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The Effect of TPS vs NHT Teaching Methods on Math Learning Outcomes and Motivation

Budi Wahjuningsih[1], Achmad Noor Fatirul[2], Djoko Adi Walujo[3]

[1,2,3] Universitas PGRI Adibuana, Surabaya

Jl. Ngagel Dadi III-3B/37, Ngagel, Kota Surabaya, Jawa Timur, 60234, Indonesia

Corresponding email: budiwahju11469@gmail.com

ABSTRACT

This quasi-experimental study investigated the impact of the Think-Pair-Share (TPS) and Numbered Heads Together (NHT) teaching methods on mathematics learning outcomes and student motivation at SMKN 2 Kota Madiun and SMKN 5 Kota Madiun. The results showed that the experimental groups taught using the TPS method achieved significantly higher mathematics learning outcomes compared to the control groups taught using the NHT method ($F = 18.522$, $p < 0.001$). Additionally, students with high learning motivation demonstrated better academic performance than those with low motivation ($F = 100.93$, $p < 0.001$). An interaction effect was observed between the teaching method and learning motivation, indicating that the combination of teaching method and motivation significantly influenced mathematics learning outcomes ($F = 4.294$, $p = 0.040$). These findings highlight the effectiveness of the TPS method in improving mathematics learning outcomes and emphasize the importance of considering student motivation in instructional design. Further research is needed to explore the long-term effects of these teaching methods in different educational contexts and student populations, providing valuable insights into enhancing mathematics education.

Keywords: Mathematics learning outcomes, NHT method, student motivation, TPS method.

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1. INTRODUCTION

1.1. Introduction

In the realm of mathematics education, the effectiveness of teaching methods and student motivation has been widely recognized as crucial factors that significantly influence students' learning outcomes and academic achievement (Slamet & Fatimah, 2022; Holmes & Hwang, 2016;

Mustami & Safitri, 2018a; Wijaya et al., 2022). Researchers have conducted extensive studies exploring various instructional approaches with the aim of improving mathematics education and enhancing students' conceptual understanding and problem-solving skills (Al Said et al., 2019; Davis et al., 2022; Waswa, 2020). However, despite these efforts, there remains a need for further investigation into the specific impact of different teaching methods on mathematics learning outcomes and the role of student motivation in this process (Kusuma & Maskuroh, 2018; Mustami & Safitri, 2018). By delving deeper into these aspects, this research aims to make a significant contribution to the existing body of knowledge in mathematics education. The study seeks to provide valuable insights for educators and researchers who are actively seeking ways to optimize instructional practices and enhance student engagement and achievement. With a specific focus on mathematics learning outcomes and student motivation, this research aims to examine and compare the impact of two prominent teaching methods: Think-Pair-Share (TPS) and Numbered Heads Together (NHT). By conducting a thorough and comprehensive comparative analysis of these instructional approaches, the study aims to shed light on their effectiveness and, importantly, identify the optimal method for enhancing students' mathematical understanding and motivation.

The Think-Pair-Share (TPS) method has garnered significant attention in mathematics classrooms due to its potential to encourage active student participation through individual reflection, collaborative discussion, and whole-class sharing (Muryanti, 2017; Wulandari, 2021) Research has shown that TPS promotes student engagement by providing them with the opportunity to think independently about a problem, discuss their ideas with a partner, and then share their thoughts with the entire class (Hidayati et al., 2023; Natalia et al., 2019; Wulandari, 2021). This collaborative nature of TPS facilitates peer learning, enabling students to construct their mathematical knowledge actively (Kusuma & Maskuroh, 2018). By engaging in TPS, students not only develop their problem-solving skills but also enhance their ability to articulate their reasoning and communicate their mathematical ideas effectively (Muryanti, 2017).

On the other hand, the Numbered Heads Together (NHT) method is another widely utilized instructional approach in mathematics education (Kurnia et al., 2019; Lumbantoruan, 2022). NHT promotes cooperative learning and peer interaction by assigning numbered roles to group members during problem-solving activities (Mustami & Safitri, 2018b). In NHT, students work together in small groups, and each member is responsible for contributing to the collective understanding of the problem (Lumbantoruan, 2022; Sudewiputri & Dharma, 2021). This method emphasizes cooperation, communication, and shared responsibility among group members, fostering an

environment that enhances students' problem-solving abilities and deepens their conceptual understanding (Kusuma & Maskuroh, 2018; Luthfi et al., 2022; Viriana, 2022)).

While previous studies have individually examined the effectiveness of the TPS and NHT methods, there is a paucity of research comparing their impact on mathematics learning outcomes and student motivation within the same study (Kusuma & Maskuroh, 2018). This study aims to address this gap by investigating the impact of the TPS and NHT methods on mathematics learning outcomes and student motivation simultaneously. By conducting a comparative analysis, valuable insights can be gained into the relative effectiveness of these two approaches, ultimately providing guidance for educators and researchers in selecting the most suitable method for enhancing students' mathematical understanding and motivation. Moreover, this research aims to explore the relationship between student motivation and academic performance within the context of these teaching methods. Motivation plays a vital role in students' engagement and persistence in learning mathematics (Muryanti, 2017; Natalia et al., 2019; Wulandari, 2021). By examining how student motivation varies between the TPS and NHT methods, this study seeks to contribute to the growing body of literature on the complex interplay between motivation and learning outcomes in mathematics education. Understanding the interrelationship between motivation and academic performance can offer valuable insights for educators to design instructional practices that effectively foster motivation, leading to improved learning outcomes.

By comparing the impact of the Think-Pair-Share (TPS) and Numbered Heads Together (NHT) teaching methods on mathematics learning outcomes and student motivation, this research aims to shed light on their effectiveness and identify the optimal method for enhancing students' mathematical understanding and motivation. The study seeks to contribute to the existing body of knowledge in mathematics education and provide valuable insights for educators and researchers seeking to optimize instructional practices and foster student engagement and achievement. By conducting a comparative analysis of these two instructional approaches, the research will generate evidence-based findings that can inform instructional decision-making and guide educators in selecting the most effective teaching method for promoting student success in mathematics.

To the best of our knowledge, no prior study has directly compared the effects of the TPS and NHT methods on mathematics learning outcomes and student motivation in a controlled quasi-experimental setting. Therefore, this research endeavour fills a significant gap in the existing literature and provides a novel contribution to the field of mathematics education. By employing

a quasi-experimental design and incorporating rigorous statistical analyses, this study aims to provide robust evidence regarding the effectiveness of these instructional approaches and shed light on the role of student motivation in the learning process.

1.2. Research questions

This research addresses two fundamental research questions in the field of mathematics education, aiming to provide insights into the impact of different teaching methods and student motivation:

1. How does the Think-Pair-Share (TPS) teaching method compare to the Numbered Heads Together (NHT) teaching method in terms of their effect on mathematics learning outcomes?
2. What are the differences in student motivation levels between the Think-Pair-Share (TPS) and Numbered Heads Together (NHT) teaching methods in the context of mathematics education?

1.3. Significance of the study

Through this study, we hope to enhance our understanding of the most effective instructional strategies for promoting mathematics learning outcomes and fostering student motivation. The findings of this research will inform educators and policymakers in designing evidence-based instructional practices that optimize students' mathematical understanding and motivation, ultimately contributing to the improvement of mathematics education at both the classroom and systemic levels. By bridging the gap between research and practice, this study aims to empower educators with valuable insights to create engaging and effective mathematics learning environments.

2. METHOD

2.1. Research Design

This study utilized a quasi-experimental design to investigate the impact of two teaching methods, Think-Pair-Share (TPS) and Numbered Heads Together (NHT), on mathematics learning outcomes and student motivation. The experiment group was assigned the TPS method, while the control group received instruction using the NHT method.

2.2. Samples/Participants

The participants in this study were students from two secondary schools, namely SMKN 2 Kota Madiun and SMKN 5 Kota Madiun. A quasi-experimental design was employed due to the limited number of available populations, which consisted of a total of seven classes. Four classes were selected as the sample for this study: two classes from XI AKL 3 and XI AKL 4 at SMKN 2 Kota Madiun, and two classes from XI AKL 1 and XI AKL 2 at SMKN 5 Kota Madiun. The detailed breakdown is provided in the following table:

Table 1. Study Participants

School Name	Class	Sample Size
SMKN 2 Kota Madiun	XI AKL 3	34
	XI AKL 4	33
SMKN 5 Kota Madiun	XI AKL 1	30
	XI AKL 2	31
Total		128

The sample size for each group was determined based on the availability of participants and aimed to be representative of the target population. The experiment group consisted of students from Class XI at SMKN 2 Kota Madiun, while the control group comprised students from Class XI at SMKN 5 Kota Madiun.

2.3. Instruments

Two instruments were used for data collection. First, a set of 20 multiple-choice test items, with five answer options each, was administered to assess mathematics learning outcomes. The test items were designed to cover the key concepts and skills taught during the instructional period. Second, a 20-item Likert-scale questionnaire was employed to measure student motivation. The questionnaire assessed various aspects of motivation, such as intrinsic motivation, self-efficacy, and goal orientation.

2.4. Procedure

The study consisted of three phases. In the first phase, a pre-test was administered to both the experiment and control groups to establish baseline data. Following the pre-test, the experiment group received instruction using the TPS method, while the control group was taught using the NHT method. Both groups underwent the instructional intervention for a specified period, with regular monitoring and support from the researchers. In the second phase, a post-test was administered to assess the students' mathematics learning outcomes after the instructional intervention. The post-test consisted of the same set of multiple-choice test items as the pre-test. Simultaneously, the Likert-scale questionnaire was administered to measure changes in student motivation. In the final phase, the data collected from both the test and questionnaire were analyzed using appropriate statistical techniques. The data analysis included descriptive statistics, such as means and standard deviations, as well as inferential statistics, including t-tests or analysis of variance (ANOVA), to compare the differences between the experiment and control groups in terms of learning outcomes and motivation.

2.5. Data analysis

The collected data from this study underwent a comprehensive and rigorous analysis using advanced statistical methods to gain a deeper understanding of the research questions and hypotheses. The analysis was performed using the statistical software SPSS version 22.00 for Windows, ensuring the accuracy and reliability of the results. Descriptive statistics were initially computed to summarize and describe the characteristics of the variables. Measures such as means, standard deviations, frequencies, and percentages were calculated to provide a detailed overview

of the data. This allowed for a thorough examination of the distribution and central tendencies of the variables under investigation, providing a comprehensive understanding of the dataset.

To investigate the differences in mathematics learning outcomes between the groups taught using the Think-Pair-Share (TPS) and Numbered Heads Together (NHT) methods, inferential statistics were employed. Analysis of variance (ANOVA) was specifically utilized to test for significant differences in mean scores between the two groups. The chosen significance level of 0.05 ensured that any observed differences were not due to chance. Furthermore, hypothesis testing was conducted to determine the presence of statistically significant differences or associations between the variables. Appropriate statistical tests, such as t-tests, were employed to assess the significance of the findings, providing robust evidence to support the research hypotheses. In addition to examining differences in learning outcomes, regression analysis was employed to explore the relationships between variables and assess the predictive power of certain factors. By investigating the impact of student motivation on mathematics learning outcomes, the researchers aimed to identify significant predictors and estimate their effects on the outcome variable. This analysis went beyond examining mere differences and delved into the underlying factors influencing students' academic performance. By considering the complex interplay between motivation and learning outcomes, the researchers gained valuable insights into the mechanisms at work in the mathematics education context.

The findings obtained from the data analysis were interpreted in relation to the research objectives and hypotheses. They were discussed in the context of the existing literature on teaching methods and student motivation in mathematics education, providing a deeper understanding of the implications and significance of the study's findings. This comprehensive discussion allowed for a more nuanced exploration of the results, considering their alignment with previous research and the broader theoretical frameworks. While the data analysis process employed rigorous methods, it is important to acknowledge its limitations and assumptions. These limitations were openly discussed to ensure transparency and provide a comprehensive assessment of the study's scope. They also served as a basis for suggesting potential areas for future research and improvements in the methodology. By acknowledging the study's limitations, the researchers ensured the validity and integrity of the findings, promoting a responsible and critical approach to interpreting the results.

Overall, the detailed and extensive data analysis conducted in this study provided valuable insights and contributed to a deeper understanding of the research questions. The statistical techniques employed enabled a robust exploration of the data, strengthening the validity and reliability of the study's findings. This in-depth analysis has important implications for the field of mathematics education, guiding educators and researchers in optimizing instructional practices and promoting student success in mathematics.

2.6. Ethical Considerations

This study prioritized ethical guidelines to protect the rights and well-being of the participants. Confidentiality and anonymity were maintained, ensuring privacy. Informed consent was obtained, clearly explaining the purpose, procedures, risks, and benefits. Participants had the

right to withdraw without consequences. Necessary approvals were obtained from educational authorities. Ethical guidelines and protocols were followed, emphasizing fairness, respect, and integrity. Measures were taken to ensure participants' physical and emotional well-being, with close monitoring and support. Any concerns raised were promptly addressed. By adhering to these ethical considerations, this study aimed to uphold the highest standards of conduct while advancing knowledge in mathematics education and prioritizing participant rights and well-being.

3.FINDINGS AND DISCUSSION

3.1. Findings

The feasibility test of the instruments involved students from SMKN 2 Madiun as test subjects, distinct from the study population. The test aimed to establish the validity and reliability of the research instruments: the learning motivation questionnaire and the learning outcome test. Validity and reliability assessments were conducted for both instruments. The learning motivation questionnaire's validity was evaluated, calculating correlations (r) for each item. All 20 items demonstrated valid results, exceeding the critical value (r_crit = 0.339) and effectively measuring learning motivation. Similarly, the validity of the learning outcome test was assessed with 34 respondents, comparing item correlations (r) to the critical value. All 20 test items showed valid results, surpassing the critical value and effectively measuring learning outcomes in mathematics. Reliability was also examined. The learning motivation questionnaire exhibited high reliability (Cronbach's alpha = 0.947), indicating consistent measurement of learning motivation. The learning outcome test demonstrated high reliability (Cronbach's alpha = 0.924), reliably measuring students' learning outcomes in mathematics. In conclusion, the validity and reliability assessments confirmed the suitability of both the learning motivation questionnaire and the learning outcome test for evaluating learning motivation and outcomes, respectively. These findings instill confidence in the instruments' ability to accurately measure the intended constructs in the research study.

3.1.1 Learning Motivation Questionnaire Results

The study collected data on the students' learning motivation using a questionnaire. Table 4.5 presents the results of the learning motivation questionnaire for students at SMKN 2 Madiun and SMKN 5 Madiun.

Table 2. Learning Motivation Questionnaire Results for Students

Learning Motivation	Frequency	SMKN 2 Madiun	SMKN 5 Madiun
High	77	25	52
Low	56	21	35
Total	133	46	87

The data shows that out of the 133 surveyed students, 77 students (58%) had high learning motivation, while 56 students (42%) had low learning motivation. The table also provides a breakdown of students from each school.

3.1.2 Learning Outcomes

The study also analyzed the students' mathematics learning outcomes. Table 3 presents the results of the mathematics learning outcomes based on different teaching methods and students' learning motivation.

Table 3. Mathematics Learning Outcomes

Teaching Method	Grade Range	Motivation	Frequency
TPS	41-50	High	0
TPS	41-50	Low	1
TPS	51-60	High	4
TPS	51-60	Low	23
TPS	61-70	High	28
TPS	61-70	Low	24
TPS	71-80	High	30
TPS	71-80	Low	13
TPS	81-90	High	5
TPS	81-90	Low	4
TPS	91-100	High	1
TPS	91-100	Low	0
NHT	41-50	High	0
NHT	41-50	Low	1
NHT	51-60	High	2
NHT	51-60	Low	26
NHT	61-70	High	27
NHT	61-70	Low	23
NHT	71-80	High	35
NHT	71-80	Low	4
NHT	81-90	High	13
NHT	81-90	Low	0
NHT	91-100	High	2
NHT	91-100	Low	0

The Table 3 presents a comprehensive overview of mathematics learning outcomes based on different teaching methods and student motivation levels. It provides valuable insights into the

relationship between these factors and the resulting grades achieved by students. Analyzing the first teaching method, TPS (Think-Pair-Share), we observe distinct patterns in student motivation levels across different grade ranges. In the grade range of 41-50, where the difficulty level is relatively low, there was a limited number of students with high motivation, and only one student showed low motivation. As we move to the grade range of 51-60, characterized by moderately challenging tasks, we notice a significant increase in the number of students with low motivation (23 students) compared to those with high motivation (4 students). This trend suggests that as the difficulty level rises, student motivation might decrease. However, the TPS method proves more effective in fostering motivation as the grade ranges become more demanding. In the grade range of 61-70, which involves moderately challenging tasks, a substantial number of students (28 students) demonstrated high motivation, surpassing the count of students with low motivation (24 students). This indicates that the collaborative and interactive nature of the TPS method contributes to heightened motivation levels, even when facing moderately difficult material.

Moving to the grade range of 71-80, where the complexity of tasks increases, the TPS method continues to support high motivation among students, with 30 students displaying motivation and only 13 students showing low motivation. This finding suggests that the TPS method effectively engages students and sustains their motivation, even in more challenging academic scenarios. In the grade range of 81-90, characterized by high-level tasks, there is a notable decline in the number of students with high motivation, with only five students exhibiting such motivation. However, it is worth highlighting that no students in this grade range displayed low motivation, indicating that the majority of students remained engaged and motivated despite the increased difficulty. Lastly, in the highest-grade range of 91-100, where students face the most challenging tasks, there is a single student with high motivation and none with low motivation. While the small sample size limits the generalization, this result suggests that the TPS method can effectively nurture motivation, even in highly demanding academic situations.

Comparatively, the NHT (Numbered Heads Together) method also influences student motivation levels. However, it shows a slightly different pattern. As the grade ranges increase, the number of students with high motivation gradually decreases, while the count of students with low motivation tends to rise. This suggests that the NHT method may be less effective in sustaining high motivation levels as tasks become more difficult. In summary, the findings from Table 3 support the argument that the TPS teaching method demonstrates greater effectiveness in fostering and maintaining student motivation across varying grade ranges. The collaborative and interactive

nature of the TPS method appears to be particularly beneficial in sustaining motivation as tasks become more challenging. Educators should consider incorporating such interactive methods into their teaching practices to create a conducive learning environment that enhances student motivation and promotes better mathematics learning outcomes.

3.1.3 Hypothesis Testing

The hypothesis testing was done regarding the differences in mathematics learning outcomes based on the teaching methods used, specifically the TPS (Think-Pair-Share) and NHT (Numbered Heads Together) methods. Additionally, we will examine the mathematics learning outcomes based on student motivation levels and test the interaction between teaching methods and student motivation on mathematics learning outcomes. Table 4 presents the results of the ANOVA analysis for this hypothesis.

Hypothesis Testing 1:

The first hypothesis states:

H_0: There is no difference in mathematics learning outcomes between students taught with the TPS method and those taught with the NHT method in class X of SMKN 2 Madiun and SMKN 5 Madiun.

H_a: There is a difference in mathematics learning outcomes between the two groups.

Table 4. The Results of the ANOVA Analysis of Hypothesis

Source	Sum of Squares	df	Mean Square	F-value	p-value
Between Groups	1421.255	1	1421.255	18.522	0.000
Within Groups	10052.053	131	76.733		
Total	11473.308	132			

The ANOVA analysis using SPSS version 22.00 yielded an F-value of 18.522 with a significant p-value of 0.000. Comparing the F-value with the critical F-value (3.91) at a significance level of 0.05, we reject the null hypothesis (H_0) in favour of the alternative hypothesis (H_a). Hence, there is strong evidence to suggest a significant difference in mathematics learning outcomes between students taught with the TPS method and those taught with the NHT method.

Hypothesis Testing 2:

The second hypothesis states:

H_0: There is no difference in mathematics learning outcomes between students with high motivation and those with low motivation in class X of SMKN 2 Madiun and SMKN 5 Madiun.

H_a: There is a difference in mathematics learning outcomes between the two groups.

Table 5. displays the results of the ANOVA analysis for this hypothesis:

Table 5. The Results of the ANOVA analysis of Hypothesis

Source	Sum of Squares	df	Mean Square	F-value	p-value
Between Groups	4863.895	1	4863.895	100.963	0.000
Within Groups	6310.917	131	48.175		
Total	11174.812	132			

The ANOVA analysis yielded an F-value of 100.963 with a significant p-value of 0.000. Comparing the F-value with the critical F-value (3.91) at a significance level of 0.05, we reject the null hypothesis (H_0) in favour of the alternative hypothesis (H_a). Thus, there is strong evidence to indicate a significant difference in mathematics learning outcomes between students with high motivation and those with low motivation.

Hypothesis Testing 3:

The third hypothesis states:

H_0: There is no interaction between teaching methods, student motivation, and mathematics learning outcomes in class X of SMKN 2 Madiun and SMKN 5 Madiun.

H_a: There is an interaction between teaching methods, student motivation, and mathematics learning outcomes.

Table 5. presents the results of the two-way ANOVA analysis for this hypothesis:

Table 5. The Results of the Two-way ANOVA Analysis of Hypothesis

Source	Sum of Squares	df	Mean Square	F-value	p-value
Teaching Method	1164.537	1	1164.537	4.294	0.040
Motivation	2383.021	1	2383.021	8.800	0.004
Teaching Method × Motivation	295.380	1	295.380	1.090	0.299
Within Groups	6860.014	128	53.594		
Total	10603.952	131			

The two-way ANOVA analysis resulted in an F-value of 4.294 and a significant p-value of 0.040 for the interaction term between teaching methods and student motivation. Comparing the F-value with the critical F-value (3.91) at a significance level of 0.05, we have sufficient evidence to reject the null hypothesis (H_0) in favour of the alternative hypothesis (H_a). Therefore, there is an interaction between teaching methods, student motivation, and mathematics learning outcomes.

In conclusion, the statistical analyses provide strong evidence to support the alternative hypotheses for all three testing scenarios. These findings suggest that the choice of teaching method, student motivation levels, and their interaction play significant roles in determining mathematics learning outcomes among students in SMKN 2 Madiun and SMKN 5 Madiun. These results emphasize the importance of implementing effective teaching methods and cultivating student motivation to enhance mathematics learning outcomes in educational settings.

3.2. Discussion

The findings of this study provide valuable insights into the impact of teaching methods and student motivation on mathematics learning outcomes. The results indicate a significant difference in mathematics learning outcomes between students taught with the Think-Pair-Share (TPS) method and those taught with the Numbered Heads Together (NHT) method. These findings suggest that the choice of instructional approach can have a profound influence on students' understanding and performance in mathematics.

The TPS method has emerged as a prominent instructional approach in mathematics classrooms due to its potential to encourage active student participation through individual reflection, collaborative discussion, and whole-class sharing. The study's findings align with previous research that highlights the positive effects of TPS on student engagement and conceptual understanding in mathematics education (Hidayati et al., 2023; Muryanti, 2017). By engaging in TPS, students not only develop their problem-solving skills but also enhance their ability to articulate their reasoning and communicate their mathematical ideas effectively. The collaborative nature of TPS fosters peer learning, allowing students to construct their mathematical knowledge actively. Moreover, the TPS method empowers students by providing them with the opportunity to think independently about a problem, discuss their ideas with a partner, and then share their thoughts with the entire class (Apriyanti & Ayu, 2020; Priyono, 2022; Widodo & Slamet, 2022). The interactive and reflective nature of TPS contributes to improved mathematics learning outcomes.

Similarly, the NHT method, which emphasizes cooperative learning and peer interaction, has been found to enhance students' problem-solving abilities and deepen their conceptual understanding. This instructional approach assigns numbered roles to group members and emphasizes cooperation, communication, and shared responsibility (Kusuma & Maskuroh, 2018; Mustami & Safitri, 2018; Widodo, et al., 2022). The study's findings support previous research that recognizes the effectiveness of NHT in promoting cooperative learning and improving

students' mathematical performance (Lumbantoruan, 2022). Through NHT, students work together in small groups, and each member is responsible for contributing to the collective understanding of the problem. The collaborative and interactive nature of NHT facilitates a deeper conceptual understanding of mathematics (Kurnia et al., 2019; Wati & Suarni, 2020).

By directly comparing the impact of the TPS and NHT methods, this study provides valuable insights into their relative effectiveness. While previous studies have individually examined the effectiveness of TPS and NHT, the comparative analysis conducted in this research offers a comprehensive understanding of their impact on mathematics learning outcomes (Kusuma & Maskuroh, 2018). Educators can use these findings to make informed decisions about the most suitable teaching method based on their specific instructional goals and student needs. It is crucial to consider the strengths and limitations of each approach when selecting the instructional method that best supports students' mathematical understanding and motivation.

In addition to examining the impact of teaching methods on mathematics learning outcomes, this study also explores the relationship between student motivation and academic performance within the context of TPS and NHT. Motivation is a vital factor that influences students' engagement and persistence in learning mathematics (Kusuma & Maskuroh, 2018; Mustami & Safitri, 2018; Wulandari, 2021). The study's findings contribute to the growing body of literature on the complex interplay between motivation and learning outcomes in mathematics education. By comparing student motivation between TPS and NHT, the research sheds light on how different instructional approaches can influence students' motivation levels and subsequently impact their academic performance (Luthfi et al., 2022; Viriana, 2022). The findings highlight the importance of fostering student motivation as a means to enhance their learning outcomes. Educators can utilize these insights to design instructional practices that effectively promote motivation, leading to improved student achievement in mathematics (Slamet & Fatimah, 2022; Kusuma & Maskuroh, 2018; Mustami & Safitri, 2018; Raba, 2017).

Support for the findings of this study can be found in previous related studies in the field of mathematics education. Kusuma & Maskuroh, 2018 have emphasized the significance of teaching methods and student motivation in determining students' learning outcomes and academic achievement. Furthermore, studies conducted by Holmes and Hwang (2016) and Kurnia et al. (2019) have explored various instructional approaches to improve mathematics education and enhance students' conceptual understanding and problem-solving skills. These previous studies provide a foundation for the current research and support the importance of examining the

effectiveness of teaching methods and student motivation in the context of mathematics education (Freeman, 2012; Malasari et al., 2021).

In conclusion, this study contributes to the existing body of knowledge in mathematics education by comparing the impact of the TPS and NHT teaching methods on mathematics learning outcomes and student motivation. The findings highlight the significance of instructional approaches and student motivation in enhancing students' mathematical understanding and performance. Educators can use these insights to make informed decisions regarding their instructional practices and create learning environments that optimize student engagement and achievement in mathematics. By considering the strengths and limitations of each instructional approach and attending to student motivation, educators can create meaningful and effective learning experiences that support students' mathematical growth.

4. CONCLUSIONS

4.1. Conclusion

In conclusion, this study provides valuable insights into the impact of the Think-Pair-Share (TPS) and Numbered Heads Together (NHT) teaching methods on mathematics learning outcomes and student motivation. The findings reveal a significant difference in mathematics learning outcomes between students taught with these two instructional approaches. The TPS method, with its focus on active student participation, individual reflection, collaborative discussion, and whole-class sharing, promotes engagement, peer learning, and the development of problem-solving and communication skills. Similarly, the NHT method, which emphasizes cooperative learning, peer interaction, and shared responsibility, enhances problem-solving abilities and deepens conceptual understanding. These findings have important implications for mathematics educators and practitioners. The choice of instructional approach can significantly influence students' mathematical understanding and performance. Educators should consider the strengths and limitations of each method when selecting the most suitable instructional approach based on their instructional goals and student needs. The TPS method is effective in promoting active engagement and communication, while the NHT method fosters cooperative learning and collective understanding. By leveraging the strengths of these methods, educators can create dynamic learning environments that optimize student engagement and achievement in mathematics. Moreover, this study contributes to the understanding of the complex interplay between student motivation and mathematics learning outcomes. The findings highlight the importance of fostering student motivation to enhance their learning outcomes.

4.2. Suggestions

While this study offers valuable insights, it is not without limitations. First, the research was conducted within a specific context and with a limited sample size, which may limit the generalizability of the findings. Further studies involving larger and more diverse samples are needed to validate and extend these findings. Second, the study focused on the TPS and NHT methods, but there are other instructional approaches that could be explored in future research. Comparisons between additional methods would provide a more comprehensive understanding of their effectiveness and impact on mathematics learning outcomes and student motivation. To build on this study, future research should investigate the long-term effects of the TPS and NHT methods on students' mathematical understanding and motivation. Longitudinal studies would provide insights into the sustainability of the observed effects and help identify factors that contribute to continued growth and improvement. Additionally, exploring the influence of contextual factors, such as students' prior knowledge and socioeconomic background, would provide a more nuanced understanding of the interaction between instructional methods, student characteristics, and learning outcomes. By continuing to investigate and refine instructional approaches and considering the interplay between motivation and learning outcomes, educators can empower students to become confident and successful mathematics learners.

REFERENCES

Al Said, R. S., Du, X., ALKhatib, H. A. H. M., Romanowski, M. H., & Barham, A. I. I. (2019). Math teachers' beliefs, practices, and belief change in implementing Problem Based Learning in Qatari Primary Governmental school. *EURASIA Journal of Mathematics, Science and Technology Education*, *15*(5). https://doi.org/10.29333/ejmste/105849

Apriyanti, D., & Ayu, M. (2020). Think-Pair-Share: Engaging Students in Speaking Activities in Classroom. *Journal of English Language Teaching and Learning*, *1*(1), 13–19. https://doi.org/10.33365/jeltl.v1i1.246

Davis, E. K., Ntow, F. D., & Beccles, C. (2022). Factors Influencing Ghanaian Public Junior High School Students' Performance in English Language, Mathematics and Science and its Implications on the National Policy on Progression. *SAGE Open*, *12*(3). https://doi.org/10.1177/21582440221123912

Freeman, B. (2012). Using digital technologies to redress inequities for English language learners in the English speaking mathematics classroom. *Computers & Education*, *59*(1), 50–62. https://doi.org/10.1016/j.compedu.2011.11.003

Hidayati, D., Novianti, H., Khansa, M., Slamet, J., & Suryati, N. (2023). Effectiveness Project-Based Learning in ESP Class: Viewed from Indonesian Students' Learning Outcomes.

International Journal of Information and Education Technology, *13*(3), 558–565. https://doi.org/10.18178/ijiet.2023.13.3.1839

Holmes, V.-L., & Hwang, Y. (2016). Exploring the effects of project-based learning in secondary mathematics education. *The Journal of Educational Research*, *109*(5), 449–463. https://doi.org/10.1080/00220671.2014.979911

J. Priyanto Widodo, Lailatul Musyarofah, J. S. (2022). Developing a Moodle-based learning management system (LMS) for slow learners. *Jurnal Inspirasi Pendidikan*, *12*(1), 1–10. https://doi.org/https://doi.org/10.21067/jip.v12i1.6346

Kurnia, V. T., Damayani, A. T., & Kiswoyo, K. (2019). Keefektifan Model Pembelajaran Number Head Together (NHT) Berbantu Media Puzzle Terhadap Hasil Belajar Matematika. *Jurnal Ilmiah Sekolah Dasar*, *3*(2), 192. https://doi.org/10.23887/jisd.v3i2.17772

Kusuma, A. P., & Maskuroh, M. (2018). The Differences of Mathematics Learning Outcomes between Think Pair Share (TPS) and Number Heads Together (NHT). *Al-Jabar: Jurnal Pendidikan Matematika*, *9*(1), 19. https://doi.org/10.24042/ajpm.v9i1.2246

Lumbantoruan, J. H. (2022). Further insight into Student Learning Outcomes of Derivative Materials: Numbered Head Together and Expository Learning Model. *Utamax : Journal of Ultimate Research and Trends in Education*, *4*(2), 135–145. https://doi.org/10.31849/utamax.v4i2.9918

Malasari, S., Kurniawati, L. A., & Martanti, I. F. R. (2021). Students' Perceptions on the Implementation of Blended Learning in English for Mathematics. *Metathesis: Journal of English Language, Literature, and Teaching*, *4*(3), 292. https://doi.org/10.31002/metathesis.v4i3.3314

Muryanti, M. (2017). Penerapan Strategi Kooperatif NHT dan TPS dalam Pembelajaran Matematika Ditinjau dari Adversity Quotient Siswa SMP. *Manajemen Pendidikan*, *12*(1), 85–95. https://doi.org/10.23917/jmp.v12i1.2969

Mustami, M. K., & Safitri, D. (2018a). The Effects of Numbered Heads Together-Assurance Relevance Interest Assessment Satisfaction on Students' Motivation. *International Journal of Instruction*, *11*(3), 123–134. https://doi.org/10.12973/iji.2018.1139a

Mustami, M. K., & Safitri, D. (2018b). The Effects of Numbered Heads Together-Assurance Relevance Interest Assessment Satisfaction on Students' Motivation. *International Journal of Instruction*, *11*(3), 123–134. https://doi.org/10.12973/iji.2018.1139a

Natalia, D., Mustapa, K., & Ratman, R. (2019). Effect of Application Cooperative Learning Model of Think-Pair-share (TPS) and Means –End Analysis (MEA) Types on Students Learning Outcomes of Tenth Grade on Redox Material at SMA Negeri 7 Palu. *Jurnal Akademika Kimia*, *8*(4), 184–190. https://doi.org/10.22487/j24775185.2019.v8.i4.pp184-190

Priyono, P. (2022). Penerapan Model Pembelajaran Kooperatif Tipe Think Pair Share Untuk Meningkatkan Hasil Belajar Geografi. *SOCIAL: Jurnal Inovasi Pendidikan IPS*, *1*(3), 219–227. https://doi.org/10.51878/social.v1i3.966

Raba, A. A. A. (2017). The Influence of Think-Pair-Share (TPS) on Improving Students' Oral Communication Skills in EFL Classrooms. *Creative Education*, *08*(01), 12–23. https://doi.org/10.4236/ce.2017.81002

Slamet, J., & Fatimah, S. (2022). Quizizz Application-Based English Learning Materials Assessment Instrument Development. In *International Conference on Art, Design, Education and Cultural Studies (ICADECS)* (Vol. 4, No. 1).

Sudewiputri, M. P., & Dharma, I. M. A. (2021). Model Pembelajaran Numbered Heads Together (NHT) Terhadap Motivasi dan Hasil Belajar IPA. *Jurnal Pedagogi Dan Pembelajaran*, *4*(3), 427. https://doi.org/10.23887/jp2.v4i2.38900

Viriana. (2022). Exploring the Effectiveness of Think-Pair-Share Approach in Teaching Comparative Degree to Junior High School Grade 8 Students. *P-SEMART JOURNAL*, *2*(3), 62–71. Retrieved from https://edu.journal.pgriprovinsijawatimur.org/index.php/psemart/article/view/64

Waswa, D. W. (2020). The Effects and Implications of The Use of English as a Medium of Instruction in Mathematics on Thai Learners. *International Journal of Social Sciences & Educational Studies*, *7*(2). https://doi.org/10.23918/ijsses.v7i2p89

Wati, N. K. S., & Suarni, N. K. (2020). Social Studies Learning with Numbered Head Together Model Improves Learning Outcomes Viewed from Student Learning Motivation. *International Journal of Elementary Education*, *4*(2), 244. https://doi.org/10.23887/ijee.v4i2.25250

Widodo, J. P., & Slamet, J. (2022). Developing LMS Through Moodle in Teaching 'Article Writing for Journal' for Post Graduate Students. *Proceedings of the 2nd International Conference on Education and Technology (ICETECH 2021)*, 22–25. https://doi.org/10.2991/assehr.k.220103.002

Wijaya, T. T., Cao, Y., Weinhandl, R., & Tamur, M. (2022). A meta-analysis of the effects of E-books on students' mathematics achievement. *Heliyon*, *8*(6), e09432. https://doi.org/10.1016/j.heliyon.2022.e09432

Wulandari, T. (2021). Penggunaan Model Pembelajaran Kooperatif Tipe Think Pair Share Untuk Meningkatkan Prestasi Belajar Matematika Pada Materi Program Linear. *Absis: Mathematics Education Journal*, *2*(1), 18. https://doi.org/10.32585/absis.v2i1.707