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The Effectiveness of Using the Kahoot Application in Developing the Ability to Understand Mathematical Concepts of Junior High School Students

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ABSTRACT

The quality of mathematics instruction in junior high schools frequently encounters obstacles, particularly in students' limited comprehension of mathematical concepts. This study examines the effectiveness of *Kahoot!*, a game-based learning platform, in improving junior high school students' conceptual understanding of mathematics. A quasi-experimental method was applied, involving two eighth-grade classes at SMP Negeri 2 Teras: one as the experimental group using *Kahoot!* and the other as the control group receiving conventional instruction. Data were collected through pretests, posttests, questionnaires, and observations. The *t*-test analysis revealed a significant difference in student performance ($t_{(count)} = 2.4132 > t_{(table)} = 2.0086$ at $\alpha = 0.05$), with the experimental group achieving a moderate N-Gain of 0.56. These findings demonstrate that *Kahoot!* fosters student engagement, encourages real-time feedback, and supports varied learning styles, thereby contributing to enhanced conceptual understanding. The integration of *Kahoot!* in mathematics instruction, particularly on abstract topics such as statistics, has been shown to create a more interactive and student-centered learning environment. Educators are encouraged to incorporate technology-enhanced tools such as *Kahoot!* to support active and meaningful learning processes.

KEYWORDS Kahoot; N-Gain; Interactive Learning; Mathematical Conceptual Understanding; t-Test.

INTRODUCTION

The quality of mathematics learning in junior high school often faces challenges, one of which is the low level of students' conceptual understanding (Andamon & Tan, 2018; Bringula et al., 2021; Indrawati et al., 2024). Teacher-centered learning and the use of conventional methods such as lectures make students less actively engaged, causing the concepts obtained to be memorized rather than understood. Technological developments offer various alternative digital learning media capable of increasing student interaction and engagement (Serrano et al., 2019; Wibowo et al., 2023). One such medium is Kahoot, a quiz-based learning platform that is interactive, collaborative, and fun. By using Kahoot, students can answer questions in real time through their digital devices, making learning more active and competitive (Plump & LaRosa, 2017; Poblaciones et al., 2021). Proper use of media can increase students' attention to the material being taught, and with the help of tools that stimulate the spirit of learning,

students become more involved in the learning process, ultimately enhancing their enthusiasm (Anwar et al., 2023; Lubis et al., 2023). Therefore, media use in the learning process can assist in understanding the material presented. It is hoped that this will support students' cognitive, affective, and psychomotor development (Naro et al., 2023).

The importance of proper conceptual understanding for achieving learning objectives is undeniable (Hansen, 2023). At the end of the learning process, it is expected that students will be able to grasp mathematical concepts and apply that understanding to solve problems, guided by teachers who can effectively facilitate mathematics lessons. Understanding mathematical concepts is central to meaningful learning in mathematics, and teachers are expected to promote deep comprehension, so students go beyond superficial connections. This conceptual understanding is also one of the aims of every material delivered by teachers, as educators help students achieve mastery of concepts. In this regard, students' understanding of concepts should enable them to explain material and solve mathematical problems according to the concepts acquired (Kholid et al., 2021; Siagan et al., 2019). Students can be said to possess conceptual understanding if they meet the indicators of mathematical comprehension; in practice, this is developed through learning paradigms, problem-solving activities, and the implementation of guided exercises (Ncube & Luneta, 2025).

The Kahoot application is one of the most effective online learning media for teachers to employ, as it can make the learning process more engaging and efficient. Kahoot is a learning tool accessible to teachers and students via https://Kahoot.com/ and https://Kahoot.it/. All platform features are available for free, with the advantage of supporting both individual and group play, requiring internet connectivity. According to Rofiyarti and Yunita Sari (2019), Kahoot offers features that allow collaborative games in the classroom. Through such games, students learn to move beyond egocentric thinking, share, compete honestly, act professionally, defend their rights, and respect the rights of others. This web-based platform includes a multiplayer feature that facilitates interaction between students and peers.

Several studies have shown that Kahoot can create a fun and competitive learning environment, encouraging active student participation. Plump and LaRossa (2017) found that Kahoot is suitable for both novice and experienced teachers because it is easy to operate and supports active, collaborative learning. Research by Bicen and Kocakoyun (2018) also revealed that students are more engaged and motivated when learning through Kahoot compared to conventional methods. In mathematics learning, Kahoot has been proven to increase interest and enhance conceptual understanding. Afshar and Shirzadi (2024) examined Kahoot's impact on mathematics learning and found that students not only achieved improved outcomes but also identified conceptual errors more effectively through the real-time feedback feature, which facilitated swift remediation.

Another advantage of Kahoot is its ability to accommodate diverse learning styles—visual, auditory, and kinesthetic. With multimedia features supporting audio, images, and text, students can absorb material through different sensory channels. According to Zarzycka-Piskorz and Podchor (2016), Kahoot significantly raises students' intrinsic motivation thanks to its contextual and enjoyable approach to learning.

This study aims to examine the extent to which the Kahoot application can enhance junior high school students' understanding of mathematical concepts, particularly in statistical topics, by comparing learning outcomes between an experimental group and a control group. The

findings are expected to offer practical benefits for teachers by presenting an innovative digital learning tool that improves student engagement and conceptual comprehension in mathematics.

RESEARCH METHOD

This research employed a quasi-experimental design with a pretest–posttest control group approach, conducted at SMP Negeri 2 Teras, Boyolali, Central Java, during the 2024/2025 academic year. The population of the study consisted of all eighth-grade students, while the sample included two classes selected through a purposive sampling technique, comprising 26 students in the experimental class (taught using the Kahoot application) and 26 students in the control class (taught using conventional methods).

The data collection techniques involved several instruments: (1) objective tests (pretest and posttest) to measure students' conceptual understanding in mathematics, (2) a Likert-scale questionnaire to assess students' perceptions of the learning process, and (3) observation sheets and documentation to record classroom learning activities. The data sources included both primary data (student test scores and questionnaire responses) and secondary data (school documents related to class profiles and learning schedules).

The data analysis techniques used in this study included the normality test (Lilliefors) to ensure data distribution validity, the homogeneity test (F-test) to confirm variance consistency between groups, the t-test to examine differences in learning outcomes between the experimental and control classes, and the N-Gain test to measure the improvement in students' conceptual understanding before and after the treatment.

RESULTS AND DISCUSSION

Pretest Data Analysis (Initial Test) Result

The results of the pretest showed that the average score of the control class was 8.29, the maximum score was 70 and the minimum score was 30. Meanwhile, in the experimental class, the average score was 8.39, the maximum score was 95 and the minimum score was 30. It can be seen that the average pretest score of the experimental class is higher than that of the control class. The results of the control class and the experimental class are presented in the following Table 1.

Table 1. Results of the Control Class and the Experimental Class Achievement

Class	N	Min	Max	Sum	Mean	Varians	Standard Deviation
Account	26	30	70	1260	8,29	113,54	10,66
Eksperimen	26	30	95	1050	8,39	993,35	19,05

source: proccesed data (2025)

Data Analysis Posttest (Final Test) Result

The results of the postestt showed an average value of 9.23 of the control class, a maximum value of 75 and a minimum value of 40. Meanwhile, in the experimental class, the average score was 16.14, the maximum score was 95 and the minimum score was 30. It was seen that the average score of the posttest of the experimental class was higher than that of the

control class. The results of the control class and experimental class posttest are presented in Table 2 below:

Table 2. Results of the Posttest of the Control Class and the Experimental Class

Class	N	Min	Max	Sum	Mean	Varians	Standard Deviation
Account	26	40	75	1260	9,23	124,00	11,14
Experiment	30	30	95	1505	16,14	362,82	19,05

source: proccesed data (2025)

Normality Test

The criterion for decision-making is that if the value is L_hitung<L_tabel, then the data is said to be distributed normally. Pretest normality test results in the control class and the experimental class. From the pretest calculation above, L_hitung=0.1360 with N=26 Significant level α = 0.05, L_tabel=0.1699, then 0.1360 < 0.1699. So, it can be concluded that the distribution sample is normal. Meanwhile, the posttest normality test in the control class was obtained L_hitung=0.1 with N=26 with a significant level of α = 0.05, L_tabel=0.1699, then 0.1 < 0.1699. So, it can be concluded that the distribution sample is normal.

The results of the pretest normality test in the experimental class were obtained L_hitung=0.0577 with N=26The significant level of α = 0.05, L_tabel=0.1699, then 0.0577<0.1699. So, it can be concluded that the distribution sample is normal. Meanwhile, the results of the posttest normality test in the experimental class were obtained L_hitung=0.1527 with N=26 The significant level of α = 0.05, L_tabel=0.1699, then 0.1527 < 0.1699. So, it can be concluded that the distribution sample is normal. So, it can be concluded that the data of both classes are normally distributed.

Homogeneity Test

The decision-making criterion is if F_hitung≥F_tabelmaka Ho is rejected. Conversely, if Fcal < Ftable then Ho is accepted, which means that both groups have equal or homogeneous variance. The test was conducted at a significance level (α) of 5%. The results of the homogeneity test are presented in Table 3.

Table 3. Homogeneity Test Results

Class	Largest Variance	Smallest Variance	Calculation	Table	Criteria
Control	120,615	58,3462	0,34	0,51	Homogeneous
Eksperimen	334,462	114,038	0,48	0,51	Homogeneous

source: proccesed data (2025)

Based on the results in Table 3 shows that the value is F_hitung<F_tabel, so Ho is accepted. Thus, it can be concluded that there was no significant difference in variance between the data groups tested. This means that the data from both groups are homogeneous.

Hypothesis test

The hypothesis test showed that t_hitung=2.4132 was greater than t_tabel=2.0086, so there was a significant difference between the experimental and control classes. The results of the hypothesis test using the t-test are presented in Table 4 below.

Table 4. Hypothesis Test Results using the t-Test

Class	Data Amount	Baku Junction	Average	Tcount	Table
Control	26	11,14	9,23	2,4132	2,0086
Experiment	26	16,14	19,05		

source: proccesed data (2025)

The hypothesis test uses the t-test formula, namely:

$$t = \frac{\bar{X}1 - \bar{X}2}{\sqrt{\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$$

$$= \frac{19{,}05 - 9{,}23}{\sqrt{\frac{(26-1)(16{,}14)^2+(26-1)(11{,}14)^2}{26+26-2}\left(\frac{1}{26}+\frac{1}{26}\right)}}$$

$$= \frac{9{,}82}{\sqrt{\frac{(25)(260{,}4996)+(25)(124{,}0996)}{50}(0{,}0385+0{,}0385)}}$$

$$= \frac{9{,}82}{\sqrt{\frac{6512{,}4900+3102{,}4900}{50}(0{,}0769)}}$$

$$= \frac{9{,}28}{\sqrt{\frac{9614{,}9800}{50}(0{,}0769)}}$$

$$= \frac{9{,}28}{\sqrt{(1922{,}996)(0{,}0769}}$$

$$= \frac{9{,}28}{\sqrt{14{,}788}} = 2{,}4132$$

= 9.28/√14.788=2.4132

N-Gain Test

The average N-Gain of the experimental class was 0.56 (medium category) compared to the control class of -0.33 (low category), indicating that Kahoot was effective in improving students' conceptual understanding. A comparison between the two classes showed that the average N-Gain index in the experimental class was higher than in the control class (0.56 > -0.33). Thus, it can be concluded that the use of kahoot applications in learning is effective in improving students' understanding of mathematical concepts at SMPN 2 Teras. The results of the Improvement Test (N-Gain) are presented in the following Table 5:

Table 5. Increase Test Results (N-Gain)

Concept Understanding	Control Class	Experimental Classes
N-Gain Index	-0,33	0,56
Increased	33%	56 %

source: proccesed data (2025)

Discussion of the Use of Kahoot Application in Developing Matermatic Concept Skills

At the stage before the implementation of the research, all instruments used have gone through a strict validation process. The research instrument has been validated by mathematics education lecturers who have expertise in their fields, ensuring that the measuring tools used are accurate and relevant to measure students' ability to understand mathematical concepts. A significant increase in understanding of mathematical concepts in the experimental class showed that the use of Kahoot was able to create a more active and enjoyable learning environment. Kahoot provides gamification elements that increase learning motivation, strengthen student engagement, and allow for direct feedback that can strengthen mastery of concepts.

Using the Kahoot app involves a simple set of steps, making it an effective choice for interactive learning platforms. Here is an overview of how to use them:

1. Create Accounts and Quizzes: Teachers create accounts on the Kahoot website (Kahoot.com) and can create new quizzes. The quiz consists of different types of questions such as multiple-choice, true/false, or puzzle, complete with pictures, videos, and music to make it more engaging. The view of Figure 1 is presented as follows:

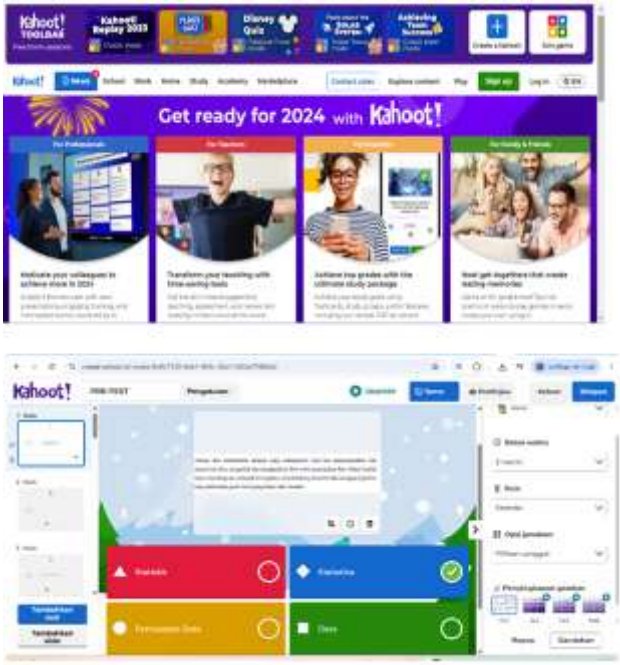

Figure 1. Initial Appearance of Kahoot and Quizzes

This image shows the teacher's screen view on the Kahoot platform while composing a new quiz. You can see various options for adding questions, setting question types (multiple-choice, true/false, or puzzle), and inserting media such as images or videos to enrich the content of the quiz.

2. Starting the Game Session: Once the quiz is ready, the teacher starts the game session. The screen will display a unique "Game PIN" that students need to enter to join. The "Game PIN" display on the teacher's device is presented in Figure 2 below:

Figure 2. "Game PIN" view

This image shows the teacher's projection layer in the classroom when the Kahoot session is about to start. You can see "Game PIN" which is a unique code for the quiz session, as well as information about the number of players who have successfully joined.

3. Facilitate Learning: Teachers lead the course of quizzes, display questions in the main layer, and manage processing time. After each question, Kahoor will display the results in a willful manner, showing the correct answers and the student's ranking. The Quiz display on the Teacher's Laptop screen is presented in the following Figure 3:

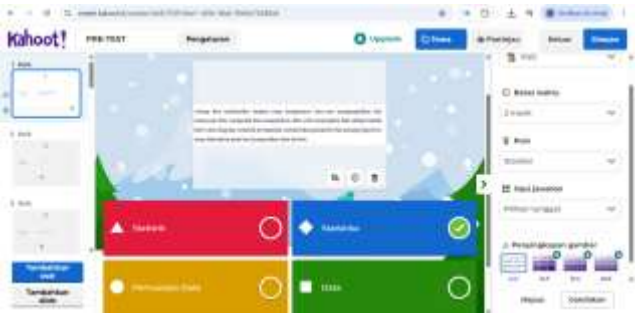

Figure 3. Quiz Display on the Teacher's Laptop Screen

4. Join the Game: Students access Kahoot through the web www.kahoot.it then enter the "Game PIN" provided by the teacher. The view is presented in the following Image: image explanation: This image shows the view on a student's mobile device when they are about to join the quiz. Students are required to enter the "Game PIN" provided by the teacher. The "Game PIN" display on the student's device is presented in Figure 4 below:

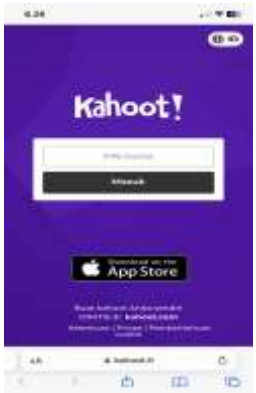

Figure 4. "Game PIN" display on student devices

5. Answering Questions: after joining, students will see the question on the main screen (teacher's screen) and students answer it on their own device. The speed and accuracy of the answers affect their scores. The display of questions and answers on the device is presented in Figure 5 below:

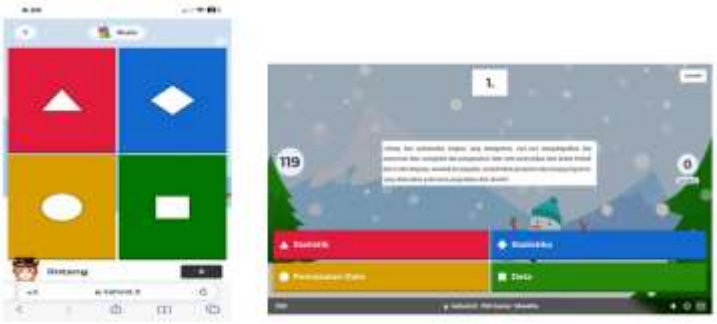

Figure 5. Question and Answer Display on Device

According to (Wang & Tahir, 2020), Kahoot is able to build a healthy competitive atmosphere in the classroom, increase attention, and strengthen concept connections through context-based quiz questions and discussions. This process is important in math learning because it enables reflective thinking and deeper understanding. Additionally, learning with Kahoot encourages a differentiated approach that accommodates visual, auditory, and kinestic learning styles. (Aisyah & Rahmat, 2023) shows that students with certain learning styles find it easier to understand mathematical concepts when the material is conveyed through appropriate media.

This is reinforced by international research by (Licorish et al., 2018) which states that Kahoot can significantly increase students' focus and engagement during the learning process. In addition, according to (Ismail et al., 2017) it shows that gamification-based learning, especially Kahoot, produces better academic achievement than traditional methods. This is due to healthy competition and increased student interest in learning through interesting visualizations.

The use of the Kahoot application in learning is able to increase student activity. This is because students not only read or listen to the teacher's explanations, but also participate in interesting and entertaining educational games. This active participation indirectly increases students' understanding of the material taught. In learning statistics material, the use of Kahoot makes it easier for students to understand the concepts learned. This is supported by visualizations and illustrations displayed in the form of educational games, so that the material becomes easier to understand. According to (Friantini & Winata, 2008), teachers can take advantage of the development of science and technology to create learning like Kahoot, teachers not only create a fun learning atmosphere but also increase student involvement in the learning process.

The study conducted (Pellas, 2024) compared the use of Kahoot with PowerPoint presentations in mathematics learning. The results showed that students who used Kahoot had a better understanding of mathematical concepts, especially in problem-solving skills. Interactive features such as animations and real-time feedback within Kahoot contribute to this

improvement. However, the learning process that actively involves students is important in the quality of learning, especially in mathematics subjects. Active involvement of students through participation in educational, engaging, ineractive, and fun games such as those provided by the Kahoot app. This will indirectly increase the ability to understand mathematical concepts in students.

The results of previous research showed that the use of Kahoot was quite effective in improving students' ability to understand mathematical concepts. The study conducted by (Rais & Zhi, 2022) involved 122 students who learned mathematics using Kahoot. The results showed that Kahoot was effective in increasing students' motivation and understanding of mathematical concepts, with a significant increase in learning outcomes, especially in students with low skills.

These results are in line with (Parra-González et al., 2021) and (Daryanes, 2023) which also show that Kahoot is able to improve students' mathematical understanding in various subjects. These results are strengthened by (Nengsih et al, 2021) in a meta-analysis study that shows that gamification-based digital media consistently improves engagement and learning outcomes in science and mathematics learning.

This research is also in line with the findings of (Yanuarto et al., 2023), which revealed that the use of Kahoot in mathematics learning can improve concept understanding through context-based quiz challenges and formative assessments. In addition, (Altawalbeh, 2023) notes that visual and verbal representations in Kahoot problems are able to strengthen the relationship between concepts, especially in abstract topics such as algebra. Similar findings were also identified by (Sofwan, 2023) and (Selepe, 2025), which emphasized the role of real-time feedback and post-quiz discussions in forming a stronger concept structure in students.

Thus, the use of Kahoot as a technology-based interactive media has proven to be effective in improving students' ability to understand mathematical concepts. The implementation of this application provides a more contextual, interactive and meaningful learning stimulus, supporting the development of cognitive, affective and psychomotor competencies in an integrated manner.

CONCLUSION

The study showed that the experimental class using the Kahoot application achieved a significantly higher posttest average score (16.14) compared to the control class (9.23), following a modest difference in pretest scores (8.39 and 8.29, respectively). Statistical analyses confirmed that the data were normally distributed and homogeneous, with the t-test results ($t_{count} = 2.4132 > t_{table} = 2.0086$, $\alpha = 0.05$) indicating a significant difference between the two groups. The N-Gain results further demonstrated that the experimental class achieved a moderate improvement (0.56), while the control class showed a decline (-0.33). These findings suggest that Kahoot effectively enhanced students' conceptual understanding. Future research is recommended to incorporate additional variables such as critical thinking or creativity and to apply the Kahoot-based learning model across different subjects and educational levels to broaden the generalizability of the findings.

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