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The Effect of the Numbered Heads Together Cooperative Learning Model Assisted by Spreadsheet on Grade XI Students' Mathematics Learning Outcomes

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ABSTRACT

Mathematics learning outcomes reflect students' attainment of instructional objectives, particularly their ability to understand concepts, apply mathematical procedures, and analyze problems. This study investigated whether students taught using the Numbered Heads Together (NHT) cooperative learning model assisted by a spreadsheet achieved better mathematics learning outcomes than students taught through conventional instruction. A quasi-experimental method with a posttest-only control group design was employed. The study involved 73 Grade XI students at SMAN 1 Gunung Talang, comprising 36 students in the experimental class and 37 students in the control class. The experimental class received NHT-based instruction supported by a spreadsheet, whereas the control class received conventional instruction. Data were collected using a five-item essay test designed to assess cognitive processes at the levels of understanding, application, analysis, and evaluate. The data were analyzed using the Mann–Whitney U test at a significance level of 0.05 because the posttest data did not satisfy the normality assumption. The experimental class obtained a mean score of 79.58, compared with 66.35 in the control class. The hypothesis test yielded a reported p-value of 0.000, which should be interpreted as $p < 0.001$, indicating a statistically significant difference between the groups. The findings suggest that NHT-assisted spreadsheet instruction was associated with better mathematics learning outcomes in the context studied. The integration of individual accountability, collaborative discussion, and computational verification may offer a productive instructional approach, although further research is needed to examine the contribution of each component separately.

Keywords: Numbered Heads Together; spreadsheet; mathematics learning outcomes; cooperative learning; quasi-experimental research

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1. INTRODUCTION

Mathematics learning outcomes are one indicator for assessing the attainment of learning objectives, particularly the mastery of concepts, the application of procedures, reasoning, and mathematical problem solving. Learning outcomes represent not only students' ability to obtain correct answers, but also the extent to which they can understand relationships among concepts, use mathematical principles appropriately, and construct solutions that are logical and justifiable. Accordingly, the attainment of mathematics learning outcomes should be viewed as a

consequence of a learning process that gives students opportunities to build understanding, develop reasoning, and apply knowledge in various situations. Sudjana (2017) positions learning outcomes as the achievement students obtain after participating in the learning process. In the context of mathematics education, this achievement is closely related to the alignment among learning objectives, the learning experiences provided, and the abilities students demonstrate through assessment.

These demands are in line with the direction of mathematics learning, which emphasizes meaningful mastery of competencies. The Mathematics Learning Outcomes for Phase F place conceptual understanding, reasoning, and the application of mathematics as important components of the competencies that students need to develop (BSKAP, 2022). Thus, mathematics learning should not be directed solely at mastering algorithms or solution procedures mechanically. Students also need opportunities to explain the reasoning behind a procedure, to connect known information with relevant concepts, and to evaluate the accuracy of their solutions. This orientation calls for learning that is not centered only on the teacher's delivery of content, but that also actively involves students in constructing and testing their own understanding.

However, the attainment of students' mathematics learning outcomes remains a challenge in education. Studies of mathematics achievement at the international level indicate that students' mastery of mathematical competencies remains a concern in educational evaluation (Wardat et al., 2023). Similar problems have also been reported in Indonesian school contexts. Sumandya et al. (2024), for example, raised the problem of attaining the mathematics mastery criterion among students at SMA Negeri 3 Denpasar. Meanwhile, Mirna et al. (2023) reported that survey results from several schools in Padang City showed that students' mathematics learning outcomes had not fully reached the standards set by the schools. These findings indicate that the attainment of mathematics learning outcomes needs continued attention, while also encouraging the examination of learning strategies that have the potential to support students' competency attainment.

The same problem was also found at SMAN 1 Gunung Talang. Based on daily mathematics assessment data obtained during the initial observation, 211 of 255 students, or 83.17%, scored below 75, which was the achievement threshold used at the time of observation. The observations also revealed that students had difficulty with number operations, including signed numbers and fractions, which may hinder them in solving more complex mathematical problems. These findings indicate that some students still need support to strengthen their foundational understanding and to use it appropriately when solving problems.

Learning outcome problems cannot be separated from the processes that take place during learning. When learning activities are dominated by teacher explanations and individual exercises, students' opportunities to give reasons, compare strategies, and check their understanding through interaction with peers may be limited. In contrast, student involvement in structured discussion can create space for expressing ideas, clarifying concepts, and correcting reasoning errors (Rahman, 2021). From a cooperative learning perspective, interaction among students is not merely a social activity but part of the learning process that enables students to help one another achieve academic goals. Slavin (2020) explains the importance of cooperative learning structures in supporting learning through group work and responsibility for achieving shared goals. Thus, applying a learning model that systematically organizes student interaction and responsibility is a relevant alternative to be examined.

One model that can be used is *Numbered Heads Together* (NHT). This cooperative learning model organizes learning activities by assigning a number to each group member, having the teacher pose a question or problem, holding a joint discussion to formulate answers, and calling a particular number to present the results of the discussion (Asmoro et al., 2023). This structure links group responsibility with individual accountability. Every member needs to understand the outcome of the discussion because the student called to answer is determined only after the group has had the opportunity to discuss. Therefore, a group's success does not depend on a single member perceived as the most capable, but requires every member to be ready to explain the agreed answer (Yuliani et al., 2021). This characteristic makes NHT relevant to mathematics learning, which requires both an understanding of procedures and the ability to explain the solution process.

Several studies have examined the application of NHT in mathematics learning and have shown its relevance for increasing student involvement in the learning process and supporting learning achievement (Jumrah et al., 2023; Saptono, 2024). Other studies have also discussed the use of cooperative learning models in mathematics learning, including the application of NHT at various educational levels and in various topics (Aulia & Lena, 2023; Hasibuan & Wahyudin, 2023; Kaharuddin & Hajeniati, 2020; Fatikasari et al., 2024). Although these studies provide a basis for the use of cooperative learning, the application of a model still needs to take into account the characteristics of the content and the cognitive demands to be achieved. In mathematics learning that involves step-by-step calculations, for example, group discussion needs to be accompanied by a mechanism that helps students check the accuracy of their procedures and calculation results.

One tool that can be used for this purpose is the spreadsheet. This application allows users to arrange data in cells, enter formulas, and perform calculations systematically (Zulkarnaen et al., 2022). In mathematics learning, a spreadsheet has the potential to help students check the results of manual calculations, trace the consistency of results when certain values change, and identify possible calculation errors. Jelatu et al. (2020) discussed the use of technology in mathematics learning as part of efforts to support mathematical representation and activity. Nevertheless, the use of technology does not in itself guarantee conceptual understanding. The results displayed by an application must still be interpreted on the basis of the mathematical concepts and procedures being learned. Accordingly, in this study the spreadsheet is positioned as a verification tool, not as a substitute for students' reasoning or as a source of answers to be accepted without checking.

The integration of NHT and the spreadsheet has complementary pedagogical foundations. NHT provides the social and procedural structure through which students engage in discussion and take responsibility for the group's answers, whereas the spreadsheet provides a means of checking the results of calculations that have been done manually. Through this integration, students are expected not to stop at agreeing on an answer within the group, but also to have the opportunity to assess the accuracy of the result through systematic checking. When the results of the manual calculation and the spreadsheet check differ, the difference can become a starting point for reviewing the procedure, the use of formulas, and the understanding of the information in the problem. In this way, technology serves to support the evaluation of mathematical work, while cooperative discussion provides space to discuss and improve understanding.

Nevertheless, the theoretical benefits of integrating these two components cannot be directly regarded as evidence of their empirical effectiveness. Using a cooperative model and technology together introduces more than one learning element, so the results obtained need to be interpreted proportionally. If a class using NHT assisted by a spreadsheet shows better learning outcomes than a class using conventional learning, the finding supports the effectiveness of the

learning package applied in the research context. However, this result does not in itself indicate the size of the contribution of NHT separately from the spreadsheet, or vice versa. This distinction is important so that the explanation of the research results remains consistent with the design and the variables actually tested.

Based on this focus, the purpose of this study was to determine whether the mathematics learning outcomes of students who learned using the Numbered Heads Together cooperative learning model assisted by a spreadsheet were better than those of students who learned using conventional instruction in Grade XI at SMAN 1 Gunung Talang. The research hypothesis stated that the mathematics learning outcomes of students in the class applying NHT assisted by a spreadsheet were better than those of students in the class applying conventional instruction.

2. METHODS

This study used a quantitative approach with a quasi-experimental type of research. The research design was a non-equivalent posttest-only control group design. The study involved two classes: an experimental class that applied the Numbered Heads Together (NHT) cooperative learning model assisted by a spreadsheet and a control class that applied conventional instruction. After the treatment was given, both classes took a final test (posttest) to obtain data on students' mathematics learning outcomes.

The population of the study was all Grade XI students of SMAN 1 Gunung Talang in the 2026/2027 academic year. The sample consisted of class XI F10 as the experimental class with 36 students and class XI F8 as the control class with 37 students. The sample classes were selected using simple random sampling, as described in the research design. The independent variable in this study was the learning model applied, namely NHT assisted by a spreadsheet in the experimental class and conventional instruction in the control class. The dependent variable was students' mathematics learning outcomes. The learning outcomes measured focused on the cognitive aspect in accordance with the item indicators used in the research instrument.

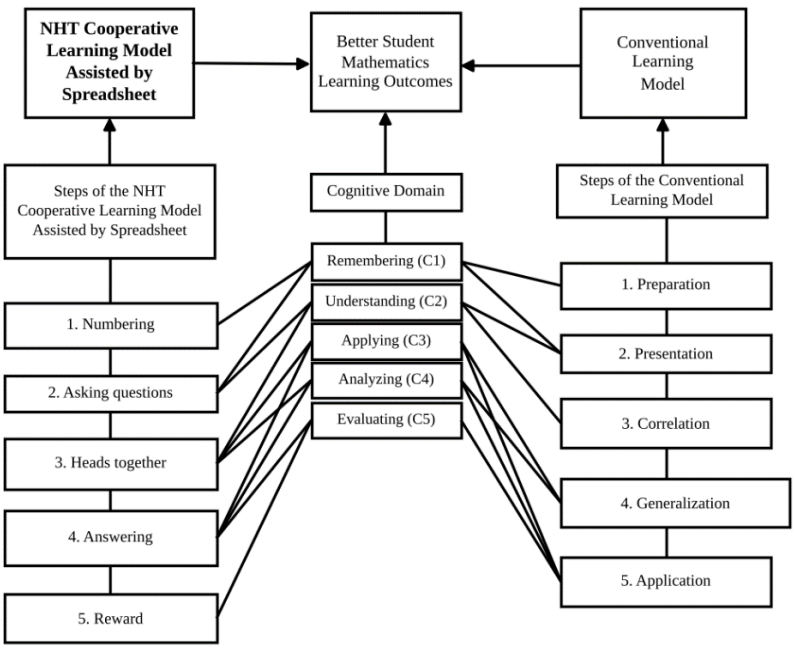


Figure 1. Conceptual Framework of the Research Method

Figure 1 explains the syntax of NHT cooperative learning and conventional learning and their relation to learning outcomes. The instrument for collecting data on students' mathematics

learning outcomes was a final test (posttest) administered at the end of the learning period and consisting of five items. The test was developed on the basis of the compound interest and annuity material that had been studied during the learning process. This material is part of the Grade XI mathematics curriculum. The items were developed on the basis of the cognitive ability indicators C2, C3, C4, and C5. Each item had a maximum score of 20, so the maximum total score was 100. Students' answers were scored on the accuracy of the answer and the completeness of the solution steps using a prepared scoring rubric.

The posttest data were analyzed descriptively and inferentially. Descriptive analysis was used to describe students' mathematics learning outcomes in both classes through statistical measures, including the mean and median. Before hypothesis testing, the normality of the data was examined using the Anderson–Darling test. The results showed that the data of the experimental class were not normally distributed at the 0.05 significance level. Therefore, the difference in mathematics learning outcomes between the two classes was analyzed using the Mann–Whitney U test at the 0.05 significance level. The test results were used to determine whether there was a difference in mathematics learning outcomes between students who learned using NHT assisted by a spreadsheet and students who learned using conventional instruction.

Before the final test was administered, the test was first tried out on Grade XI F1 students at SMA Negeri 2 Gunung Talang. The tryout data were used to analyze the validity, reliability, discriminating power, and difficulty index of the items. The results can be seen in Table 1.

Table 1. Classification of Tryout Items of the Mathematics Learning Outcome Test

Item No.	Ip	Criterion	I_k	Criterion	Classification
1	2.195	Significant	0.73	Easy	Used
2	2.934	Significant	0.79	Easy	Used
3	2.616	Significant	0.60	Moderate	Used
4	3.418	Significant	0.74	Easy	Used
5	2.840	Significant	0.60	Moderate	Used

The reliability of the test can be calculated using the *Cronbach's alpha* formula, as follows:

$$(r_{11}) = \left[\frac{k}{k-1}\right]\left[1 - \frac{\sum \sigma_i^2}{\sigma_t^2}\right] \quad (1)$$

Where,

$$\sigma_t^2 = \frac{\sum X_i^2 - \frac{(\sum X_i)^2}{N}}{N} \quad (2)$$

Notes:
r_{11} : Reliability to be determined
k : Number of test items
$\sum \sigma_i^2$: Sum of the variances of the item scores
$\sum X_i$: Sum of the scores of each item
$\sum X_i^2$: Sum of the squared scores of each item
σ_t^2 : Total variance
N : Number of students

Based on the results of the analysis, the five items were declared suitable for use as an instrument for testing students' mathematics learning outcomes. The reliability of the instrument was calculated using the *Cronbach's alpha* formula, yielding a coefficient of 0.49,

which falls in the moderate category. This indicates that the test instrument has a moderate level of consistency in measuring students' mathematics learning outcomes. The final test data were analyzed descriptively to describe students' mathematics learning outcomes in the experimental and control classes. Next, a normality test was conducted using the *Anderson–Darling* test. Because the learning outcome data of the experimental class were not normally distributed, hypothesis testing was conducted using the *Mann–Whitney U* test at the significance level ($\alpha = 0.05$) to determine whether the mathematics learning outcomes of students who followed learning with the *Numbered Heads Together* (NHT) cooperative model assisted by a spreadsheet were better than those of students who followed conventional instruction.

3. RESULT AND DISCUSSION

The research data were obtained from a final mathematics learning outcome test in essay form consisting of five items. The experimental class applied the Numbered Heads Together (NHT) cooperative learning model assisted by a spreadsheet, while the control class applied conventional instruction.

The final test results of both classes are presented in Table 2.

Table 2. Descriptive Statistics of Students' Mathematics Learning Outcomes

Statistic	Experimental	Control
Number of students	36	37
Mean	79.58	66.35
Median	81	66
Standard deviation	10.78	14.50
Variance	116.31	210.29
Minimum score	40	42
Maximum score	96	92
Range	56	50

Based on Table 2, the experimental class obtained a mean mathematics learning outcome of 79.58, whereas the control class obtained a mean of 66.35. The median of the experimental class was 81, higher than that of the control class, which was 66. In terms of data dispersion, the experimental class had a standard deviation of 10.78 and a variance of 116.31, whereas the control class had a standard deviation of 14.50 and a variance of 210.29. These results show that the dispersion of students' scores in the experimental class was smaller than in the control class. Thus, descriptively, the experimental class not only obtained a higher mean learning outcome but also had lower score variation than the control class.

In addition to central tendency and dispersion, students' mathematics learning outcomes were also analyzed in terms of attainment of the minimum mastery criterion (*Kriteria Ketuntasan Minimal*, KKM) of 75. In the experimental class, 29 of 36 students (80.6%) reached or exceeded the KKM, while 7 students (19.4%) did not. In the control class, 12 of 37 students (32.4%) reached or exceeded the KKM, while 25 students (67.6%) did not. The percentage of students reaching the KKM in the experimental class was higher than in the control class. Overall, the descriptive analysis shows that the experimental class had better mathematics learning outcomes than the control class in terms of the mean, the median, score dispersion, and the percentage of mastery. This finding provides additional information on the distribution of learning outcome attainment

in the two classes. A comparison of the scores of the experimental and control classes can be seen in Figure 2.

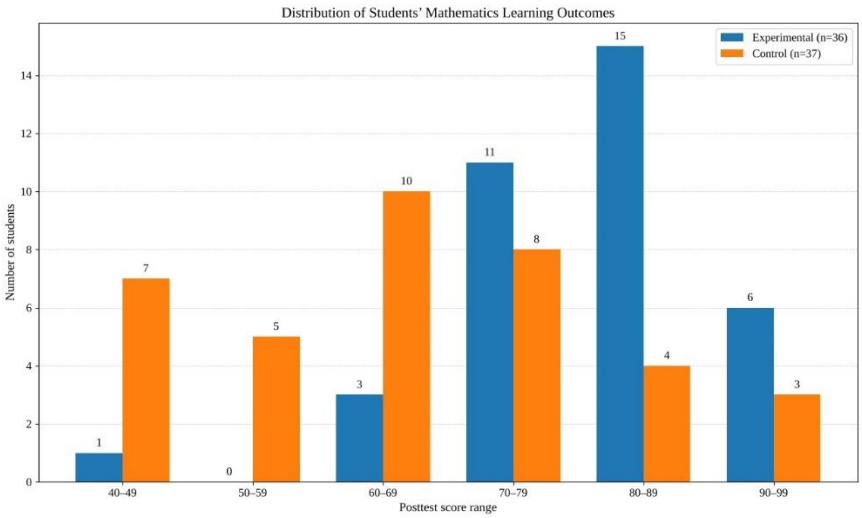


Figure 2. Distribution Chart of the Sample Classes' Scores

Based on Figure 2, the test scores of students in the experimental and control classes show considerable variation. In the experimental class, most scores fall in the middle to high range, although several students obtained relatively low scores. In the control class, students' scores also vary, with some high scores and some in the low range. This pattern shows that learning outcomes were not uniform within each class. Although the experimental class's scores tend to be higher overall, the chart also shows that some students in the control class scored higher than some students in the experimental class. Therefore, the difference in learning outcomes between the two classes should be understood in terms of group tendencies, while still taking into account the variation in individual students' scores.

To obtain a more detailed picture of students' mathematics learning outcomes, the mean score on each item of the final test was analyzed. The test consisted of five essay items with a maximum score of 20 each. Each item represented a learning indicator on the compound interest and annuity material. The results of the analysis of the mean scores and the percentage of attainment on each indicator in the experimental and control classes are presented in Table 3.

Table 3. Mean Scores of Students' Mathematics Learning Outcomes by Item Indicator

Item No.	Indicator	Experimental			Control			Mean difference
		Mean	SD	Var	Mean	SD	Var	
1	C2	14.11 (70.55%)	4.53	20.56	11.19 (55.95%)	5.51	30.38	2.92
2	C3	17.67 (88.35%)	2.63	6.91	15.43 (77.15%)	3.26	10.64	2.24
3	C5	14.94 (74.70%)	4.94	24.40	12.65 (63.25%)	3.90	15.18	2.29
4	C3	18.00 (90.00%)	2.08	4.34	14.95 (74.75%)	3.44	11.83	3.05
5	C4	14.86 (74.30%)	3.54	12.53	12.14 (60.70%)	4.46	19.90	2.72

Based on Table 3, the mean score of the experimental class was higher than that of the control class on all five items. The difference in mean scores ranged from 2.24 to 3.05 points. The largest difference was on item 4, at 3.05 points, while the smallest difference was on item 2, at 2.24 points. In terms of score dispersion, the standard deviation of the experimental class was lower than that of the control class on four of the five items. On item 3, however, the standard deviation of the

experimental class (4.94) was higher than that of the control class (3.90). These descriptive findings show that the experimental class's advantage in mean learning outcomes appeared on all items, although score variation on each item showed different patterns.

On item 1, which measured the ability to explain the difference between simple interest and compound interest, the mean score of the experimental class was 14.11, or 70.55% of the maximum score. The control class, meanwhile, obtained a mean of 11.19, or 55.95%. The difference of 2.92 points indicates that the experimental class's attainment on this indicator was higher. The experimental class had a standard deviation of 4.53 and a variance of 20.56, whereas the control class had a standard deviation of 5.51 and a variance of 30.38. This indicates that the scores of students in the experimental class were less dispersed than those in the control class. This indicator required students not only to recognize the two types of interest but also to explain the difference in how interest is calculated and in how the value of an investment grows. Thus, these results illustrate a difference between the two classes in attainment in explaining the concepts of simple and compound interest.

On item 2, which measured the ability to calculate the final value of an investment using compound interest, the experimental class obtained a mean score of 17.67, or 88.35%, while the control class obtained 15.43, or 77.15%. The difference in means between the two classes was 2.24 points. Compared with the other indicators, item 2 had the highest mean score in the experimental class. In terms of score dispersion, the experimental class had a standard deviation of 2.63 and a variance of 6.91, whereas the control class had a standard deviation of 3.26 and a variance of 10.64. This shows that the experimental class's scores were more concentrated around the mean. These results show that students in the experimental class had relatively high attainment in calculating the final value of an investment from the initial capital, the interest rate, and the investment period. Nevertheless, the difference between the two classes on this indicator was the smallest, so the difference in attainment between classes on item 2 was relatively smaller than on the other indicators.

On item 3, students were asked to calculate the final value of two investment alternatives and to evaluate an opinion about which investment choice was more appropriate. The mean score of the experimental class was 14.94, or 74.70%, while the control class obtained 12.65, or 63.25%. The difference in means of 2.29 points indicates higher attainment in the experimental class. The experimental class had a standard deviation of 4.94 and a variance of 24.40, higher than the control class, which had a standard deviation of 3.90 and a variance of 15.18. This shows that students' scores in the experimental class were more varied on this item. This item required more than the application of the compound interest formula because students also had to compare the calculation results and give reasons for the decision they made. Therefore, attainment on this indicator reflects students' ability to connect calculation results with decision making based on the investment context.

On item 4, which measured the ability to calculate the annuity from the loan amount, the interest rate, and the repayment period, the experimental class obtained a mean score of 18.00, or 90.00%. The control class obtained a mean of 14.95, or 74.75%. The difference of 3.05 points was the largest among the five items. In terms of score dispersion, the experimental class had a standard deviation of 2.08 and a variance of 4.34, whereas the control class had a standard deviation of 3.44 and a variance of 11.83. Thus, the experimental class's scores on this item were less dispersed than the control class's. Descriptively, these results show that the difference in attainment between the two classes was greatest on the indicator of calculating the annuity. Solving this item required students to identify the known information, determine the appropriate formula, carry out the calculation, and present the final answer. These results are consistent with the general picture that the mean learning outcomes of the experimental class were higher than those of the control class.

On item 5, students were asked to calculate the annuity of two credit alternatives with the same loan amount and interest rate but different repayment periods, and then to analyze the effect of the difference in repayment period. The mean score of the experimental class was 14.86, or 74.30%, while that of the control class was 12.14, or 60.70%. The difference in means of 2.72

points indicates higher attainment in the experimental class. The experimental class had a standard deviation of 3.54 and a variance of 12.52, whereas the control class had a standard deviation of 4.46 and a variance of 19.90. This shows that the dispersion of scores in the experimental class was smaller than in the control class. This indicator required students to perform calculations for both credit alternatives while explaining the relationship between the repayment period and the size of the annuity. Thus, students needed to combine calculation skills with the ability to interpret the results obtained.

Overall, the analysis by indicator shows that the experimental class, which followed the Numbered Heads Together (NHT) cooperative learning model assisted by a spreadsheet, obtained higher mean scores on all items than the control class, which followed conventional instruction. The difference was evident in the indicators of understanding the concept of interest, calculating investment values, evaluating investment alternatives, calculating annuities, and analyzing the effect of the repayment period. These descriptive results complement the comparison of overall learning outcomes. However, differences in means on individual items do not in themselves prove statistical significance on each indicator, because the research hypothesis was tested on the overall learning outcome data.

The normality test was conducted using the Anderson–Darling method with the help of Minitab software. The results are presented in Table 4.

Table 4. Results of the Normality Test

Class	*p-value*	Remark
Experimental	0.016	Not normally distributed
Control	0.455	Normally distributed

Based on Table 4, the data of the experimental class had a *p-value* of 0.016, smaller than 0.05, so they were not normally distributed. Meanwhile, the data of the control class had a *p-value* of 0.455, greater than 0.05, so there was not enough evidence to state that the control class data deviated from a normal distribution. Because one of the groups did not satisfy the normality assumption, hypothesis testing proceeded using the Mann–Whitney U test.

Hypothesis testing was conducted using the Mann–Whitney U test at the 0.05 significance level. The Minitab analysis yielded a *p-value* of 0.000, which in statistical reporting is written as $p < 0.001$. Thus, this value is smaller than 0.05, so the null hypothesis was rejected. This result shows a statistically significant difference between the mathematics learning outcomes of the experimental class and the control class. Taking into account that the median of the experimental class was higher than that of the control class, the results support the conclusion that the mathematics learning outcomes of students who learned using the NHT model assisted by a spreadsheet were better than those of students who learned using conventional instruction.

The difference in mathematics learning outcomes between the experimental and control classes can be examined in terms of the characteristics of the learning applied. The *Numbered Heads Together* (NHT) cooperative learning model gives students the opportunity to engage in group discussion and build understanding through the exchange of opinions (Rahmawati & Siti Poerwanti, 2022). Each group member has a number that allows the teacher to call on students at random to present the results of the discussion. Thus, students do not depend on particular group members but need to understand the material and the solutions that have been discussed together (Shofa & Azizah, 2022).

These characteristics are relevant to mathematics learning, which requires students to understand concepts, apply procedures, and analyze problems. In this study, students worked on problems related to compound interest, investment, and annuities. These problems require an understanding of the known information, the selection of appropriate concepts, and accuracy in

carrying out calculations. Through group discussion, students had the opportunity to explain solution steps, compare answers, and improve their understanding when results differed. This process can support mastery of the material before students face the test individually.

These results are in line with the study of Aulia and Lena (2023), who reported an improvement in learning outcomes after the application of the NHT model, from a mean of 78.4 in cycle I to 87 in cycle II. Hasibuan and Wahyudin (2023) also discussed the application of NHT to improve mathematics learning outcomes. In addition, Jayantika et al. (2024) examined the application of the NHT model in efforts to improve students' mathematics learning outcomes. The findings of this study strengthen the relevance of using NHT as an alternative mathematics learning model. In implementing NHT, every group member is responsible for understanding the results of the discussion because any student may be called on to present the group's answer. This mechanism gives students the opportunity to be involved in discussing problems and to prepare themselves to explain the solution. Thinking together also allows students to exchange solution methods and to discuss the errors they find.

The use of the spreadsheet supported this process as a tool for checking the results of calculations previously completed manually. Jelatu et al. (2020) discussed the use of spreadsheets in mathematics learning, particularly for the topic of function graphs. In this study, the use of the spreadsheet on the topics of interest and annuities provided students with a means of verifying calculation results and reviewing their solutions when differences were found. Thus, technological assistance was used to support answer checking, while the process of understanding the problem and determining the solution steps remained the students' own work.

Nevertheless, the results of the statistical test do not mean that every student in the experimental class obtained a higher score than every student in the control class. The minimum score in the experimental class was 40, while the maximum score in the control class reached 92. This shows that students' learning outcomes still varied within each class. Thus, the conclusion of the study is based on group-level tendencies in learning outcomes and on the results of the statistical test, not on the assumption that all students achieved the same results.

Overall, the findings of this study support the use of the NHT cooperative learning model assisted by a spreadsheet as an alternative for mathematics learning, particularly on the topics of compound interest, investment, and annuities. Its application gives students the opportunity to discuss, explain solution steps, and verify calculation results. This conclusion still needs to be limited to the research context, namely Grade XI students of SMAN 1 Gunung Talang, the material studied, and the quasi-experimental design used.

Although the results show a significant difference, these findings need to be understood within the scope of the study, namely Grade XI students of SMAN 1 Gunung Talang on the material taught during the study. The results do not necessarily prove that the NHT model assisted by a spreadsheet would give the same results across all topics and learning contexts. However, the results of this study indicate that applying the model has the potential to be an alternative in mathematics learning to support students' learning outcomes.

4. CONCLUSION

Based on the results of the study, it can be concluded that the mathematics learning outcomes of students who learned using the *Numbered Heads Together* (NHT) cooperative learning model assisted by a spreadsheet were better than those of students who learned using conventional instruction. This is shown by the mean score of the experimental class of 79.58, which was higher than that of the control class of 66.35. The Mann–Whitney test also showed a significance value (p

< 0.001), indicating a significant difference in learning outcomes between the two classes. Descriptively, the experimental class also obtained higher mean scores at all the cognitive levels measured, namely C2, C3, C4, and C5. Thus, the NHT cooperative learning model assisted by a spreadsheet can be an alternative for mathematics learning to support students' learning outcomes.

The results of this study have implications for mathematics learning, particularly in applying cooperative learning models assisted by technology. The NHT model assisted by a spreadsheet can be an alternative for teachers in designing learning that encourages student involvement through group discussion, individual responsibility in answering questions, and more systematic checking of calculation results. The use of a spreadsheet can also help students check the results of manual calculations so that the learning process focuses not only on obtaining answers but also on understanding solution procedures. Therefore, applying the NHT model assisted by a spreadsheet has the potential to support a more interactive mathematics learning process and to help students' learning outcomes.

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