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Unlocking the Potential for Creative Thinking Ability and Self-Efficacy: Implementation of Numbered Head Together and Algebra Blocks in Middle School Students

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Unlocking the Potential for Creative Thinking Ability and Self-Efficacy: Implementation of Numbered Head Together and Algebra Blocks in Middle School Students

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Keywords

Numbered Head Together Creative thinking ability Sefl-efficacy Algebraic block Abstract

This study examines how algebra block support and the Numbered Head Together (NHT) learning paradigm affect secondary school students' mathematical creativity and self-efficacy. The literature review highlights the necessity of creative teaching strategies in mathematics education. In this study, a non-equivalent control group was utilized in a controlled experimental design, with one group implementing the NHT model with algebra block support and another group employing traditional teaching techniques. Pretest, posttest, and self-efficacy instruments were used to gather data. The study's results indicated a significant increase in students' mathematical creativity capacity when utilizing algebra blocks to support the NHT model. In addition, there was a noticeable increase in the pupils' self-efficacy. An examination of the data using statistical methods revealed notable distinctions between the experimental and control groups. The primary finding indicates that the NHT learning paradigm, in conjunction with algebra blocks, helps enhance secondary school students' mathematical creativity and self-efficacy capacity. The study's findings offer insightful information about initiatives to enhance methods for teaching mathematics.

Introduction

Increasing students' critical thinking skills and self-efficacy is the main focus of this research. This study explores the possibilities that can be unlocked using the Numbered Head Together (NHT) model, bolstered by middle school students' use of algebra blocks. Creativity and self-efficacy significantly impact student learning outcomes (Chen et al., 2022). Students must develop critical thinking skills and self-confidence in an increasingly complicated society (Liu et al., 2021; Nufus et al., 2018). Using algebra blocks and learning methodologies like NHT, this project will offer empirical insight into how students can develop their creative problem-solving skills and self-efficacy. This study's findings will significantly contribute to our understanding of secondary school education from

a practical standpoint, influencing how pupils approach problems and perceive their chances of success.

To boost pupils' capacity for creative thought and self-efficacy, education at the secondary school level has taken center stage (Anderson et al., 2021). Even with the widespread use of learning strategies, there still needs to be more understanding about how particular techniques, like the combination of Numbered Head Together (NHT) and algebra blocks, can help students reach their full potential in creative problem-solving and boost their self-efficacy. The significance of creativity in problem-solving and self-efficacy as critical abilities are highlighted by the demands for innovation, fierce rivalry, and global unpredictability (Park et al., 2020). Further comprehensive empirical research is necessary to elucidate the effects of NHT with algebra blocks on students' capacity for creative thought and their sense of self-efficacy in a secondary school setting. Consequently, to close this knowledge gap, this study will investigate how it affects students' ability to express themselves creatively and build self-efficacy. The results will be insightful for educational practitioners and scholars studying this topic.

Even though there has been prior research in secondary school teaching and learning, this study is innovative in several important ways. Initially, the research suggests implementing the Numbered Head Together (NHT) model in secondary school settings. This paradigm is widely utilized in collaborative learning situations in higher education settings. This novel method has not received much attention (Álvarez-Huerta, 2021). Second, there is a novelty factor added when algebra blocks are used in the context of learning mathematics. Using algebra blocks in conjunction with NHT at the middle school level offers a fresh approach to creative problem-solving in mathematics. Algebra blocks are a learning aid that can help students grasp mathematical topics more deeply (Disasmitowati & Utami, 2017). These components are combined in this study to understand better how this method might support kids in realizing their creative potential and bolstering their self-assurance in handling the demands of high school education. This substantially adds to our knowledge of this level's creative and successful learning approaches.

There is a need for more research, even if various instructional strategies and tactics have been thoroughly studied to enhance students' capacity for creative thought and sense of self-efficacy in secondary education. Although prior study has yielded valuable insights, further progress is still needed. This research uses two primary approaches—Numbered Head Together (NHT) and Algebra Blocks—to uncover secondary school students' creative thinking and self-efficacy capacity. Algebra Blocks is a tool that helps illustrate abstract mathematical concepts, whereas NHT is a collaborative approach that can help students think critically and communicate effectively (Dwiputri et al., 2023). Using this combination, we aim to comprehend how using Algebra Blocks and NHT can affect students' growth in self-efficacy and capacity for creative thought at the secondary school level. The research's findings are intended to offer fresh perspectives on efficient and long-lasting teaching strategies to boost students' potential going forward.

In an attempt to fully realize the potential of secondary school students' creative thinking skills and

self-efficacy, this research offers significant insights. Numbered Head Together (NHT) and Algebra Blocks are two strategies we use to broaden our understanding of teaching strategies that support students' growth in critical thinking abilities and boost their self-esteem in the classroom. The findings of this study lay the groundwork for creating a curriculum that is more pertinent and effective in including students in the learning process. Teachers and educational policymakers can create better learning strategies to support students in expressing their creative potential by using the implications of this research. This study promotes innovative thinking and renewal in secondary school teaching to produce a more self-assured and creative generation.

Method

Research Design

The control group in this investigation was not equivalent, and the study employed a quasiexperimental design (Table 1). The research subjects were two SMP Negeri 1 Kibin classes, Class VIII-F and Class VIII-I. Class VIII-F served as the control group, using traditional learning methods. In contrast, Class VIII-I served as the experimental group, using the Numbered Head Together (NHT) learning model using algebra blocks. Population and Sample: In the odd semester of the 2023–2024 academic year, all class VIII students at SMP Negeri 1 Kibin make up the population of this study. The research sample was drawn from Class VIII-I and Class VIII-F student body, the current classes (Nasrullah et al., 2023). Research Elements: The independent variable is the numbered Head Together (NHT) learning paradigm with algebra block assistance. Students' capacity for creative mathematical thought is the dependent variable.

Table 1.	Nonequiva	lent control	group	design
			0r	

Class	Pre-Test	Treatment	Posttest
Experiment	Т	Х	Т
Control	Т	0	Т

Note:

T: Test students' creative thinking abilities.

X: NHT learning assisted by algebra blocks.

O: Learning with conventional learning models

Instrument

Instrument: a) Pretest and Posttest: Five essay questions comprise this summative test of streamlined algebraic content. A pretest will be administered before implementing the learning model to gauge the pupils' preliminary aptitude for mathematical creativity. After the learning period, a posttest will be issued to calculate how much the students' creative mathematical thinking has changed; b) A self-efficacy questionnaire will measure how confident the students feel about their ability to learn mathematics.

Research procedure

Research procedure: a) Pre-Implementation: Students' initial mathematical creative thinking abilities were measured using a pretest on both classes (Class VIII-I and Class VIII-F); b) Implementation: Class VIII-I uses algebra blocks to implement the NHT learning model, while Class VIII-F continues to use conventional learning; c) Post-Implementation: Students' changes in mathematical creative thinking abilities were measured using a posttest on both classes after the learning period; d) Questionnaire Data Collection: Students from the experimental class (Class VIII-I) will complete the Self-Efficacy Questionnaire after the learning period.

Data Analysis

Data Analysis: To determine whether there are statistically significant differences in the mathematics creative thinking abilities of the experimental group and the control group, data from the pretest and posttest will be analyzed using statistical tests such as the t-test. To measure the level of student self-efficacy is a descriptive analysis of data obtained from the Self-Efficacy questionnaire.

Interpretation of Results

Interpretation of Results: The data analysis results will be used to determine how well students' mathematical creative thinking skills are being developed by the Numbered Head Together (NHT) learning model with the help of algebra blocks, as well as to gauge how self-sufficient they are in handling their math learning. To determine whether the learning model successfully raises students' self-efficacy and mathematical creative thinking levels, conclusions will be made based on the data analysis findings.

Results

Problem-Solving Ability

Pretest and Posttest Descriptive Analysis.

	Class	Ν	Max	Min	Mean	SD
Pretest	Experiment	31	40	65	49.03	6.380
	Control	32	30	60	46.25	9.919
Post test	Experiment	31	65	95	79.68	8.557
	Control	32	55	85	70.16	9.288

Table 2. Descriptive Statistics of Students' Creative Mathematical Thinking Ability

According to Table 2, the experimental class's pretest average score was 49.03, with 65 being the highest and 40 being the lowest. The posttest average score was 79.68, with 95 being the highest and 65 being the lowest. In contrast, the Control class received an average score of 46.25 on the pretest, with 60 being the highest and 35 being the lowest, and an average score of 70.16 on the posttest, with 85 being the highest and 55 being the lowest.

In the pretest, descriptive analysis results revealed that the experimental group (Class VIII-I) outperformed the control group (Class VIII-F) in average mathematical creative thinking ability. After the learning period, however, the experimental group showed a statistically significant increase in their capacity for mathematical creative thinking, while the control group did not.

The descriptive analysis's findings (Table 1) demonstrate that the two groups' average levels of mathematical creativity were comparable before applying the learning model. However, following the learning phase, the experimental group using the NHT learning model with algebra blocks saw a notable improvement in their capacity for mathematical creativity. On the other hand, the control group, which kept using traditional learning methods, showed no discernible improvement.

Pretest and Posttest Normality Test Results

Next, a Kolmogorov-Smirnov Normality test was conducted to determine whether the data was normally distributed. The normality test results are shown in Table 3.

Class	Kolmogorov-Smirnov Sig.
Pretest Experiment	0.054
Post-test Experiment	0.195
Pretest Control	0.067
Post-test Control	0.084

According to Table 3, the experimental and control classes' significant pretest values are 0.067 and 0.54, respectively, with a p-value greater than 0.05. Similarly, the p-value was more than 0.05, and the significant values for the experimental and control class posttests were 0.195 and 0.136, respectively, demonstrating the normal distribution of the study data.

Pretest and posttest homogeneity test results

The next step is to test Levene's homogeneity to determine whether the data is homogeneously distributed. The homogeneity test results are shown in Table 4.

1 1	8 5
Class	Sig. Based on Mean
Experiment dan Contro	l 1.635

Table 4 indicates that the significance level (Sig) based on the mean is 1.635 > 0.05. The variance of the pretest and posttest data in the experimental and control classes is homogeneous since the significant value of the data for the pretest and posttest is > 0.05. According to the homogeneity test results, the homogeneity assumption was satisfied, which revealed that both groups' pretest and

posttest variances were homogeneous.

The pretest and posttest data in both groups are regularly distributed according to the findings of the normality test, confirming that the normalcy assumptions are met. Furthermore, as the homogeneity test shows, both groups' pretest and posttest data variances are uniform, satisfying the homogeneity assumption and enabling a more exact analysis using the relevant statistical tests.

Paired Sample Test

The t-paired sample test is then used to compare the experimental class—which uses algebra blocks to implement the Numbered Head Together (NHT) learning model—to the control class, which uses traditional teaching methods, in order to see if there are any differences in the pretest data regarding students' mathematical creative thinking abilities prior to treatment. Table 5 shows the outcomes of the t-paired sample test.

Table 5. Paired Sample Test Pretest Results			
Class Sig. (2-tailed)			
Experiment and Control	0.139		

The sig value is derived from Table 5 above. Since the 2-tailed value is 0.139 > 0.05, HI is rejected, and HO is approved. There is no discernible difference between the experimental and control classes' pretest results regarding the students' capacity for creative thought because HO is accepted and H1 is denied.

Utilize the independent sample test after that. The goal of the independent sample test is to determine, through posttest data, whether students' capacities for creative mathematical thought differ between the experimental class, which employs the Numbered Head Together (NHT) learning model with the aid of algebra blocks, and the control class, which employs traditional learning methods. Table 6 displays the outcomes of the independent sample test.

Table 6. Posttest independent sample test results			
Class Sig. (2-tailed)			
Experiment and Control	0.00		

According to Table 6, The sig 2-tailed value is 0.00 < 0.05, HI is accepted, and HO is refused. There is a significant difference between the experimental and control classes' post-test results regarding the students' capacity for creative thought because HO is rejected and H1 is approved.

The experimental group (Class VIII-I) and the control group (Class VIII-F) in the posttest had significantly different mathematical creative thinking skills, according to the results of the independent sample test. Compared to traditional learning, the NHT learning paradigm with algebra blocks dramatically enhances students' mathematical creative thinking skills.

Self-efficacy

Descriptive results of self-efficacy.

Statements from the questionnaires completed by the experimental class were converted into quantitative data. A questionnaire is a statement to gather information on a subject through statements about circumstances, experiences, knowledge, attitudes, and views. Utilizing math blocks and the Numbered Head Together (NHT) learning methodology, pupils are given questionnaires to assess their abilities (self-efficacy). Twenty brief phrases about pupils' mathematical self-efficacy make up the questionnaire statement. The findings of the questionnaire's descriptive analysis are shown in Table 7 below.

Table 7. Descriptive results of self-efficacy					
Class	Ν	Min	Max	Mean	Std. Deviation
Experiment	31	62	71	66.87	2.187

The 31 respondents who completed the self-efficacy questionnaire in the experimental class had an average score of 66.87, with a maximum score of 71 and a lowest score of 62, as shown in table 7. above. The proportion of each self-efficacy indicator used in the experimental class is visible—thirty-one responders in total in Table 8.

Percentage results of students' mathematical self-efficacy indicators

- . .

No.	Self-efficacy Indicator	Skor Max	Percentage of Experimental Class	Criteria
1.	The magnitude of self-efficacy:	744	83%	Very strong
	Confidence in carrying out or completing			
	tasks or problems according to the level			
	of difficulty			
2.	Strength of self-efficacy: Students'	868	85%	Very strong
	confidence or steadfastness when making			
	assignments, questions, or mathematics			
	exams and their steadfastness in			
	mathematics subjects.			
3.	Generality of self-efficacy: Students'	868	82%	Very strong
	beliefs about the breadth of topic areas			
	and mathematics tasks.			
	Average Percentage		83%	Very strong

Table 8. Descriptive results of self-efficacy

Table 8 percentage findings demonstrate how vital the criteria are for each of the three self-efficacy indicators. The highest percentage of the Strength of Self-Efficacy Indicator is 85%, representing the students' confidence or steadfastness when completing tasks, problems, or tests in mathematics. On

the other hand, the category with the lowest percentage, the generality of Self-Efficaciousness, had 82% of students said that the variety of topics and mathematical assignments was adequate.

Discussion

Creative thinking ability

This study adds significantly to the knowledge of mathematics education, particularly when creating instructional plans that support secondary school students' capacity for mathematical creativity (Table 6). Our results align with earlier studies emphasizing creative methods' contribution to bettering mathematics learning outcomes. This study supports previous research on the effects of cooperative learning on students' comprehension of mathematical ideas by demonstrating that students' skills can be enhanced by using algebra blocks in conjunction with the Numbered Head Together (NHT) learning paradigm (Lumentut et al., 2015). Additionally, studies have shown that problem-based learning can enhance students' capacity for innovative mathematical thought (Hendriana et al., 2019). In this situation, the NHT method with algebra blocks as support provides a helpful substitute for raising students' mathematical comprehension and critical thinking proficiency.

The findings of this study advance our knowledge of how to use visual aids and collaborative teaching strategies while teaching mathematics. This result is consistent with other studies that highlight the value of visual aids in enhancing mathematics comprehension (Fitrianna et al., 2018; Yang & Meng, 2020). The study's findings suggest that using algebra blocks as a visual aid for math instruction can improve students' understanding of the subject matter and foster their capacity for mathematical creativity. This research offers a foundation for schools and education policy to consider integrating creative learning models in the secondary school mathematics curriculum and being novel in mathematics education. This method may help students become ready for more complex mathematical problems in the future by bringing about notable gains in their capacity for innovative mathematical thought. Kania, Fitriani, & Bonyah, (2023), critical thinking skills are very urgent for everyone today related to 21st century life skills competencies.

Teachers can use algebra blocks in conjunction with the Numbered Head Together (NHT) learning approach to give their students engaging and relevant experiences in solving real-world problems. Students can use algebra blocks and the Numbered Head Together (NHT) learning approach to enhance their self-efficacy and acquire new mathematical skills and critical and creative thinking talents. This method pushes individuals to seek the knowledge required to increase their desire to learn. Additionally, it encourages students to look into more pertinent outside resources to help them with mathematics challenges.

Self-efficacy

Nopriana, (2023), the habits of mind of prospective mathematics teachers have developed well in each indicator. Twenty brief statements regarding students' mathematical self-efficacy were included in the

questionnaire used to collect quantitative data for this study. According to the findings of the descriptive analysis, the average student self-efficacy score among the 31 participants in the experimental class who completed the questionnaire was 66.87, with a maximum score of 71 and a minimum score of 62 (Table 8). According to these findings, most students in the experimental class show a comparatively high degree of mathematical self-efficacy.

A percentage study of the three self-efficacy indicators—the magnitude, strength, and generality of self-efficacy—showed that each indicator has a "Very Strong" proportion. When tackling mathematical activities, such as exams, students in the experimental class exhibit exceptional strength and drive, as evidenced by the "Strength of self-efficacy" indicator, which displays a percentage of almost 85% (Table 8). These results attest to the usefulness of the NHT learning paradigm in raising students' self-efficacy when combined with algebra blocks.

The findings of this study are consistent with other studies (Zakariya et al., 2022; Schöber et al., 2018), emphasizing self-efficacy's role in academic accomplishment. Their study revealed that raising one's level of self-efficacy can improve one's comprehension of mathematics. Thus, the study's findings corroborate this conclusion by demonstrating that raising students' self-efficacy in the context of learning mathematics may be accomplished by applying the NHT learning model with the aid of algebra blocks.

Although this study's findings are insightful, they have a few shortcomings. The drawback of this research is its limited generalizability due to the small sample size and the particular school in which it was conducted. To get a more representative image, the primary proposal is to drive more extensive research, including a more significant number of schools and students. This study also emphasizes creative mathematical thinking skills and self-efficacy. Future studies should examine additional variables affecting students' mathematics learning outcomes. By taking these actions, further studies can offer a more thorough understanding of the NHT learning model's efficacy in mathematics instruction when combined with algebra block help.

Based on the discussion presented, the implications of this research can be a guide for developing a more innovative and effective mathematics curriculum and learning, following previous research that emphasizes the importance of a collaborative approach and the use of visual aids in increasing student self-efficacy.

Conclusion

The study's findings show that students' self-efficacy in studying mathematics at the secondary school level is significantly impacted by implementing the Numbered Head Together (NHT) learning paradigm using algebra blocks. The quantitative data gathered via questionnaires indicates that the mathematical self-efficacy of students enrolled in this learning paradigm is exceptionally high. Several self-efficacy metrics, including generality, strength, and magnitude, met the "Very Strong" standard. Since self-efficacy and academic achievement are positively correlated, these findings significantly add to the body of research on mathematics education. It has been demonstrated that using algebra blocks in conjunction with the NHT learning paradigm is a successful strategy for raising students' mathematical self-efficacy. The practical implication is that educators can use this learning model to improve learning outcomes for mathematics, foster a positive learning environment, and raise student self-efficacy. To sum up, this learning paradigm can significantly improve secondary school pupils' learning outcomes in mathematics.

Recommendations

The findings of this study suggest future directions for the development and application of the Numbered Head Together (NHT) learning paradigm, which uses algebra blocks to promote learning in mathematics at the secondary school level. Educators and educational institutions should contemplate the integration of visual aids such as algebra blocks in mathematics lessons, fostering students' creativity and self-confidence. Future research could extend its reach, encompassing a variety of schools and age groups.

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