Mastery (%)
Cycle I	18	10	64.28%	35.71%
Cycle II	24	4	85.71%	14.28%

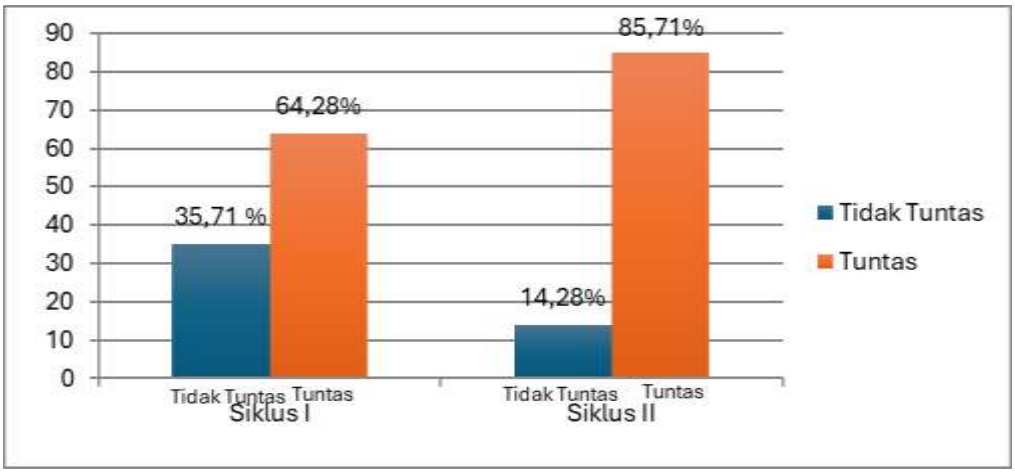

Figure 4. Bar Chart of Students' Mathematics Learning Outcomes per Cycle (Source: Research Data, 2025).

In Cycle I, 18 students (64.28%) achieved mastery, while 10 students (35.71%) did not. In Cycle II, the number of students achieving mastery rose to 24 (85.71%), while non-mastery cases decreased to four students (14.28%). The 21.43% increase in mastery aligns with findings by Boz & Kiremitci (2020) who demonstrated that integrating active, game-based learning into mathematics significantly boosts cognitive performance. Furthermore, Bustamante et al. (2024) emphasize that playful, hands-on activities promote deeper conceptual understanding a principle consistent with the outcomes of this study.

Overall, the implementation of the Snowball Throwing model assisted by the Smart Wheel media made a significant contribution to improving both the learning process and students' academic outcomes in mathematics. The teacher was able to apply the learning steps effectively, students became more actively engaged, and learning outcomes improved substantially. By the final meeting of Cycle 2, teacher activity reached 94.11% and student activity 85.71%, both of which exceeded the predetermined success indicator of 85%. This confirms that the research successfully met the criteria for classroom action research, demonstrating that the applied intervention was effective in enhancing mathematics learning. These findings reinforce previous research that integrating active learning methods with engaging and interactive media can create an effective and enjoyable learning experience, ultimately leading to improved academic achievement (Al Hafidz & Arifin, 2019; Boz & Kiremitci, 2020; Bustamante et al., 2022; Rismaini et al., 2020).

E. Conclusion

This study concludes that the implementation of the Snowball Throwing learning model assisted by the Smart Wheel media successfully improved both the quality of the learning process and mathematics learning outcomes for fourth-grade students at SDN 112/II Purwobakti. Improvements were evident from Cycle I to Cycle II in both teacher performance and student engagement. Teacher observation scores increased from 64% in the first meeting of Cycle I to 94.11% in the second meeting of Cycle II, while student observation scores rose from 53.57% to 85.71% over the same period. Learning outcomes also showed significant progress, with the percentage of students achieving mastery increasing from 64.28% to 85.71%, surpassing the predetermined success indicator. This success was supported by active student participation in collaborative activities, the use of the Smart Wheel as a stimulating and interactive medium that fostered curiosity, and improved teaching strategies in Cycle II, such as more effective time management, clearer instructions, and optimal facilitation of group discussions. These factors encouraged students to be more active, ask questions, and engage in the learning process, while also enabling the teacher to manage the classroom more effectively. Based on the findings, it is recommended that teachers consistently apply active learning models such as Snowball Throwing, utilize interactive media to enhance student engagement, and continue innovating in classroom management. Schools are encouraged to provide support through training and creative learning facilities. Future research could explore the application of this model in other subjects, examine its impact on non-cognitive aspects, develop digital-based versions for online learning, and investigate the sustainability of its effects over the long term.

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