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Snowball throwing learning strategy and learning motivation: keys to success in improving science learning outcomes for high class students

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ABSTRACT

Snowball Throwing is a pedagogical strategy that employs ice balls or "snowballs" to introduce new concepts or ideas to students. This approach was developed by researchers interested in enhancing the effectiveness and engagement of learning, particularly in the context of science education. Moreover, students exhibit enthusiasm toward participation in learning activities due to the engaging nature of the snowball-throwing model. This study aims to assess the impact of employing the Snowball Throwing learning model alongside students' learning motivation on their academic performance in lessons at the elementary public school 002, Air Molek 1. The study involved 172 students across 4th, 5th, and 6th grade classes, comprising 99 boys and 76 girls. Data were collected through written tests and learning motivation questionnaires. The written test comprised 20 multiple-choice questions designed to evaluate student learning outcomes, while the learning motivation questionnaire gauged the students' level of motivation toward learning. Data analysis was conducted using the two-way ANOVA test. The results of the analysis demonstrated the significant influence of learning motivation on student learning outcomes. Notably, student learning motivation positively correlates with enhanced learning outcomes. Furthermore, the adoption of the snowball-throwing learning model exhibited a beneficial impact on student learning outcomes. Additionally, the interaction between the snowball-throwing learning model and student learning motivation significantly influenced student learning outcomes. Consequently, it can be inferred that the efficacy of Snowball Throwing in education stems from its ability to bolster learning motivation and improve learning outcomes, particularly within the realm of science education.

1. Introduction

The importance of student learning lies in the process of acquiring the knowledge, skills and understanding necessary to confront future challenges. Additionally, student learning enhances critical and analytical thinking skills, which are crucial for making informed decisions. Moreover, it fosters creativity and innovation, essential for problem-solving in everyday life. Optimal learning outcomes can be achieved through various factors, including internal and external influences as well as learning approaches [1], [2]. Snodgrass, Vaval, and Bowers concluded that internal factors, such as the physical or spiritual condition of the student, along

with external factors like environmental conditions and learning approach factors, significantly influence student learning efforts [3]. Consequently, teachers must discern the appropriate approach to teaching [4], [5]. Utilizing effective learning approaches and models is crucial for activating students and facilitating changes in their learning activities [6], [7]. Hence, these approaches and models should be meticulously designed to optimize learning outcomes [8], [9].

Educators play a pivotal role in fostering conducive learning environments that enhance students' motivation and outcomes [10], [11]. By crafting engaging lessons, educators can offer meaningful learning experiences [12], [13]. Student enthusiasm and motivation thrive when they comprehend the subject matter, aided by teacher guidance [14]–[16]. Additionally, teachers serve as mentors, encouraging independent learning and facilitating group activities [17], [18]. Educators must maintain high levels of motivation to effectively guide students [19], [20]. This motivation drives continual improvement in teaching quality and cultivates positive learning environments [21], [22]. With heightened motivation, educators can create meaningful learning experiences, preparing students for future success. Motivation is a critical factor correlated with student achievement [21], [23]. Efforts should be undertaken to ensure students are motivated, as motivation significantly impacts learning outcomes [24], [25]. Sometimes, the teaching and learning process falls short due to insufficient motivation or encouragement [21]. While students with high motivation may excel despite lower intelligence, those lacking motivation, even with high intelligence, may struggle, underscoring the importance of fostering motivation for optimal learning outcomes [26].

This study holds significant importance as it investigates the correlation between learning strategies and learning motivation on science learning outcomes among upper-class students by delving deeper into how learning strategies and learning motivation impact student learning outcomes [27], [28], educators can develop more efficacious learning programs to enhance student academic achievement, particularly in the field of science. Previous research pertaining to this topic may have assessed the effectiveness of various learning strategies and factors influencing learning motivation on student learning outcomes. Some studies might have indicated that employing interactive learning strategies and fostering high learning motivation positively affects students' academic performance. However, there remains a gap in the literature where the relationship between specific learning strategies (e.g., the Snowball Throwing Learning Strategy) and learning motivation with upper-class students' science learning outcomes has not been explored [29], [30].

The deficiency in existing research lies in the lack of studies focusing on the association between the Snowball Throwing Learning Strategy and learning motivation with upper-class students' science learning outcomes. Consequently, researchers must address this gap by conducting more comprehensive and in-depth studies to ascertain the extent to which learning strategies and learning motivation influence students' science learning outcomes. The objective of this study is to examine the impact of the Snowball Throwing Learning Strategy and learning motivation on the science learning outcomes of upper-class students, while also assessing the effectiveness of these two factors in enhancing students' academic achievement. Hence, it is anticipated that this study will offer novel insights into the development of more effective learning strategies and the motivation of students to engage in science learning more effectively.

2. Method

This research adopts an experimental design, specifically a quasi-experimental approach. Its primary objective is to assess the impact of the snowball-throwing model and learning motivation on student learning outcomes at Elementary Public School 002, Air Molek 1. The variables under investigation are the Snowball Throwing model and Learning Motivation as Variable X, whereas student learning outcomes represent Variable Y. Employing a quantitative approach, this study utilizes experimental methods in the form of a quasi-experimental design. It was conducted among upper-grade classes (4, 5, and 6) at Elementary Public School 002, Air Molek 1, encompassing a total of six classes. The experimental treatment was administered to classes 4A, 5A, and 6A, while the control group, devoid of treatment, consisted of classes 4B, 5B, and 6B. Table 1 shows the student population. Research data were collected through tests to assess student learning outcomes and through motivation questionnaires to measure student motivation. Data analysis in this research encompassed normality tests, homogeneity tests, and hypothesis testing. The normality test determines whether the distribution of research data is

normal, while the homogeneity test ensures equal variances across all groups, thereby enhancing result validity. Hypothesis testing in this research employed a two-way ANOVA to examine significant differences between the means of the experimental and control groups, as well as the interaction effect between the Snowball Throwing model and learning motivation on student learning outcomes. These hypothesis test results aid in analyzing the significant influence of the snowball-throwing model and learning motivation on student learning outcomes. Through the utilization of this quasi-experimental method, a comprehensive understanding of the impact of the snowball-throwing model and learning motivation on student learning outcomes at Elementary Public School 002, Air Molek 1 is anticipated.

Table 1. Population of student

Grade	Total of Student		Total
	Male Students	*Female Students*	
IV A	19	13	**32**
IV B	17	15	**32**
V A	13	17	**30**
V B	12	13	**25**
VI A	19	9	**28**
VI B	19	9	**28**
Total	**99**	**76**	**172**

The findings of this research are expected to offer valuable insights for enhancing the quality of education in schools, particularly in bolstering students' learning motivation and improving their academic achievements. Furthermore, data analysis for this study involved gathering data from upper-level students who employed study strategies and comparing them with students who did not utilize these strategies. The requisite data included exam results, academic credentials, learning motivation, and adherence to the learning strategy. Normality tests (z-test or t-test) were conducted to determine if differences in exam results between groups were statistically significant. The homogeneity test (F-test) verified whether the variance of examination results within each student group was uniform. Two-way ANOVA was employed to evaluate the influence of two independent variables, namely learning strategy and student grade, on learning outcomes. Data were categorized into groups based on the utilization of learning strategies and then compared regarding learning motivation, study behavior, and academic outcomes. Additionally, other statistical tests, such as correlation tests, could be utilized to elucidate the relationships between variables. In the research report, comprehensive details of the data analysis methods and results should be provided to facilitate readers' understanding and instill trust in the research findings.

3. Results and Discussion

Based on the results of the hypothesis test, specifically the two-way ANOVA test, the obtained results indicate for factor A, namely Fhit > Ftab, where Fhit was 3.85 and Ftab was 3.42. This rejection of H0 suggests an influence of learning motivation on student learning outcomes, implying that motivation significantly affects student learning outcomes, see Table 2. These findings align with research by Sadoughi, indicating that students' motivation for learning plays a crucial role in their academic progress and achievements in particular subjects [31]. When students possess high motivation, they are more likely to succeed in the learning process, resulting in higher grades. It can be inferred that individuals with higher levels of motivation exert greater effort toward achieving success in learning. Motivation can be defined as the influence of needs and desires on a person's intensity and direction, propelling them toward achieving goals at a certain level. Consequently, motivation, as an internal or psychological process inherent to individuals, is significantly influenced by both external factors (environment) and internal factors inherent in each person (innateness), including the level of education, past experiences, and desires or aspirations for the future. Zhou *et al,* categorized learning motivation into two groups: intrinsic and extrinsic motivation. Intrinsic motivation stems from internal factors within students, including health, psychological factors, interests, talents, intelligence, and readiness [32]. Conversely, extrinsic motivation arises from external factors such as family, school, and community. The second test result pertains to factor B, where

Fhit > Ftab, with Fhit being 3.43 and Ftab being 3.42. This rejection of HO indicates an influence of the Snowball Throwing learning model on student learning outcomes. Analysis of the test results reveals that the average learning outcomes of experimental classes utilizing the snowball-throwing learning model surpassed those of control classes employing conventional learning models. This finding is consistent with research conducted by Ofridaningsih *et al*, which demonstrated that implementing the cooperative learning model with Snowball Throwing enhances student learning outcomes compared to conventional learning models [33]. Additionally, Fadilah *et al,* concluded that despite differences in materials, the use of the snowball-throwing learning model still positively impacts student learning outcomes [34]. This improvement in student learning outcomes can be attributed to several advantages of the Snowball Throwing learning model, including creating a fun learning atmosphere as students enjoy the activity of throwing paper balls to one another, providing opportunities for students to develop their critical thinking skills by creating and sharing questions with peers, preparing students for various possibilities as they engage in peer-to-peer questioning, fostering active student involvement in learning, eliminating the need for educators to create teaching aids as students directly participate in hands-on activities, and enhancing the effectiveness of learning, thereby enabling the achievement of cognitive, affective, and psychomotor learning objectives.

Table 2. ANOVA Result

Variace Source	Dk	SS	MS	F_{hit}	F_{tab}
Factor (A)	1	306.28	306.28	3.85**)	3.42
Factor (B)	1	272.25	272.25	3.43**)	3.42
Interaction (AB)	1	512.5	512.5	6.44**)	3.42
In cell	97	7632.03	1091.03		
Total	100	**8723.03**			

For factor A, where Fhit = 3.85**), the significance indicates the rejection of the null hypothesis, signifying an effect of learning motivation on student learning outcomes. Similarly, for factor B, with Fhit = 3.43**), the significance indicates the rejection of the null hypothesis, implying an effect of employing the snowball-throwing learning model on student learning outcomes. The third test result pertains to the interaction of factors A and B, where Fhit > Ftab with Fhit = 6.44 and Ftab = 3.42. This rejection of H0 suggests an interaction between the Snowball Throwing learning model and learning motivation on student learning outcomes. Consequently, the use of the snowball-throwing learning model influences the improvement in student learning outcomes, while student learning motivation also impacts student learning outcomes. Utilizing the snowball-throwing learning model can enhance student learning outcomes for both those with high and low learning motivation. This indicates that this learning model can engage and motivate all students to participate in learning activities, resulting in better learning outcomes compared to before implementing the snowball-throwing learning model. Learning methods represent efforts to implement prepared plans into real activities, thereby achieving optimal goals. Based on the calculation, it can be concluded that the significance level (α = 0.05) indicates Fhit < Ftable, thus H0 is accepted, indicating that the two groups of data have homogeneous variances across class 4, class 5, and class 6, see Table 3. Regarding the results of the hypothesis test, specifically the two-way ANOVA test, the obtained results for factor A indicate Fhit > Ftab where Fhit is 3.85 and Ftab is 3.42. This rejection of H0 suggests an effect of learning motivation on student learning outcomes, signifying that motivation significantly impacts student learning outcomes. These findings align with research by Sholekah *et al*, which underscores the pivotal role of student motivation in their learning progress and achievement in specific subjects [35]. When students possess high motivation, they are more likely to succeed in the learning process, resulting in higher scores. This implies that individuals with higher levels of motivation exert greater effort toward achieving success in learning.

Table 3. Homogenity Result

Grade	N	F_{hit}	F_{tabel} (α= 0,05)	Note
4	34	1,07	3,74	$F_{hit} < F_{tabel} = H_0$ is accepted
5	34	1,63	3,74	$F_{hit} < F_{tabel} = H_0$ is accepted
6	34	1,75	3,74	$F_{hit} < F_{tabel} = H_0$ is accepted

3.1. The Extent To Which The Snowball Throwing Learning Strategy Influences Students' Motivation To Study Science

The snowball-throwing learning strategy is employed to enhance student motivation in learning. This method entails engaging students in a game where they virtually throw snowballs at their peers. In the realm of science education, the snowball-throwing strategy fosters student participation in the learning process and fosters positive peer relationships. Studies have demonstrated the significant impact of the Snowball Throwing strategy on students' motivation to learn science. By involving students in interactive and enjoyable activities, this strategy heightens their inclination to learn and nurtures their interest in science. Furthermore, Snowball Throwing cultivates students' motivation and confidence in tackling challenging subject matter. In my view, the snowball-throwing learning strategy is an effective approach to boosting students' motivation to learn science. Through increased active participation and collaborative interaction among students, this strategy engenders a more enjoyable and engaging learning atmosphere, thereby enhancing student motivation and enthusiasm for learning. Additionally, Snowball Throwing aids in the development of student's social skills and critical thinking abilities, essential for comprehending scientific concepts. The findings derived from our research underscore the positive impact of the Snowball Throwing learning strategy on students' motivation to learn science. Students engaged in this strategy demonstrate higher levels of motivation and achieve superior learning outcomes compared to their counterparts not exposed to this method. Hence, it is imperative for teachers and educators to contemplate integrating Snowball Throwing into the learning process to augment students' motivation and interest in learning science.

3.2. The Relationship Between The Use Of The Snowball Throwing Learning Strategy And Improving Student Learning Outcomes In The Field Of Science

The efficacy of the snowball-throwing learning strategy in enhancing student learning outcomes in the science domain has been substantiated as an effective concept in augmenting students' comprehension of subject matter. This strategy entails cooperative engagement among students to exchange their knowledge and understanding of the topic under study. In this method, each student articulates their ideas or responses on a piece of paper, subsequently passing it to their peer, who then reads, supplements it with new information, and passes it on to another student. By employing the snowball-throwing strategy, students become more actively engaged in the teaching and learning process, fostering direct participation and knowledge sharing, thereby facilitating comprehension of complex concepts and fostering collaboration and communication skills among peers. Through the reciprocal sharing and acquisition of new information from peers, students find it easier to grasp the subject matter and reinforce their proficiency in applying scientific concepts. Moreover, enhancements in student learning outcomes in the science domain are evidenced by heightened levels of information retention. Through student interaction and knowledge exchange, students tend to retain and comprehend the subject matter more effectively. Additionally, they become more intrinsically motivated to engage in independent learning and develop metacognitive skills throughout the learning process. In a practical context, numerous studies have demonstrated that the utilization of the snowball-throwing learning strategy leads to improvements in student learning outcomes across various subjects, including science. By employing an interactive and collaborative approach, educators can cultivate a more captivating and engaging learning milieu for students. Consequently, the incorporation of the snowball-throwing learning strategy emerges as an effective means to enhance the quality of education and elevate student learning outcomes in the science domain.

3.3. Factors Influencing The Effectiveness Of The Snowball Throwing Learning Strategy In Improving The Learning Outcomes Of Upper Class Students

The snowball-throwing learning strategy is a pedagogical approach wherein students respond to questions or solve problems and then pass the "ball" to another student to continue the discourse. This strategy has proven effective in fostering active participation, critical thinking, and collaboration among students. Nevertheless, its efficacy can be influenced by various factors. One such factor is the level of student engagement, which significantly impacts the strategy's effectiveness. Since the strategy hinges on active student participation in discussions and interactions, disengagement or lack of interest among students may diminish

its efficacy in enhancing learning outcomes. Thus, teachers must cultivate a supportive and engaging learning environment to bolster student engagement and participation. Another factor affecting the strategy's effectiveness is the quality of questions or prompts utilized during the activity. Well-crafted questions and prompts have the potential to stimulate critical thinking and meaningful discussions among students. Consequently, teachers should meticulously design questions that challenge students' thinking and prompt them to articulate their ideas and opinions effectively. Additionally, the class size can also influence the strategy's effectiveness. In larger classes, it may prove more challenging for all students to actively participate and contribute to discussions. To address this, teachers may opt to divide the class into smaller groups, facilitating more meaningful interactions and ensuring every student has the opportunity to engage in the activity. In summary, the Snowball Throwing learning strategy holds promise as an effective tool for enhancing learning outcomes among upper-class students when implemented adeptly. By fostering student engagement, posing thought-provoking questions, and cultivating a conducive learning environment, teachers can optimize the benefits of this strategy. However, it is imperative to consider the factors that can impact its effectiveness and make necessary adjustments to ensure its success in promoting student learning.

4. Conclusion

From the title "Snowball Throwing Learning Strategy and Learning Motivation: Keys to Success in Improving Science Learning Outcomes for High-Class Students," it is evident that employing the snowball-throwing learning strategy alongside robust learning motivation can significantly enhance science learning outcomes for high-class students. This approach fosters active participation and engagement in the learning process, which is crucial for effective learning. Combining a fun and interactive learning activity with high motivation levels can lead to better retention of information and comprehension of complex scientific concepts. However, it is imperative to acknowledge the limitations of this approach. Firstly, not all students may be receptive to this type of learning strategy; some may find it too juvenile or may feel uncomfortable participating in physical activities like snowball throwing. Moreover, the success of this method may hinge on the availability of resources and appropriate facilities for conducting such activities, which may not be universally accessible across all schools. To mitigate these limitations, it is advisable to offer alternative learning strategies for students who may not find snowball-throwing activities suitable. This could entail integrating more traditional teaching methods, such as lectures and group discussions, to accommodate diverse learning styles. Ensuring inclusivity and engagement in the learning process necessitates providing a variety of activities that appeal to different interests and abilities. Moreover, maintaining high levels of motivation among students throughout the learning process is crucial. This can be achieved by establishing clear learning goals and objectives, providing regular feedback on student's progress, and fostering a positive and supportive learning environment. Encouraging student ownership of their learning and active participation in class activities cultivates a sense of responsibility and accountability. Additionally, collaboration among teachers, students, and parents is paramount for the success of this approach. Regular communication between teachers and students, as well as involving parents in supporting their children's academic endeavors, contributes to student motivation and success. In conclusion, the combination of the snowball-throwing learning strategy and high learning motivation holds promise for significant improvements in science learning outcomes for high-class students. Addressing limitations and implementing recommended strategies can help create a comprehensive and effective learning environment that maximizes student engagement and success in science education. However, specific recommendations for achieving these goals remain unclear in the current study. Future research could explore different learning strategies, such as project-based, collaborative, or competency-based approaches. Introducing an attitude management system and providing incentives for student achievement, along with establishing clear learning goals and relevant content, could further enhance student motivation and success. Incorporating data-driven learning and analysis to foster critical thinking and creativity, as well as utilizing game-based learning to make concepts more engaging, are additional strategies worth exploring. To achieve these objectives, teachers must adapt and innovate in their teaching practices to make learning more stimulating and effective.

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