Quantitative Study: Mathematics Learning Outcomes In Different Schools

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ABSTRACT

This study aims to analyze the differences in students' mathematics learning outcomes across three schools: SD Yayasan Beribu, SDN 074 Ayudia in Bandung City, and SD Santa Maria Dolok Sanggul. The study involved the entire student population from these three schools, with samples of 20 students from SD Yayasan Beribu, 27 students from SDN 074 Ayudia, and 37 students from SD Santa Maria, totaling 84 students. The research focused on sixth-grade students at each of the schools. The study used a quantitative approach with a comparative method. The sampling technique employed stratified random sampling, and the data collection instrument was a test. The results show that the highest average learning outcome was obtained by SDN 074 Ayudia at 89.81, followed by SD Yayasan Beribu at 83.50, and SD Santa Maria at 82.43. The normality test indicated that the data were normally distributed, but the homogeneity test showed that the variance was not homogeneous (Sig. = 0.008). The ANOVA test revealed significant differences in mathematics learning outcomes between the three schools (Sig. = 0.000). Post Hoc analysis revealed significant differences between SD Yayasan Beribu and SDN 074 Ayudia, as well as between SDN 074 Ayudia and SD Santa Maria, but no significant difference between SD Yayasan Beribu and SD Santa Maria. This study emphasizes the importance of evaluating teaching practices to create more equitable learning outcomes across schools.

Keywords: Mathematics Learning Outcomes, ANOVA, Post Hoc.

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A. INTRODUCTION

Education plays a crucial role in shaping an individual's social status, influencing, changing, and developing perspectives, attitudes, and life skills. It is also the key to national progress and the future of Indonesia. The planned and conscious educational process, along with habits, intelligence, and personal, social, and national growth, is essential. To achieve high-quality education, professional teachers with proper qualifications and fair compensation are an urgent need. Advanced nations have proven the importance of education in achieving progress. However, the abstract nature of mathematics presents challenges for many students. Mathematics, as an element of education, is very important to be taught from elementary school (SD). This is because, at this developmental stage, children exhibit deductive, axiomatic, formal, and abstract attitudes, along with their symbolic language, which requires early introduction (Nisa et al., 2023).

Primary education in elementary schools aims to develop students' knowledge, intelligence, and personality so that they are prepared for independent living and to continue their education to a higher level. Informatics education at the elementary school level helps students develop structured learning skills, understand the syntax and semantics of languages, think logically in mathematics, and analyze and interpret data in science. As the 21st century approaches (Zubaidah, 2016), society requires individuals to possess basic life skills to face various challenges. These 21st-century skills align with the Pancasila Student Profile, which integrates these skills with character development for all students in Indonesia. The Pancasila Student Profile aims to preserve the nation's character values, manifest 21st-century competencies, and create complete, tolerant, and just citizens.

Mathematics, as an essential element of education, is very important to be taught from elementary school (SD). This is because at this stage of development, children's attitudes are deductive, axiomatic, formal, and abstract, along with their symbolic language, requiring early introduction (Saputra et al., 2023), Unlike social sciences, mathematics is a precise science, and its abstract nature often causes learning difficulties. The importance of focusing on mathematics education is clear, as many people consider mathematics difficult, often feeling overwhelmed when solving problems, which leads to anxiety and the perception that the subject is challenging (Permatasari, 2021). This is reflected in classroom inactivity, indecisiveness, and reluctance to complete homework (Utami & Warmi, 2020).

To fill the gap in previous research, this study aims to analyze the mathematics learning outcomes across various schools. This is useful to determine whether there are significant differences in student outcomes in mathematics learning. Therefore, this study offers novelty as it is conducted at the elementary school level, where both mathematical concepts and students' initial mathematical abilities need to be addressed according to the needs of each school, considering various aspects such as students' geographical factors and available facilities at each school.

B. LITERATURE REVIEW

Education in Schools

In school education, knowledge, understanding, and experience about education at the elementary school level need to be continuously updated and enriched. The concept of education continues to evolve along with changes in

human civilization and society. The knowledge and concepts of education at the elementary school level are the results of human thought that are dynamic and constantly changing due to the influence of life situations and conditions (Mustadi, 2020). A good understanding of the essence of education in elementary schools will enrich perspectives and increase confidence, providing a strong foundation for carrying out various educational efforts at school. Every action and belief in the learning process reflects an understanding of the essence of education. For example, teachers who only use lecture methods in class tend to believe that the essence of education is merely to change children from being unaware to being knowledgeable (Hidayati, 2022).

Education is a complex process that involves various aspects, such as character development, skills, and knowledge. Educators at the elementary school level must have a broad understanding of the essence of education to carry out their duties effectively (Dewi et al., 2023). Education is a developmental process that helps students achieve their full potential. This process is not about imposing adult will on children, but about creating a conducive environment for their growth. Children are active in developing themselves, while teachers act as facilitators, helping them reach their full (Amaliyah & Rahmat, 2021).

Although it is difficult to define education precisely, we need guidelines to ensure that our actions at school are well-founded. Law No. 20 of 2003 on the National Education System. (Pelawi & Is, 2021) provides a clear framework for the organization of formal education in schools, including for teachers. This law defines education as a conscious effort to create a learning environment that encourages students to fully develop their potential. The goal is to equip them with spiritual strength, self-control, character, intelligence, noble morals, and skills needed for personal, social, national, and state life. In short, education is a child-centered process aimed at helping them develop optimally and become knowledgeable, morally upright members of society who contribute positively. Law No. 20 of 2003 provides clear and binding guidance for all parties involved in education in Indonesia (Noviansyah & Reza, 2023).

Primary education, which lasts for 9 years (6 years in elementary school and 3 years in junior high school or equivalent), is a critical stage in the educational journey. Elementary schools play a key role as social institutions responsible for this foundational education. The main goal of elementary education is to prepare students to achieve the national education objectives, which include developing faith, noble character, knowledge, skills, physical and mental health, stable and independent personalities, as well as social and national responsibility (Absawati, 2020). The education goals represent the desired outcomes of the learning process. These goals serve a dual purpose: showing the ideal condition to be achieved and providing guidance for the educational process itself. The goals of elementary education must align with the national and basic education objectives, considering student development, the environment, regional and national development needs, as well as the advancement of global science and technology. Elementary education focuses on forming the basic personality of students as Indonesian citizens during their development. Practically, the elementary school curriculum emphasizes mastery of basic skills in reading, writing, and

arithmetic, as well as essential knowledge and skills relevant to the students' age, while also preparing them to continue their education to junior high school (Setiaji, 2023). These goals are directed toward the development of students to strengthen their faith, develop good habits, provide basic knowledge and skills, maintain health, enhance learning abilities, form independent personalities, and foster social and national responsibility (Zulfikar & Dewi, 2021).

Mathematics Learning

Mathematics is an abstract, deductive science with a unique logical structure. Mathematics learning involves efforts to help students learn and gain experience, focusing on facilitating the student learning process. This process is often considered challenging due to its abstract nature (Tamphu et al., 2024). Mathematics learning in schools is often perceived as less enjoyable, despite the fact that mathematics is highly relevant to everyday life. Experts emphasize the importance of connecting mathematical concepts with real-life experiences to make learning meaningful and enjoyable. Learning that is detached from real-life contexts causes students to forget quickly and struggle to apply mathematics. Focusing on the application of mathematics in real life has been found effective. This approach, which has been successful in the Netherlands, will be discussed further in this study to provide an insight into a more engaging and meaningful mathematics learning process (Sohilait, 2021).

Mathematics learning is a process of interaction between students, teachers, and learning resources within a learning environment (Siswondo & Agustina, 2021). The stages of mathematics learning include understanding concepts, explaining effective relationships to solve problems, and using reasoning and mathematical manipulation to make generalizations and construct proofs for mathematical ideas and statements. Furthermore, mathematics learning also involves problem-solving strategies, including problem understanding, mathematical model design, model solution, and interpretation of the obtained solution. Additionally, this strategy emphasizes student capabilities (Hulu et al., 2023).

Education, as stated in Law No. 20 of 2003, is a process of developing human character and potential influenced by the environment through the process of learning and teaching. The main goal of national education, as outlined in Law No. 20 of 2003 on the National Education System (Sisdiknas), is to form a nation with a dignified character and civilization, aiming to enlighten the life of the nation. Education aims to develop the potential of students to become individuals who are faithful, pious, noble, healthy, knowledgeable, competent, creative, independent, and responsible democratic citizens. Specifically, mathematics education aims to train reasoning and thinking abilities to draw conclusions through activities such as research, exploration, experimentation, and demonstrating similarities, differences, consistency, and inconsistency. In addition, mathematics education also aims to develop creativity and imagination (Yanti & Nursyamsi, 2020).

C. METHOD

This study uses a quantitative approach with a comparative method. In the quantitative approach, data is collected and analyzed using descriptive and inferential statistical techniques to answer the research questions by comparing mathematics learning outcomes across different

elementary school groups to determine whether there are significant differences or not.

The research was conducted at SD Yayasan Beribu, SDN 074 Ayudia in Bandung City, and SD Santa Maria Dolok Sanggul, with the population consisting of all students from these three schools, and a sample of 20 students from SD Yayasan Beribu, 27 students from SDN 074 Ayudia in Bandung City, and 37 students from SD Santa Maria Dolok Sanggul, totaling 84 students. The research was conducted with sixth-grade students from each of the schools, using stratified random sampling for the sampling technique, and data collection was done through a test instrument.

The data analysis prerequisites consisted of descriptive tests to provide an overview of mathematics learning outcomes at each school with average scores and standard deviations. Then, a comparative test was used to compare learning outcomes between variables using parametric statistical tests, namely One-Way Analysis of Variance (ANOVA) if the data were normally distributed, and non-parametric statistical tests, such as the Kruskal-Wallis test, an extension of the Mann-Whitney test when there were more than two independent variables. Normality analysis of the data was conducted using the Kolmogorov-Smirnov and Shapiro-Wilk tests, assisted by SPSS version 26.

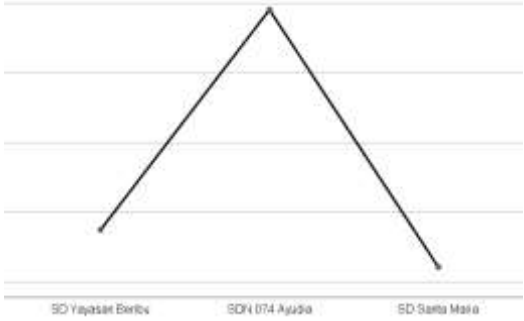
D. RESULTS AND DISCUSSION

RESULTS

Table 1. Descriptives

	Mean	Std. Deviasi
SD Yayasan Beribu	83.50	5.277
SDN 074 Ayudia	89.81	3.752
SD Santa Maria	82.43	7.654
Total	85.06	6.871

Based on Table 1 above, it can be seen that the average score and standard deviation for mathematics learning outcomes at SD Yayasan Beribu are 83.50 and 5.277, respectively. At SDN 074 Ayudia, the average score is 89.81 with a standard deviation of 3.752. At SD Santa Maria, the average score is 82.43 with a standard deviation of 7.654. Therefore, the overall average score and standard deviation for the three schools are 85.06 and 6.871, respectively.



Picture 1. Means Plots

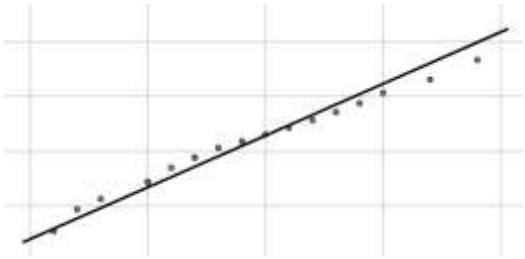
Based on Figure 1 above, it can be seen that the highest average score of students' mathematics learning outcomes is found at SDN 074 Ayudia, followed by SD Yayasan Beribu, while the lowest average score is at SD Santa Maria. Therefore, to determine if there are significant differences among these three schools, an inferential statistical test needs to be conducted with normality tests for the data as follows.

Table 2. Tests of Normality

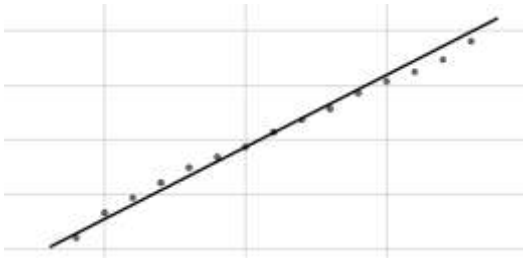
Origin of the School	Statistic	Sig.
SD Yayasan Beribu	.112	.200*
SDN 074 Ayudia	.083	.200*
SD Santa Maria	.111	.200*

Based on Table 2 above, it can be seen that the significance value of the mathematics

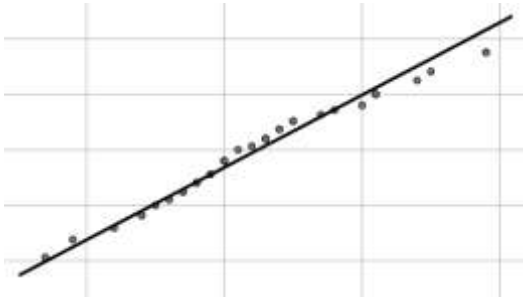
learning outcomes at SD Yayasan Beribu, SDN 074 Ayudia, and SD Santa Maria is 0.200. This data shows that the Sig. value is > 0.05, so it can be concluded that the mathematics learning outcomes scores of the students are normally distributed.



Picture 2.
Normal Q-Q Plot of SD Yayasan Beribu



Picture 3.
Normal Q-Q Plot of SDN 074 Ayudia



Picture 4.
Normal Q-Q Plot of SD Santa Maria

Based on Figures 2, 3, and 4 above, it can be seen that the data or points on the diagram spread around the diagonal line and are close to the line, indicating that the data is normally distributed. Next, a homogeneity test was performed to ensure whether the variance or distribution in each independent group is consistent or not.

Table 3. Test of Homogeneity of Variance

	Levene Statistic	Sig.
Based on Mean	5.122	.008

Based on Table 3 above, it can be seen that the significance value for Based on Mean is 0.008. From this data, the Sig. value is < 0.05, which leads to the conclusion that the data variance across the three classes is not homogeneous, meaning they do not have the same variance in relation to the mathematics learning outcomes in each school. However, the One Way ANOVA test can still proceed because the data meets the normality assumption. Since the data is not homogeneous, the Post Hoc Multiple Comparisons test is conducted using the Games-Howell test.

Table 4. Analysis of Variance (ANOVA)

	F	Sig.
Between Groups	12.329	.000

Based on Table 4 above, it can be seen that the significance value for the ANOVA test is 0.000. This data shows that the Sig. value is < 0.05, which allows us to conclude that there are significant differences in the mathematics learning outcomes among the three schools. However, to specifically examine the differences between SD Yayasan Beribu, SDN 074 Ayudia, and SD Santa Maria, a Post Hoc test is conducted as follows.

Table 5. Multiple Comparisons

Origin of the School	Origin of the School	Sig.
SD Yayasan Beribu	SDN 074 Ayudia	.000
	SD Santa Maria	.810
SDN 074 Ayudia	SD Santa Maria	.000

Based on Table 5 above, it can be seen that the significance value between SD

Yayasan Beribu and SDN 074 Ayudia, as well as between SDN 074 Ayudia and SD Santa Maria, is 0.000. This data shows that the Sig. value is < 0.000, which means that the mathematics learning outcomes of students at SD Yayasan Beribu and SDN 074 Ayudia, as well as between SDN 074 Ayudia and SD Santa Maria, have significant differences. Meanwhile, the mathematics learning outcomes of students at SD Yayasan Beribu and SD Santa Maria do not show a significant difference. This is evidenced by the significance value between SD Yayasan Beribu and SD Santa Maria, which is 0.810 > 0.05.

DISCUSSION

The results of the study indicate that there are significant differences in mathematics learning outcomes among the three schools that were subjects of the research, namely SD Yayasan Beribu, SDN 074 Ayudia, and SD Santa Maria. Based on the average scores, SDN 074 Ayudia achieved the highest score of 89.81, followed by SD Yayasan Beribu with 83.50, and SD Santa Maria with the lowest average score of 82.43. The overall average score of 85.06 from the three schools indicates that, in general, the students' mathematics learning outcomes are categorized as good, despite significant differences among the schools.

The normality test for the data from the three schools yielded significance values of 0.200 (>0.05), indicating that the mathematics learning data from the three schools are normally distributed. This finding is further supported by the Normal Q-Q Plot visualization, where data points appear scattered around the diagonal line. With the normality assumption met, further inferential analysis could be conducted. However, the homogeneity test revealed that the data variances across the three schools were not homogeneous (Sig. = 0.008 < 0.05). Therefore, although ANOVA can still be used, a Post Hoc analysis was performed using the Games-Howell method to accommodate the heterogeneity of the data.
The ANOVA test results show significant differences in the mathematics learning outcomes of students from the three schools (F = 12.329; Sig. = 0.000). More specifically, the Post Hoc analysis revealed significant differences between SD Yayasan Beribu and SDN 074 Ayudia (Sig. = 0.000), as well as between SDN 074 Ayudia and SD Santa Maria (Sig. = 0.000). However, no significant difference was found between SD Yayasan Beribu and SD Santa Maria (Sig. = 0.810 > 0.05). This indicates that while SDN 074 Ayudia has superior mathematics learning outcomes, the results from SD Yayasan Beribu and SD Santa Maria are relatively comparable.

Overall, this study suggests that certain factors, such as the quality of teaching, the methods used, and the students' level of understanding, influence the differences in mathematics learning outcomes among schools. (Nurhikmah, 2024) emphasizes that the most influential factor in students' learning outcomes is the quality of teaching itself, including how teachers deliver the material and support the development of students' understanding. (Nursalam., Nurhikmah., & Purnamasari, N, 2019) identifies that more active and collaborative teaching strategies, such as problem-based learning or group work, have a significant positive impact on students' learning outcomes. In line with Marzano's explanation, the level of students' understanding of the material is greatly influenced by various factors, including learning styles, motivation, and the teaching strategies employed by the teacher

(Nurhikmah, Nursalam, Eko Prayetno, 2024). Using methods that align with students' characteristics and the material being taught can enhance their understanding and learning outcomes.

These expert statements support the idea that various factors, including the quality of teaching, the methods used, and the students' level of understanding, play a crucial role in influencing the differences in mathematics learning outcomes among the schools studied. The findings imply that improving mathematics learning outcomes in other schools can be achieved by adopting best practices from schools with superior results, such as SDN 074 Ayudia.

E. CONCLUSION

The results of the study indicate significant differences in the mathematics learning outcomes of students across the three schools studied, namely SD Yayasan Beribu, SDN 074 Ayudia, and SD Santa Maria. SDN 074 Ayudia had the highest average score of 89.81, followed by SD Yayasan Beribu with an average score of 83.50, and SD Santa Maria with an average score of 82.43. These results reflect disparities in learning outcomes among the schools, even though the overall average score of 85.06 is categorized as good.

Inferential statistical tests show that the mathematics learning data from the three schools are normally distributed, but not homogeneous. Nonetheless, the ANOVA test confirms significant differences in the students' learning outcomes across the three schools (Sig. = 0.000). Further Post Hoc analysis revealed significant differences between SD Yayasan Beribu and SDN 074 Ayudia, as well as between SDN 074 Ayudia and SD Santa Maria. However, no significant difference was found between SD Yayasan Beribu and SD Santa Maria.

Overall, this study demonstrates that students' mathematics learning outcomes can be influenced by various factors in the learning environment of each school, such as the quality of teachers, teaching methods, and learning facilities. With SDN 074 Ayudia showing superior results, other schools may use the teaching practices at this school as a reference to improve their students' learning outcomes. This study provides a foundation for the development of more effective and equitable teaching strategies across schools.

F. AUTHOR'S NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The author confirms that the data and content of the article are free from plagiarism.

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