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The Effectiveness of the GGE and Clis Models Assisted by the Jarimatika Method on Motivation and Mathematics Learning Outcomes of Third Grade Elementary School Students

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ABSTRACT

This research is motivated by the essential issue of low motivation and learning outcomes in Mathematics at the elementary school level, particularly in the Woha District area. This phenomenon requires innovative interventions in the selection of learning models that can create an interactive, collaborative, and enjoyable learning environment for students. Therefore, the main objective of this study is to test the comparative effectiveness between the Group to Group Exchange (GGE) learning model and the Children Learning in Science (CLIS) learning model, integrated with the Jarimatika method as a supporting variable, and to analyze the interaction of these three factors on students' motivation and mathematics learning outcomes. This quantitative study employed a 2×2 factorial experimental design involving 36 third-grade students from two elementary schools in Woha District. The design compared the GGE and CLIS learning models with students' initial motivation levels (high/low) as a moderating factor. Data were analyzed using one-way ANOVA, Kruskal–Wallis, and post hoc Tukey tests. The results show a significant difference ($p < 0.05$) between the two learning models in enhancing students' motivation and learning outcomes, with the GGE learning model proving to be more effective than CLIS. This research concludes that the combination of cooperative learning models with practical methods such as Jarimatika is an effective strategy to improve the quality of mathematics learning in elementary schools.

INTRODUCTION

Education is a fundamental and essential pillar in efforts to sustainably improve the quality of a nation. In the midst of ongoing social and technological transformation, the development of human resources through the learning process is a priority that must be taken seriously (Fatimah, 2022). Learning functions not only as a means of knowledge transfer but also as an integral medium for shaping character, fostering motivation, and optimizing the potential of each individual student (Sudatha & Agustini, 2026).

The juridical foundation of the national education system in Indonesia, as stated in Law Number 20 of 2003, explicitly mandates the creation of a conducive, active, creative, and enjoyable learning atmosphere (Darmawan & Pujiastuti, 2023). The quality of this learning atmosphere is expected to improve students' critical and analytical thinking skills, which are vital prerequisites for facing increasingly complex future challenges. Furthermore, the main goal of national education is to educate the life of the nation and to develop Indonesian people as a whole, based on the values of Pancasila and the 1945 Constitution (Suryati, Mulyani, & Shadiqin, 2026).

However, the reality on the ground shows that the implementation of these noble goals still faces substantial obstacles, especially in Mathematics instruction (Nugraheni, 2024). Preliminary data indicate that the proportion of students who obtain substandard scores in Mathematics examinations reaches 47.37%. This figure reflects a significant deficit in mastery of basic mathematical concepts, which in turn contributes to weakened learning motivation among students (Putri, Hidayati, & Qodariyah, 2025).

This condition is exacerbated by teaching practices in elementary schools that are often dominated by conventional lecture methods, which tend to be instructive and lack variety. Such monotonous approaches make Mathematics learning feel boring, less meaningful, and disconnected from students' daily lives. As a result, student activity and involvement in the learning process remain low (Dusalan & Wirahmad, 2024).

Specifically, initial observations conducted at SD Inpres Pucuke and SDN Inpres Wadu Wani in Woha District, Bima Regency, West Nusa Tenggara (NTB), confirmed that many Grade III students experience serious difficulties in understanding basic Mathematics concepts (Kurniawan et al., 2026). These difficulties are believed to stem from learning models and methods that do not sufficiently encourage active student engagement, with teachers tending to focus on completing the curriculum rather than attending to students' cognitive and affective readiness. Consequently, most students are passive, reluctant to ask questions, and lack confidence in expressing their opinions (Prigaswari, Wiarta, & Anzelina, 2025).

Other challenges relate to limited infrastructure that supports active learning. In both schools, Mathematics teaching aids and access to adequate information technology are still lacking (Jarmita, Hayati, & Meilita, 2024). These limitations hinder the integration of technology-based learning methods and demand adaptive innovation and optimal use of existing resources. Therefore, a pedagogical breakthrough is needed through a combination of proven models and methods to create a more dynamic and interactive learning environment (Loliyana, 2022).

The Group to Group Exchange (GGE) learning model is proposed as one innovative solution. This model emphasizes collaboration between groups and encourages students to think critically, develop creativity, and analyze problems through discussion and exchange of ideas with peers. According to (Siew & Mapeala, 2017), GGE is a discussion format that involves different tasks for different groups, requiring students to discuss and share knowledge (Siregar, 2025).

In addition to GGE, the Children Learning in Science (CLIS) model is also considered for its focus on active student engagement through exploration and discovery processes, which are expected to foster deeper conceptual understanding. Relevant research indicates that the application of CLIS is effective in increasing students' interest in learning science and Mathematics (Ariana, Rachmah, Khasanah, & Hasanah, 2025).

To strengthen the understanding of operational concepts, this study integrates the Jarimatika method, an approach that combines physical finger movements with basic mathematical operations (such as addition and subtraction). This method is known to help students grasp basic concepts in a more enjoyable and concrete way (Mardiani, 2024).

Literature studies show that collaborative and constructivist learning approaches positively impact learning outcomes. However, the comparative effectiveness of GGE and CLIS, particularly when supported by Jarimatika for students with varying motivation levels, has not been extensively explored empirically. This research gap needs to be addressed to provide both theoretical and practical contributions to basic education.

The combination of the GGE, CLIS, and Jarimatika models constitutes a novelty in efforts to improve the quality of Mathematics learning in Woha District, Bima Regency, NTB. Previous studies have generally examined these models separately. Their integration is expected to generate synergy between social interaction through GGE, knowledge construction through CLIS, and technical skills development through Jarimatika.

Based on this background and the urgency of pedagogical innovation, this study seeks to empirically test the effectiveness of the Group to Group Exchange (GGE) and Children Learning in Science (CLIS) learning models assisted by the Jarimatika method on the motivation and Mathematics learning outcomes of Grade III elementary students in Woha District. The aim is to make a tangible contribution to formulating learning strategies that are adaptive, inclusive, and aligned with students' needs. This research is expected to provide both theoretical and practical benefits. Theoretically, it enriches the study of comparative effectiveness between cooperative (GGE) and discovery-based (CLIS) learning models integrated with the Jarimatika method in elementary Mathematics education. Practically, the findings serve as a reference for teachers in designing innovative, student-appropriate learning strategies; offer students more interactive and meaningful learning experiences that can enhance motivation and outcomes; provide schools with empirical evidence to inform policies aimed at improving learning quality; and open pathways for future researchers to explore the application of these models across different topics, grade levels, or moderating variables.

In detail, this study is formulated to answer four main questions: (1) Is there a significant difference in Mathematics learning motivation between students taught using the GGE and CLIS models? (2) Is there a significant difference in Mathematics learning outcomes between students taught using the GGE and CLIS models? (3) Is there a significant difference in Mathematics learning motivation between students who are taught with the Jarimatika method and those who are not? (4) Is there a significant difference in Mathematics learning outcomes between students who are taught with the Jarimatika method and those who are not?

METHOD

The type of research applied in this study is quantitative experimental research using a 2x2 Factorial Experimental Design. This design was specifically chosen because it allows researchers to analyze simultaneously and separately the main effects of two independent variables (Learning Model: GGE vs CLIS, and Method: Jarimatika vs Non-Jarimatika), as well as to test the existence of an interaction effect between the two factors on the dependent variable (Motivation and Mathematics Learning Outcomes).

The research was conducted in two elementary schools in Woha District, Bima Regency, namely SD Inpres Pucuke and SDN Inpres Wadu Wani. The research was conducted in the even semester of the 2024/2025 academic year. The selection of this location was based on the characteristics of the students and the relatively homogeneous conditions of the school environment, thus fulfilling the requirements for conducting a comparative study.

The population in this study was all third grade students in Woha District, totaling 881 students. The sampling technique used multistage sampling with a purposive sampling method, which resulted in a specific sample from two selected schools. The total sample used in the data analysis was 36 students, who were then grouped into four experimental groups based on the combination of learning models and motivation levels.

Sample Count Table for Each Group

Table 1. Sample Count Table for Each Group

Group	Learning model	Motivation	Number of Students
A1B1	*Group to Group Exchange* (GGE)	Tall	9
A1B2	*Group to Group Exchange* (GGE) with Jarimatika	Low	9
A2B1	*Children Learning in Science* (CLIS)	Tall	9
A2B2	*Children Learning in Science* (CLIS) with Jarimatika	Low	9

Source: Primary data processed by the author (2025)

Information:

A1B1: Groups using the GGE model with high motivation.

A1B2: Groups using the Jarimatika-assisted GGE model with low motivation.

A2B1: Groups using the CLIS model with high motivation.

A2B2: Groups using the Jarimatika-assisted CLIS model with low motivation.

The operational definition of variables in this study is crucial. The Group to Group Exchange (GGE) model is operationalized as a learning process that requires students to collaborate in small groups, complete different tasks, and then exchange and discuss results with other groups. Meanwhile, the Children Learning in Science (CLIS) model is operationalized as a student-centered learning process that facilitates concept discovery through active exploration and direct experience. The Jarimatika method is operationalized as the use of fingers as counting tools to visualize and simplify basic mathematical operations (addition and subtraction).

The data collection procedure was carried out through several stages, starting from preparation and implementation to evaluation. The instruments used included observation sheets to monitor the implementation of learning, learning outcome tests (pretest and posttest) in multiple-choice format, and questionnaires to measure students' learning motivation using a Likert scale. Data collection techniques involved observation (of student and teacher activities), questionnaires (pre- and post-questionnaires for motivation), and tests (pretest and posttest for learning outcomes). Student observation sheets covered aspects such as discussion engagement, collaboration, responsiveness, and enthusiasm in learning.

Before the instruments were used, validity and reliability tests were conducted to ensure the accuracy of the measuring tools. Validity testing employed Pearson Product Moment correlation. Based on the results of the instrument trials, all statement items in the motivation questionnaires (both pre and post) were declared valid because the correlation coefficient (calculated r) was greater than the table r at the 5% significance level. Likewise, in the learning outcome test instrument, all questions demonstrated significant validity.

Reliability testing was carried out using the Cronbach's Alpha formula. The instrument reliability test results indicated high consistency. The mathematics learning motivation questionnaire yielded a Cronbach's Alpha value of 0.930 from 20 items, far exceeding the minimum threshold of 0.60. Meanwhile, the mathematics learning outcome test instrument demonstrated a reliability value of 0.663, which is considered sufficiently reliable for measuring learning outcomes.

The collected data were then analyzed using descriptive and inferential statistics. Prerequisite analysis tests included a data normality test using the Shapiro–Wilk test and a homogeneity of variance test using Levene's test. The Shapiro–Wilk test was chosen due to the relatively small sample size (fewer than 50 participants), thus providing more accurate normality detection than alternative methods.

The main data analysis techniques for hypothesis testing used one-way and two-way Analysis of Variance (ANOVA), as well as the nonparametric Kruskal–Wallis test as a supporting procedure if the normality assumption was not fully met. In addition, further testing (post hoc test) was conducted using the Tukey HSD method to specifically identify differences between treatment groups that showed significance. The indicator of this research's success can be seen from significant differences in mean scores between experimental groups, as well as increases in scores from pretest to posttest. Data analysis was carried out with the aid of SPSS software version 25 to ensure precision in statistical calculations.

External variables were controlled by matching teaching materials, time allocation, and teacher qualifications in both experimental classes. This was done to minimize bias so that any differences in learning outcomes could be attributed to the learning model and students' motivation levels.

RESULT AND DISCUSSION

The research began with observations of teacher activities during the intervention process. Observations showed that teachers were able to implement both learning models, Group-to-Group Exchange (GGE) and Children Learning in Science (CLIS), with thorough preparation. This implementation included preparing lesson plans and structured teaching modules, as well as using teaching aids such as visual media.

In particular, the application of the Jarimatika method in the treatment group was effective, with the teacher demonstratively teaching the technique of using fingers to visualize addition and subtraction operations. The use of Jarimatika was considered successful in increasing students' enthusiasm, making them more engaged and focused during Mathematics learning.

Classroom management carried out by the teacher was also considered good. The instructor successfully maintained classroom order, facilitated smooth transitions between group discussions and presentations, and provided constructive and supportive feedback. This contributed positively to increasing student self-confidence in both schools.

Descriptive analysis of student learning motivation (questionnaire) showed an increase in the average post-questionnaire score across all treatment groups compared to the pre-questionnaire. For instance, in the Children Learning in Science (CLIS) group with relatively low initial motivation that used Jarimatika (A2B2), the average pre-questionnaire score was 29, increasing to 40 in the post-questionnaire, indicating an 11-point improvement.

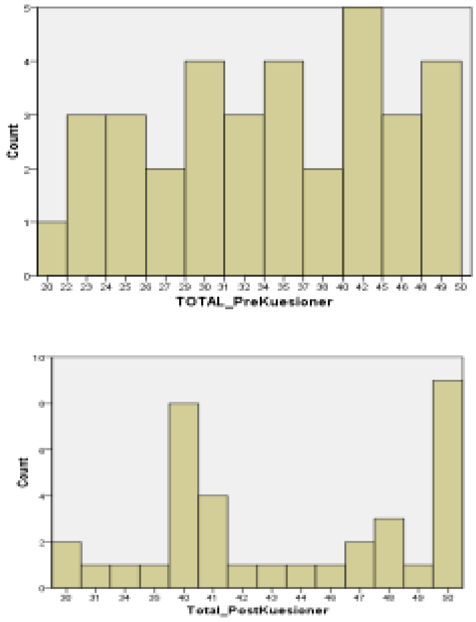

Figure 1. Pre-Questionnaire and Post-Questionnaire Scores of Student Learning Motivation
Source: Primary data processed by the author (2025)

Similar to motivation, the results of the descriptive analysis for learning outcomes showed substantial increases in *posttest* scores across treatment groups compared to *pretest scores*.

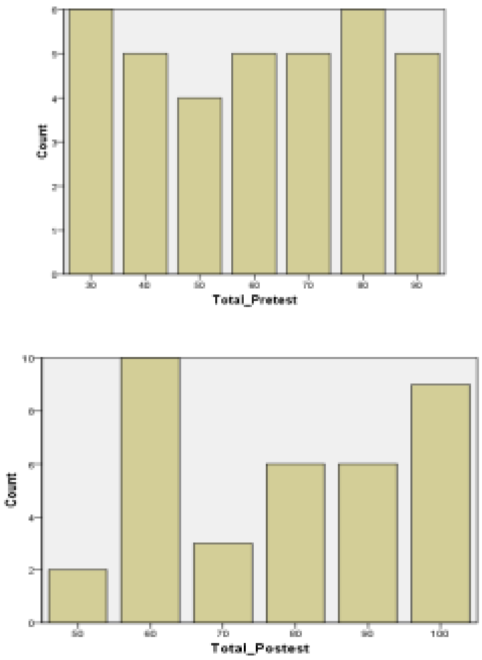

Figure 2. Pretest and Posttest Scores of Student Mathematics Learning Outcomes
Source: Primary data processed by the author (2025)

The results of the descriptive statistical analysis provide an initial picture of the increase in students' learning motivation. In the initial measurement (pre-questionnaire), the learning motivation score had an average of 35.36 with a standard deviation of 9.293 and a variance of 86.352. The range of scores spanned from a minimum of 20 to a maximum of 50. After the learning intervention, the final measurement (post-questionnaire) showed an increase in the mean to 43.22, with a smaller standard deviation of 6.114. This decrease in standard deviation indicates that the distribution of students' motivation scores became more homogeneous and that motivation increased collectively after the intervention.

In terms of mathematics learning outcomes, the pretest data showed an average score of 60.00 with a standard deviation of 20.840. The lowest score obtained by students was 30 and the highest was 90. After the implementation of learning using the GGE and CLIS models assisted by Jarimatika, the average posttest score increased markedly to 78.61. Data variability also decreased, as indicated by the posttest standard deviation of 17.097. The minimum posttest score increased to 50 and the maximum score reached a perfect score of 100, indicating the effectiveness of the pedagogical intervention applied.

The results of the homogeneity of variance test using Levene's test indicate that the research data met the homogeneity assumption. For the motivation questionnaire, the significance values were 0.325 for the pre-questionnaire and 0.939 for the post-questionnaire, both well above the 0.05 significance level. Similarly, for the learning outcome data, the significance values for the pretest and posttest homogeneity were 0.842 and 0.734, respectively. These results confirm that the variances between groups were equal (homogeneous), allowing comparative analysis using ANOVA to be appropriately conducted.

Although the Shapiro–Wilk normality test showed that some data distributions were not perfectly normal (significance value < 0.05 in the posttest), the analysis was continued using ANOVA due to its robustness against violations of the normality assumption when data are homogeneous. To further strengthen the validity of the conclusions, the researchers also employed the non-parametric Kruskal–Wallis test. The Kruskal–Wallis results for learning motivation showed Chi-Square values of 26.456 (pre) and 19.419 (post), both with significance values of 0.000, confirming the existence of real differences between groups.

Summary of Descriptive Test Results

The following is a summary of the descriptive test results showing the significance of the differences between the treatment groups:

Table 2. Summary of Descriptive Test Results

Statistical Test	Dependent Variable	Testing Objectives	Significance (p < 0.05)
Kruskal-Wallis test	Motivation (Post-Questionnaire)	Testing group differences	Significant
ANOVA test	Motivation (Post-Questionnaire)	Testing the difference in group means	Significant
ANOVA test	Learning Outcomes (Posttest)	Testing the difference in group means	Significant
Kruskal-Wallis test	Learning Outcomes (Posttest)	Testing group differences	Significant

Source: Primary data processed by the author (2025)

The findings showing significant differences in motivation and learning outcomes between treatment groups confirm that the learning models and methods used have a substantial influence on students' academic processes and achievements. The GGE model provides advantages through its emphasis on collaboration and knowledge exchange between groups, which effectively addresses the low confidence and limited ability to formulate ideas observed in the initial phase. In line with theory, cooperative learning using GGE has been shown to increase motivation and strengthen conceptual understanding.

The CLIS model, with its focus on discovery-based learning, encourages students to actively engage in experimentation and construct their own knowledge. This approach is consistent with constructivist theory, which views learning as an active process in which students build meaning from real-life experiences. The integration of the Jarimatika method successfully overcomes one of the main obstacles in Mathematics learning, namely difficulty in understanding basic arithmetic operations. This method functions as a concrete and easily accessible teaching aid, compensating for the limited visual infrastructure in schools. The success of Jarimatika in making learning more enjoyable and interactive has had a positive impact on student engagement in the classroom.

However, the results also show that the effectiveness of Jarimatika is not absolute. The case of group A2B2 (CLIS + Jarimatika), which experienced a smaller increase in motivation than A2B1 (CLIS without Jarimatika), indicates that methodological aspects must be balanced with internal student factors and the teacher's implementation strategies. The pedagogical implications of this research highlight the importance for teachers to engage in critical reflection and innovation when selecting and integrating learning methods. Teachers need to ensure that each method used not only focuses on the technical aspects of calculation but also supports students' holistic conceptual understanding and social skills.

This study recommends a harmonious combination of cooperative learning models (GGE) or discovery-based learning models (CLIS) with creative methods such as Jarimatika, to create Mathematics learning that is effective, enjoyable, and relevant to the context of elementary school students. Thus, the results of this study provide empirical evidence that innovative learning models combined with practical methods like Jarimatika are a strategic effort to improve the motivation and Mathematics learning outcomes of third-grade elementary school students in Woha District. This effort is in line with the principle of change emphasized in religious teachings, that God will not change the condition of a people until they strive to change what is within themselves (QS. Ar-Ra'd: 11).

CONCLUSION

The results of this study indicate that the Group to Group Exchange (GGE) learning model is more effective than Children Learning in Science (CLIS) in improving the motivation and Mathematics learning outcomes of third-grade elementary school students in Woha District. This is evidenced by one-way ANOVA and Kruskal–Wallis test results showing significance values of less than 0.05. Student motivation and learning outcomes also improved significantly through the use of the Jarimatika method. The application of this method has been shown to strengthen students' motivation and understanding in the learning process, especially in groups using the GGE model. This is reflected in the positive contribution of the Jarimatika method in fostering enthusiasm for learning Mathematics. In addition, the Jarimatika method supports the creation of an interactive learning atmosphere and increases students' self-confidence. Overall, the GGE learning model is superior to the CLIS model in improving student motivation and

Mathematics learning outcomes. The Jarimatika method serves as an effective tool to enhance students' abilities, although it does not replace the central role of the main learning models.

The success of this implementation confirms that innovation in teaching methods is key to overcoming learning difficulties and low motivation identified in the early stages of the research. Teachers need to use these findings as input to develop tasks and strategies aligned with the curriculum, thereby reducing gaps in conceptual understanding. For students, the implementation of the GGE and CLIS models supported by Jarimatika has fostered essential skills such as problem solving, collaboration, communication, and higher-order thinking. This has provided a more convenient and positive experience in learning Mathematics. For schools, the results of this study offer a strong empirical basis for strategic decision-making. Schools are encouraged to provide facilities and infrastructure that support the implementation of innovative and interactive teaching and learning processes, in line with these findings. This research also offers valuable experience for researchers in implementing and evaluating the GGE, CLIS, and Jarimatika models, while providing solutions to academic problems encountered in the field. Ultimately, these findings represent a form of ongoing innovation in education and are expected to serve as a basis for further research and as inspiration for educators to continuously create lively and engaging learning environments capable of producing intelligent and morally upright future generations. The principle of change for the better must begin with oneself, as emphasized in the Qur'an (QS. Ar-Ra'd: 11).

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