



The Effect of the Numbered Head Together Cooperative Learning Model Assisted by the Quizlet Application on Students' Mathematical Concept Understanding Ability

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ABSTRACT

This study aimed to determine the effect of the Numbered Head Together (NHT) cooperative learning model assisted by the Quizlet application on students' mathematical conceptual understanding ability in the topic of relations and functions. The study employed a quantitative approach using an experimental method with a One Group Pretest-Posttest Design. The sample consisted of 30 students from class VIII-B. The research instrument was a mathematical conceptual understanding test administered before and after the treatment. Data were analyzed using the Shapiro-Wilk normality test, Levene homogeneity test, Paired Sample t-Test, Cohen's d effect size analysis, and N-Gain test. The results showed that the average pretest score of 54.47 increased to 80.00 in the posttest. The hypothesis test yielded a significance value of $0.000 < 0.05$, indicating a significant effect of the NHT learning model assisted by Quizlet on students' mathematical conceptual understanding ability. The effect size analysis produced a Cohen's d value of 5.03, which falls into the large category. Meanwhile, the N-Gain value was 0.563 or 56.33%, categorized as moderate, indicating that the learning process was sufficiently effective in improving students' mathematical conceptual understanding. Therefore, the NHT cooperative learning model assisted by the Quizlet application can be considered an effective alternative for enhancing students' mathematical conceptual understanding.

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1. INTRODUCTION

Mathematics is frequently viewed as an arduous and theoretical discipline. Nevertheless, at its core, mathematics constitutes a scholarly domain intricately connected to a multitude of quotidian endeavors (Maysarah et al., 2026). Mathematics can be conceptualized as a scientific discipline dedicated to the investigation of regularities, frameworks, and interconnections among abstract notions, which serve to elucidate diverse phenomena observed in our environment. As a theoretical science, mathematics transcends mere computation or numerical manipulation, encompassing instead the capacity for logical deduction, pattern analysis, and structured argumentation (Anggriany & Rakhmawati, 2024). These proficiencies are of considerable significance and find application across a broad spectrum of academic fields, including but not limited to physics, economics, and technology (Si et al., 2025)

The acquisition of mathematical knowledge constitutes a crucial domain within educational frameworks, exerting a profound influence on human existence, inasmuch as manifold quotidian endeavors are inextricably linked to the practical application of mathematical principles (Maysarah et al., 2023). The pedagogical engagement with mathematics represents a systematic endeavor designed to cultivate learners' comprehension of mathematical truths, theoretical constructs, foundational tenets, and proficiencies commensurate with their individual aptitudes (Lubis et al., 2025). Within this pedagogical paradigm, educators assume the role of facilitators, disseminating instructional content, while students actively engage in the construction and refinement of their own conceptual grasp of diverse mathematical ideas and frameworks. Moreover, the process of mathematical instruction also seeks to enhance the capacity for problem resolution, a skill indispensable across a spectrum of life circumstances (Muttaqin & Darmawan, 2022).

The field of mathematics education encompasses a multitude of concepts requiring student mastery, with the topic of relations and functions being one such area. As indicated by Ramadan & Arfinanti (2019) in their work referenced by (Arfany & Faradiba, 2022), the subject of relations and functions constitutes a foundational element of considerable significance within mathematical pedagogy. A robust comprehension of this concept is imperative, given its role as a prerequisite for grasping subsequent mathematical subjects, including but not limited to, linear equations and systems thereof. Consequently, a proficient grasp of relations and functions exerts a substantial influence on students' academic achievements in navigating more intricate mathematical conceptst.

Subsequent to preliminary observations undertaken on December 15, 2025, within the pedagogical context, it was ascertained that a significant determinant of students' diminished comprehension levels was attributed to the prevailing direct instruction model. This model was predominantly characterized by didactic exposition and the assignment of discrete tasks. During its application, the educator occupied a central role in the educational trajectory, consequently leading to suboptimal student engagement in instructional and learning endeavors. This scenario engendered a disposition of passivity among learners, thereby curtailing their avenues for proactive involvement in the academic discourse (Talib et al., 2025).

This aligns with the findings of (Darwan et al., 2023), who posited that a deficiency in students' capacity to grasp mathematical principles can be attributed, in part, to pedagogical approaches that remain predominantly teacher-centric. Such an environment fosters a reliance on the instructor as the primary purveyor of knowledge, consequently diminishing avenues for self-directed inquiry and the active construction of mathematical comprehension. Therefore, the potential for students to cultivate and internalize mathematical concepts autonomously has not been fully realized or optimized.

Addressing the aforementioned challenges, the suboptimal comprehension of mathematical conceptst among students necessitates focused consideration and the

deployment of effective interventions (Narpila, 2023). Consequently, the integration of novel pedagogical approaches in mathematics instruction, coupled with the judicious selection of instructional resources, is imperative to foster enhanced student engagement, autonomy, and active participation throughout the educational journey. This, in turn, is anticipated to facilitate the optimal development and enhancement of students' capacity for understanding mathematical concepts (Talib et al., 2025).

Among the pedagogical frameworks amenable to elevating students' proficiency in grasping mathematical concepts is the Numbered Heads Together (NHT) learning model. This instructional strategy affords students the prospective avenues for discourse and the exchange of perspectives with their respective group constituents, thereby enabling the expansion of their knowledge base and the profundity of their comprehension. Via collaborative group endeavors, students are also incentivized to apply acquired principles in the collective resolution of diverse problem sets (Pasaribu et al., 2024).

The pedagogical approach known as Numbered Heads Together (NHT) commences with the educator presenting a problem for students to resolve. Following this, students engage in collaborative deliberation within their respective groups to ascertain solutions to the posed problem (Batubara & Reflina, 2023). Upon conclusion of the group discussions, the instructor randomly selects a student's number to articulate the outcomes of the collective inquiry. This structured procedure is intended to foster the active participation of all learners and to distribute accountability for the group's endeavors equitably, thereby mitigating the tendency of individual students to monopolize instructional engagement (Fadly, 2022).

Beyond the adoption of suitable pedagogical frameworks, leveraging technology as a conduit for mathematical instruction presents a promising avenue for enhancing the efficacy of students' educational trajectories (Rafiela & Andhany, 2023). Educational media encompass any instrument or resource employed in conveying didactic content across diverse communication platforms, with the capacity to engage students' cognitive, affective, and psychomotor domains (Hasri et al., 2026). Consequently, educational media can foster a more robust learning environment, aid students in the assimilation of novel concepts, and contribute to the expedited attainment of learning objectives (Daniyati et al., 2023).

The implementation of digital learning resources can significantly bolster students' comprehension of mathematical principles. Furthermore, the synthesized effect size derived from meta-analyses of empirical research indicates a substantial positive impact, underscoring the potent influence of digital media on the improvement of mathematics learning achievements (Azkia et al., 2023).

Among the digital media available, the Quizlet application presents a valuable resource. Quizlet is characterized as a straightforward, novel, and user-friendly educational tool that actively facilitates student learning. This application is accessible for download via the Play Store or can be directly utilized through its official online portal at <https://quizlet.com/>. Annually, Quizlet garners engagement from over 20 million active participants, utilizing both its web-based platform and its dedicated mobile application. The inherent user-friendliness of Quizlet renders it appropriate for a broad spectrum of educational strata, extending from primary education to tertiary institutions (Panjaitan & Siregar, 2024). Furthermore, Quizlet is engineered and refined to underpin pedagogical endeavors across a diverse array of academic disciplines, transcending the confines of mere language acquisition. Educators can leverage this platform to curate instructional content, develop exercise modules, and implement learning assessments in a manner that is both more dynamic and efficacious (Sari, 2019).

Subsequent scholarly investigations by (Dadri et al., 2019) have demonstrated that the application of the Numbered Heads Together (NHT) cooperative learning paradigm can lead to enhancements in students' academic achievements and their capacities for critical

analysis. This suggests that the NHT model fosters a more enriching pedagogical environment by promoting active student engagement, synergistic collaboration, and direct involvement in the educational process.

This perspective is further corroborated by the research of Akuba et al (2025), who reported that the integration of the Numbered Heads Together (NHT) learning model alongside interactive instructional resources has effectively bolstered students' cognitive proficiencies. Moreover, this synergistic approach is instrumental in cultivating social competencies, nurturing a sense of accountability, and augmenting students' self-reliance in the acquisition of mathematical knowledge (Faisal et al., 2023).

This observation is similarly corroborated by the findings of Tiwow et al (2022), whose investigation elucidated a significant impact of Powtoon animated learning media on students' mathematical academic achievements. Beyond the utilization of Powtoon, educators possess the capacity to leverage a diverse array of supplementary technology-driven pedagogical tools, including but not limited to Kahoot!, Quizizz, Wordwall, and Quizlet, to augment the instructional experience.

The theoretical lacuna addressed by this investigation stems from the observed discrepancies between established theoretical frameworks and the empirical evidence derived from prior scholarly endeavors. Concurrently, from a pedagogical standpoint, the Numbered Heads Together (NHT) cooperative learning methodology is posited to enhance student engagement and cognitive assimilation due to its inherent emphasis on collaborative discourse and the assignment of distinct individual accountability. Furthermore, the integration of digital instructional resources, exemplified by platforms such as Quizlet, is anticipated to facilitate a deeper comprehension of subject matter through the provision of interactive drills and prompt evaluative responses. Nevertheless, a review of the extant literature reveals that the efficacy of the NHT model and the Quizlet application has predominantly been evaluated in isolation. Investigations pertaining to NHT typically concentrate on its impact on students' academic achievements or levels of active participation. Conversely, research concerning Quizlet more frequently explores its capacity to foster enhanced learning motivation or its utility as a tool for reinforcing academic material through practice activities. Research integrating the Numbered Heads Together (NHT) pedagogical framework with the Quizlet digital platform within a systematic educational setting to ascertain their impact on students' comprehension of mathematical principles remains relatively scarce.

The distinctive contribution of the present inquiry resides in the synergistic amalgamation of the Numbered Heads Together (NHT) pedagogical framework and the Quizlet digital application, orchestrated within a structured educational design. Prior scholarly endeavors examining the NHT model and the deployment of Quizlet in mathematical instruction have predominantly pursued these components in isolation and have been comparatively scarce. This research, conversely, effectuates a convergence of these methodologies, thereby enabling the concurrent application of a collaborative learning paradigm and digital instrumentation to enhance students' proficiency in grasping mathematical concepts.

Consequently, there is a compelling need to investigate the influence of the Numbered Heads Together (NHT) cooperative learning paradigm, augmented by the Quizlet application, on students' capacity to grasp mathematical concepts. It is anticipated that this investigation will foster advancements in pedagogical approaches to mathematics, promoting more dynamic, engaging, and efficacious methods for enhancing students' mathematical conceptual understanding.

2. METHOD

This investigation adopted a quantitative methodology, specifically utilizing an experimental research design. The employed framework was a pre-experimental design, structured as a one-group pretest-posttest model, which encompassed a solitary experimental cohort devoid of a control counterpart. This particular design was selected to ascertain the impact of integrating the Numbered Heads Together (NHT) cooperative learning strategy, augmented by the Quizlet digital application, on students' proficiency in comprehending mathematical concepts related to relations and functions. Inferential statistical techniques were employed for the analysis of the gathered data. The analytical process commenced with a prerequisite assessment, namely a normality test conducted via the Shapiro-Wilk test. Subsequently, hypothesis testing was executed utilizing a paired sample t-test to discern any statistically significant differences between the mean scores obtained from pretest and posttest assessments. The determination of significance was performed at a 5% alpha level ($\alpha = 0.05$). Consequently, should the calculated significance value fall below 0.05, the null hypothesis (H_0) would be rejected in favor of the alternative hypothesis (H_1), indicating that the Numbered Heads Together learning model assisted by the Quizlet application has an effect on students' mathematical concept understanding ability.

3. RESULTS AND DISCUSSION

3.1 Result

The investigation encompassed a cohort of thirty students from the eighth-grade B class, constituting the research sample. To ascertain the students' proficiency in comprehending mathematical concepts prior to and subsequent to the integration of the Numbered Heads Together (NHT) pedagogical model, augmented by the Quizlet digital platform, both an initial assessment (pretest) and a concluding evaluation (posttest) were administered. The pretest data revealed student scores spanning the range of 42 to 68, whereas the posttest findings indicated scores from 66 to 88. Prior to the intervention, the students' capacity for grasping mathematical concepts was notably underdeveloped. Crucially, not a single student attained the stipulated Minimum Mastery Criterion (KKM) of 75, with the highest pretest score registering merely 68. This outcome strongly suggests that the students encountered considerable challenges in achieving a thorough comprehension of the principles governing relations and functions. The integration of the NHT learning model, augmented by the Quizlet application, demonstrably enhanced students' proficiency in comprehending mathematical concepts. Analysis of the posttest score distribution revealed a preponderance of high-scoring students, with the modal score range of 86–89 encompassing 11 individuals, representing 36.67% of the cohort. Furthermore, the majority of students surpassed the established minimum passing grade (KKM), signifying a discernible improvement in their capacity for mathematical concept mastery subsequent to the pedagogical intervention.

Normality Test Results

Table 1. Normality Test Results

kode	Statistic	df	Sig
Pre-test	0.935	30	0.066
Post-test	0.934	30	0.063

The results derived from the statistical analysis indicated that the pretest dataset yielded a Shapiro-Wilk statistic value of 0.066, based on a sample size (degrees of freedom) of 30. As this obtained value surpassed the conventional alpha level of 0.05 ($0.066 > 0.05$),

it was inferred that the pretest data exhibited a normal distribution. This observation signifies that the initial distribution of student performance metrics, prior to the intervention or the application of the pedagogical model, did not exhibit a departure from normality. Subsequent analysis of the posttest data also revealed a Shapiro-Wilk statistic value of 0.063, with an equivalent sample size (degrees of freedom) of 30. This significance metric similarly exceeded the 0.05 threshold ($0.063 > 0.05$), substantiating the normality of the posttest data distribution. Collectively, these findings affirm that the student score distributions subsequent to the intervention also satisfied the prerequisite of normality. The fact that both significance values were greater than 0.05 underscores the normal distribution of the data, thereby fulfilling the requisite assumptions for the application of parametric statistical techniques.

Homogeneity Test Results

Table 2. Homogeneity Test Results

	Levene Statistic	df1	df2	Sig
Based on Mean	3.037	1	58	0.087
Based on Median	2.820	1	58	0.098
Based on Median and with adjusted df	2.820	1	57.071	0.099
Based on trimmed mean	2.973	1	58	0.090

The Levene's Test for Homogeneity of Variances yielded a significance value of 0.087 in the "Based on Mean" row. As this value exceeds the conventional alpha level of 0.05 ($p = 0.087 > 0.05$), it suggests that the variances of the research data are indeed homogeneous. Consequently, the dataset exhibits a comparable dispersion or scatter across the different observational groups, satisfying the assumption of equal variances. In light of these findings from the homogeneity assessment, it can be definitively stated that the research data adhere to the homogeneity assumption, evidenced by all computed significance levels surpassing the 0.05 threshold. Therefore, the dataset is deemed appropriate for subsequent parametric statistical inferential procedures, including but not limited to the t-test, to ascertain any statistically significant differences or effects attributable to the applied treatment on learning outcomes.

Hypothesis Test Results

Table 3. Paired Sample Test Result

	Mean	Std. deviation	Std. Error Mean	95% confidence interval of the difference		t	df	Sig.(2 - tailed
				lower	upper			
Pair 1 Pre test- post test	-25.800	5.129	0.936	-27.71	23.885	-27.553	29	0.000

An investigation employing hypothesis testing, specifically the Paired Sample t-Test, was undertaken to ascertain the impact of the NHT learning model, augmented by the Quizlet application, on students' proficiency in comprehending mathematical concepts. The t-test yielded a mean difference of -25.800. This statistical finding signifies a demonstrable enhancement in learning outcomes when comparing pretest and posttest assessments, with posttest scores exceeding those of the pretest. Consequently, it can be inferred that the integration of the Numbered Heads Together learning model, in conjunction with the Quizlet application, led to an augmentation of students' ability to grasp mathematical concepts. Moreover, the calculated standard deviation was 5.129, and the Standard Error of the Mean was 0.936. These metrics suggest that the variance in the differences between pretest and posttest scores exhibited favorable statistical properties, and the magnitude of the average difference observed among the student cohort was commendably consistent.

The statistical analysis yielded a t-value of -27.553 with 29 degrees of freedom. The probability value for a two-tailed test (Sig. (2-tailed)) was determined to be 0.000. Given that this probability value is less than the conventional significance level of 0.05 ($0.000 < 0.05$), the null hypothesis (H_0) was rejected in favor of the alternative hypothesis (H_1). This outcome suggests that the integration of the Numbered Heads Together (NHT) learning model, augmented by the Quizlet application, exerted a statistically significant positive influence on students' acquisition of mathematical concepts. Consequently, it can be inferred that employing the Numbered Heads Together learning model in conjunction with the Quizlet application demonstrates a notable impact on students' comprehension of mathematical concepts within the subject of relations and functions. These findings therefore imply that this pedagogical approach contributes to a substantial enhancement in students' grasp of mathematical concept.

Effect Size Results

Table 4. Effect Size Results

Statistic	value
Number of sample	30
Mean of pre-test	54.47
Mean of post-test	80.00
Mean difference	25.80
Standar deviation	5.12
Cohen's d	5.03
Category	Large

The calculation of effect size using Cohen's d revealed that the study encompassed a sample of 30 students. The average pre-test score was recorded as 54.47, whereas the average post-test score reached 80. These figures suggest a substantial improvement of 25.8

points in the mean score following the application of the employed treatment or learning materials.

Additionally, the standard deviation (SD) for the score differences was calculated to be 5.12. This relatively small standard deviation implies a limited degree of variability in score enhancements across the student cohort, suggesting a consistent trend of improvement in learning outcomes for the majority of participants. The calculated Cohen's d value was 5.03. Applying standard interpretation guidelines for Cohen's d , this value is classified as representing a large effect ($d \geq 0.80$). Consequently, the effect size data indicate that the intervention administered had a significant and positive impact on enhancing students' proficiency in understanding mathematical concepts.

N-Gain Result

Table 5. N-Gain Result

Statistic	value
Mean of pre-test	54.47
Mean of post-test	80
Mean difference (post-test – pre-test)	25.8
N-Gain	0.563
N-Gain percentage	56.33
Category	medium

Consequently, it can be ascertained that the integration of the Numbered Heads Together instructional approach, augmented by the Quizlet application, exerts a discernible influence on students' comprehension of mathematical concepts within the domain of relations and functions. The findings suggest that this pedagogical model substantially enhances students' grasp of mathematical principles. Furthermore, the calculated N-Gain of 56.33% is indicative of a moderate level of efficacy in advancing students' conceptual understanding. Nevertheless, this outcome also signifies that opportunities exist for further refinement to elevate the learning process to a highly effective standard. Elements such as student engagement in educational activities, the appropriateness of employed methodologies, the distribution of instructional time, and the inherent properties of the learning materials are critical considerations for achieving superior learning outcomes.

3.2 Discussion

The research findings indicate that incorporating the Numbered Heads Together (NHT) learning model, enhanced by the Quizlet application, positively influenced students' comprehension of mathematical concepts related to relations and functions. This conclusion is supported by the comprehensive analysis of the collected data, which included assessments of normality, homogeneity, hypothesis validation via paired sample t-tests, and simple linear regression.

The hypothesis testing, specifically the paired sample t-test, yielded a significance value of 0.000. As this value is less than the predetermined threshold of 0.05, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_1) was accepted. Consequently, it can be inferred that the Numbered Heads Together (NHT) cooperative learning model, when utilized in conjunction with the Quizlet application, demonstrably impacts students' ability to understand mathematical concepts.

The effect size was calculated using Cohen's d to quantify the impact of the implemented model. The resulting Cohen's d value was 5.03. According to established

interpretation guidelines for Cohen's d , this score falls within the "large" effect size category ($d \geq 0.80$). Consequently, the findings from the effect size analysis suggest that the intervention had a substantial influence on enhancing students' comprehension of mathematical concepts.

The N-Gain score was computed to assess the learning progress, yielding a value of 0.563, equivalent to 56.33%, which is classified as a medium effect. This score signifies that students demonstrated an improvement in their learning outcomes subsequent to engaging in the educational activities and receiving the intervention. A medium classification suggests that the learning model employed exerted a beneficial effect on augmenting students' understanding and proficiency in the subject matter, even though the level of improvement did not reach the high category.

The implementation of the Numbered Heads Together (NHT) pedagogical framework, when supported by the Quizlet application, demonstrates considerable efficacy in the acquisition of mathematical knowledge, specifically concerning the subject matter of relations and functions. This instructional methodology offers a viable alternative strategy capable of enhancing student engagement, fostering cooperative learning, and augmenting their proficiency in comprehending mathematical principles.

Furthermore, the integration of the Quizlet application plays a significant role in the enhancement of students' comprehension of mathematical concepts. The characteristic features of Quizlet, such as digital flashcards, supplementary practice modules, and interactive assessments, facilitate students' assimilation of the principles governing relations and functions through repeated visual engagement. Moreover, the instantaneous feedback mechanisms enable students to pinpoint and rectify their errors, thereby optimizing the educational experience. The synergistic combination of the NHT model and Quizlet cultivates a more stimulating educational setting and elevates student involvement throughout the instructional period.

This investigation further corroborates the findings of Akuba et al (2025), who posited that the synergistic application of the Numbered Heads Together (NHT) pedagogical framework and dynamic educational resources demonstrably enhances students' cognitive competencies. Beyond its salutary effect on academic achievements, this judicious integration concurrently cultivates interpersonal proficiencies, instills a profound sense of accountability, and augments student autonomy within the mathematical educational milieu.

Rodliyah (2021) posited that the synergistic integration of the Numbered Heads Together (NHT) pedagogical framework and the Baamboozle digital platform demonstrably fostered a dynamic, participatory, and salient educational experience for learners. Empirical evidence from the investigation suggests that the deployment of technologically augmented cooperative learning methodologies offers a novel avenue for enhancing student academic achievement, especially within disciplines frequently perceived as challenging, such as mathematics.

4. CONCLUSION

Following the comprehensive analysis of research findings and discourse pertinent to the impact of the Numbered Heads Together (NHT) cooperative learning methodology, augmented by the Quizlet application, on students' proficiencies in comprehending mathematical concepts within the domain of relations and functions, it can be definitively asserted that the integration of this pedagogical approach demonstrably influences students' capacity for understanding mathematical concepts. This assertion is substantiated by the outcomes of the hypothesis verification process, employing the Paired Sample t -Test, which yielded a statistical significance value (Sig. 2-tailed) of 0.000, a figure considerably lower than the predetermined alpha level of 0.05. The extent of the influence exerted by the

Numbered Heads Together (NHT) cooperative learning model, synergistically combined with the Quizlet application, on the students' grasp of mathematical concepts has been classified as substantial. This classification is corroborated by the calculation of the Effect Size (Cohen's d), which produced a metric of 5.03, unequivocally placing it within the parameters of a significant or large effect. The efficacy of enhancing students' comprehension of mathematical concepts, as assessed by the N-Gain test, was determined to be of a moderate level. Subsequent analysis revealed an N-Gain score of 0.563, translating to 56.33%, which falls within the medium classification. These findings suggest that the instructional approach employing the NHT model, augmented by the Quizlet application, demonstrated considerable success in advancing students' proficiency in grasping mathematical concepts.

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