M A T H L I N E
JURNAL MATEMATIKA DAN PENDIDIKAN MATEMATIKA
ISSN 2502-5872 (Print)
ISSN 2622-3627 (Elektronik)

Volume 10 Number 2, May 2025, 521-537

EXPERIMENTATION OF VIDEO BASED LEARNING METHODS WITH GAME BASED LEARNING IN IMPROVING STUDENTS' UNDERSTANDING OF MATHEMATICAL CONCEPTS

Sinta Mawalia[1*], Heru Agni Setiaji[2]
[1,2]Program Studi Tadris Matematika, Institut Agama Islam Negeri (IAIN) Kudus, Kudus, Indonesia
*Correspondence: mawaliasinta@gmail.com

ABSTRACT

The low level of students' understanding of mathematical concepts is a crucial problem in education that has an impact on academic achievement in general, so innovation in learning methods is needed. This study aims to compare the effectiveness of video-based learning (VBL) and game-based learning (GBL) in improving students' understanding of mathematical concepts. This study adopted a quasi-experimental design with two experimental classes, each using the VBL and GBL methods, and a control class with traditional learning methods. The research instruments were pre-test and post-test essay tests that were validated and reliable. The results of data analysis using One Way ANOVA proved that there were significant differences between the 3 groups. The VBL and GBL approaches proved to be more effective than the traditional approach in improving students' mathematical understanding of mathematical concepts. This study suggests the use of video and game-based learning methods as innovative alternatives to improve the quality of mathematics learning in schools.

Keywords : Video Based Learning, Game Based Learning, Understanding Mathematical Concepts

How to Cite: Mawalia, S., & Setiaji, H. A. (2023). Experimentation Of Video Based Learning Methods With Game Based Learning In Improving Students' Understanding Of Mathematical Concepts. *Mathline: Jurnal Matematika dan Pendidikan Matematika, 10*(2), 521-537. http://doi.org/10.31943/mathline.v10i2.942

PRELIMINARY

Understanding mathematical concepts is a very important skill in mathematics education because it is the main basis for mastering more complex mathematical material. According to Hiebert and Lefevre (2022), the ability to understand mathematical concepts in learning allows students to understand, explain, and apply mathematical concepts comprehensively. Mathematics consists of interrelated and sequential concepts, so if students understand basic concepts well, they will find it easier to understand more complex mathematical material later. By gaining a deep understanding of concepts, students can effectively develop critical thinking skills and problem-solving abilities. They are able to apply mathematical knowledge in various situations both in academic environments and in everyday life, creating more meaningful learning than just memorizing.

In addition, conceptual understanding allows students to explain mathematical ideas in their own words, connect existing ideas, and present concepts in various forms such as

pictures, tables, and mathematical expressions. This ability also allows students to form their own knowledge, put forward creative ideas, and create appropriate and efficient problem-solving algorithms (Radiusman, 2020). This explains that conceptual understanding is a fundamental skill that supports independent learning.

Furthermore, Richard Skemp (2021), categorizes the ability to understand mathematical concepts into 2 types, namely instrumental and relational understanding. Instrumental understanding refers to the ability to apply mathematical procedures without understanding the reasons behind the procedure, while relational understanding refers to the ability to understand the relationship between concepts in order to be able to interpret and develop the concept as a whole (Giriansyah et al., 2023). The results of research on linear programming material show that high-ability students can complete all indicators of conceptual understanding, while low-ability and medium-ability students are limited to only some of the indicators (Nurajijah et al., 2023).

However, looking at the problems that are currently emerging, many students have low ability to understand mathematical concepts. In fact, it is based on the results of the PISA survey which was carried out starting in 2000 and was last carried out in 2022. The OECD made a survey that assessed international scale learning activities consisting of tests and questionnaires. Of the 81 countries surveyed, Indonesia was ranked 68th with 690 thousand students. The results show that Indonesia obtained a better ranking than in 2018 (UPI, 2022). However, when viewed from the PISA score results, the 2022 score decreased compared to 2018. The 2022 literacy score was the lowest score during the PISA survey and decreased from 371 to 359. Likewise, the 2022 mathematics score was the second lowest score during the PISA survey and decreased from 379 to 366. Meanwhile, the science score tended to be stable from year to year, but the 2022 score decreased from 396 to 383. Globally, the 2022 PISA survey results showed a sharp decline in step learning loss worldwide in the 3 aspects tested due to the Covid-19 pandemic (Alam, 2023). This means that almost all countries experienced a decline in PISA scores, although Indonesia experienced an increase in scores but was still below average due to the decline. During the PISA survey, Indonesia always ranked in the bottom 10 which from year to year experienced an increase in participating countries.

The PISA survey measures three areas, one of which students must master is mathematics. According to OECD (2023), mathematical concept understanding is part of the ability assessed in the PISA survey through mathematical questions. Therefore, one of the causes of the low PISA 2022 score in mathematics is related to students' low mathematical

concept understanding ability. Another fact is proven by the results of a preliminary study of the mathematical concept understanding ability of class VII students at MTs Mansyaul Ulum in Pati, it was found that the percentage of student success was 25% in solving mathematical concept understanding problems. If this problem is ignored continuously, students' mathematics learning achievement will have a bad effect.

The low ability of students to understand mathematical concepts arises due to external and internal aspects. External aspects include ineffective learning methods, the habit of memorizing without understanding, and difficulties in connecting and communicating mathematical concepts, while internal aspects include students' lack of interest, motivation, and concentration (Darwani et al., 2023). Based on interviews, teachers still apply monotonous learning methods and only rely on lectures without visual media or direct practice and practice questions without variation, often making students feel bored and less motivated. When learning motivation decreases, students tend to be inactive in the learning process, so they are unable to grasp mathematical concepts completely and critically.

This is in line with Dewi and Abadi (2022), which states that conventional research methods are still used in many fields of education and science.. Sinaga et al. (2025) also stated that conventional learning methods in mathematics are generally expository, where the teacher plays a dominant role as the center of learning, providing explanations of materials, examples of questions, and directing students directly. This method allows for limited interaction and teacher dominance in the teaching and learning process. To overcome this problem, a learning method is needed that can improve students' mathematical concept understanding abilities, especially to motivate them to always be active and not feel bored during the mathematics learning process. One alternative that can be applied is the video-based learning method (Video Based Learning) and game-based learning (Game Based Learning). The video-based learning method is effective because it is able to present material visually and audio that is interesting, so that it can improve students' memory and interest in learning (Alifah & Utami, 2022). In addition, learning videos allow students to learn independently and repeatedly at their own pace, which is not possible in conventional methods (Fitria & Nurafni, 2021). Research according to Nur et al., (2024), stated that the learning method using videos can improve students' abilities in understanding mathematical concepts. While game-based learning provides an interactive and enjoyable learning experience, so that it can significantly increase student motivation and involvement (Ramadina & Nindiasari, 2025). Game Based Learning also helps students develop critical thinking and problem solving skills through challenges presented in educational games

(Agustiani et al., 2024). Other research states that methods that use games can improve students' abilities in understanding mathematical concepts (Ardani & Salsabila, 2021).

The Video Based Learning (VBL) method is an approach that uses video as the main media to convey knowledge or skills in learning. The video used in this method must have 2 main elements, namely visual and audio, which function to clarify and enrich learning materials (Zubaedah & Efendy, 2023). This video can be in the form of camera footage, animation, graphics, text, and sound that create an engaging multisensory learning experience. Video Based Learning can also stimulate students' emotional, intellectual, and psychomotor aspects, making it suitable for today's digital generation (Faraby et al., 2021).

Game Based Learning (GBL) method is a method that uses games as a medium in teaching certain concepts or skills in learning. In this method, game elements such as challenges, rules, scores, and feedback are used to motivate student involvement in the learning process (Azzahra et al., 2022). Game Based Learning aims to make learning more fun, interactive, and encourage students to think actively and participate in learning through simulations and scenarios in the game (Hermawan, 2024). In addition, in the context of mathematics learning using game-based learning media, it has a positive impact on students' cognitive abilities, such as numeracy skills, mathematical communication, mathematical representation, and students' high-level thinking skills. This is because games specifically designed for mathematics learning support students in understanding abstract material in a more interesting and enjoyable way (Khoirunnisya et al., 2024).

The main focus of teachers in implementing the Video Based Learning (VBL) method and the Game Based Learning (GBL) method is to build an active, fun, and student-centered learning atmosphere. With this approach, students will not only understand the material better, but also be motivated to continue learning independently and collaboratively. According to Rohpinus, the ability to understand mathematical concepts is obtained through an emphasis on verbal concept mastery, mathematical representation, application of concepts, and the ability to connect and develop concepts in various mathematical contexts (Sari Rambe et al., 2024). Research shows that video-based learning media is effective in improving students' mathematical problem-solving abilities and learning outcomes, as evidenced by the use of interactive videos assisted by quizizz in elementary schools with significant improvements in problem-solving abilities and learning outcomes (Astuti et al., 2024). In addition, research in junior high schools also found that learning with video media is more effective than conventional learning in improving students' understanding of mathematical concepts (Gusmania & Wulandari, 2018). The use of learning videos has also

been shown to increase students' motivation to learn and mathematics learning outcomes, with the level of learning completion increasing significantly after the implementation of learning videos (Yulianto et al., 2022).

On the other hand, many previous studies have also examined the application of the Game Based Learning (GBL) method in mathematics learning, such as the use of game media based on Squid Game and Among Us which have been proven to increase the interest and learning activity of junior high school students (Yustina & Yahfizham, 2023). Other research also shows that game-based learning with an edutainment approach can make the process of learning mathematics more attractive and increase motivation to learn independently (Sari & Ahmad, 2022). In addition, the implementation of GBL assisted by Kahoot! has also been proven to significantly increase student activity and learning outcomes (Sembiring & Listiani, 2023).

From several research results, researchers see that most of these studies only focus on one learning method, either Video Based Learning or Game Based Learning separately, without combining or directly comparing the effectiveness of the two methods in the same context. In fact, Video Based Learning has the advantage of presenting concepts visually which helps students' understanding in depth, while Game Based Learning adds aspects of interactivity and learning motivation through games. Therefore, this study has a novelty by combining and directly comparing the Video Based Learning method with Game Based Learning in one experiment to improve students' understanding of mathematical concepts. This study aims to fill the gap in research that has not studied the effectiveness of the combination or comparison of the two methods comprehensively. With this approach, it is hoped that a more complete picture will be obtained regarding how the two methods can complement each other and have a positive impact on students.

From this background, researchers are interested in conducting research on Experimentation of Video Based Learning Methods with Game Based Learning in Improving Students' Understanding of Mathematical Concepts.

METHODS

This type of research uses a Quasi Experimental Design with three groups, namely two experimental groups and one control group. The two experimental groups were given different learning methods, namely Video Based Learning and Game Based Learning, while the control group used traditional/conventional learning methods. The three groups were

selected non-randomly based on existing classes, so they are included in the quasi-experimental category. The following is a description of the research design:

Table 1. Research Design Depiction

Group	Treatment of Learning Methods	*Pretest*	Treatment	*Posttest*
Experiment 1	*Video Based Learning*	O1	X1	O2
Experiment 2	*Game Based Learning*	O3	X2	O4
Control	Traditional/Conventional	O5	-	O6

Information:

O = Observation (*pretest*/*posttest*)

X = Treatment of learning methods

To measure the effect of treatment on mathematical concept understanding ability, the three groups were tested using a pretest before treatment and a posttest after treatment. The difference in pretest and posttest scores was analyzed to determine the effect of each learning method on improving students' mathematical concept understanding ability.

The research was conducted at MTs Mansyaul Ulum Pati in the 2024/2025 academic year with the main learning material of Algebraic Addition and Subtraction. The population of the study was all 76 students in grade VII, divided into 3 classes, namely VII-A, VII-B, and VII-C. In this study, the researcher used total sampling (saturated sample), namely by involving all members of the population as research samples. The class division is class VII-A and VII-B, each consisting of 25 students and used as the experimental class, while class VII-C consisting of 26 students is used as the control class.

The research instrument used was a conceptual understanding ability test in the form of an essay test that was compiled based on the test grid and adjusted to the curriculum in force in the school. This test consisted of an initial test (pre-test) and a final test (post-test) of six questions from six indicators of conceptual understanding ability according to Bloom's Taxonomy, namely: (1) restating the concept using their own language (2) giving examples and non-examples (3) classifying objects according to their concepts, (4) representing in various ways from concepts, (5) connecting concepts in mathematics, and (6) applying concepts to solve everyday problems (Murtiyasa & Sari, 2022). Before being used, the instrument was tested for validity by three expert validators in the fields of mathematics and education. The validation results show:

Table 2. Content Validity Result of Pretest and Posttest Questions

Validation Aspect	Average Validation Score	Category
Suitability of Content	0.85	Very Valid
Presentation	0.83	Very Valid
Language	0.78	Valid

The results in the Table 2, the instrument is declared valid for use in research. Furthermore, the pretest and posttest questions were tested in class VIII for the purpose of the feasibility test, which includes validity testing, reliability testing, difficulty level analysis, and calculation of discriminatory power. The results of the analysis obtained are as follows:

Table 3. Results of Validity, Reliability, Difficulty Level, and Distinguishing Power Tests

Test Type	Range Value	Description
Validity Test (R Count)	0.59 – 0.85	All questions are valid because Rcount > Rtable (0.2586)
Reliability Test (*Cronbach's Alpha*)	0.852	High, indicating good instrument consistency
Difficulty Level Test	0.36 – 0.59	Medium category, suitable for measuring student abilities
Distinguishing Power Test	0.22 – 0.31	Questions are able to differentiate students with high to low abilities

Hypothesis testing in this study used One Way ANOVA because it aims to determine whether there are significant differences in students' mathematical concept understanding abilities between three groups that received different treatments, namely classes guided by the Video Based Learning (VBL) method, Game Based Learning (GBL), and traditional/conventional learning methods. One Way ANOVA was chosen because the independent variable is a learning method consisting of three categories, while the dependent variable is a mathematical concept understanding score that is quantitative, so this test is appropriate for comparing the average of more than two groups at once. Before conducting ANOVA, a normality test was carried out using Kologorov-Smirnov and Shapiro-Wilk to ensure that the data was normally distributed in each group, as well as a homogeneity test of variance with Levene to ensure that the variance between groups was uniform. The assumption of data independence was also considered so that the test results were valid.

The proposed hypothesis states: H0 = there is no significant difference in the ability to understand mathematical concepts between the three groups, and H1 = there is a significant difference between the groups. The criteria for accepting the hypothesis are determined using a significance value (p-value) of 0.05; if the p-value is greater than 0.05 then H0 is accepted and it is concluded that there is no significant difference, whereas if the p-value is less than or equal to 0.05 then H0 is rejected and it is concluded that there is a significant difference in the ability to understand mathematical concepts between groups.

Data relating to students' ability to understand mathematical concepts is obtained through a scoring mechanism that refers to the assessment rubric for each answer to each question item. The technique for calculating the final score of the concept understanding ability test is:

$$NA = \frac{Acquisition\ Score}{Maximum\ Score} \times 100$$

Information:

NA = Final Score

After obtaining data from student scores, categorization or grouping will be carried out based on the range of scores. The guidelines for categorizing mathematical concept understanding abilities are as follows.

Table 4. Conceptual Understanding Ability Level Category

Score	Criteria
86 – 100	Very High
71 – 85	High
56 – 70	Enough
41 – 55	Low
0 – 40	Very Low

(Melinia & Mulyono, 2022)

RESULT AND DISCUSSION

This research aims to compare the effectiveness of three teaching methods in improving students' mathematical concept understanding, namely Video Based Learning (VBL), Game Based Learning (GBL), and traditional learning. The test was conducted using One Way ANOVA statistical analysis on the posttest scores obtained from three groups of students, each of whom used a different learning method. Before the learning process was carried out, an initial test was given to the three classes. From the results of the initial test of the concept understanding ability of MTs Mansyaul Ulum Pati students in the experimental class and control class, descriptive statistics were obtained as in the following table.

Table 5. Descriptive Statistics of Pretest Scores of Experimental Class and Control Class

Class		N	Mean	Std. Deviation	Variance	Category
Experiment	VBL	25	37.45	10.88	118.457	Very Low
	GBL	25	36.65	11.04	121.950	Very Low
Control		26	37.34	10.76	115.749	Very Low

Based on Table 5, it can be seen that the average achievement of the initial test results of the experimental class using the VBL method was 37.45 in the very low category, using the GBL method was 36.65 in the very low category, and the control class was 37.34 in the very low category. Furthermore, treatment was given in the form of implementing learning in the three classes, namely two experimental classes using the Video Based Learning and Game Based Learning methods, while the control class used conventional learning methods. After that, a final test was given to the three classes. Based on the results of the final test of

students' mathematical concept understanding abilities, descriptive statistics were obtained as in the following table.

Table 6. Descriptive Statistics of Posttest Scores of Experimental Class and Control Class

Class		N	Mean	Std. Deviation	Variance	Category
Experiment	VBL	25	81.30	5.44	29.620	High
	GBL	25	81.23	5.21	27.196	High
Control		26	74.19	4.76	22.749	High

Based on Table 6, it can be seen that the average achievement of the final test results of the experimental class using the VBL method was 81.30 in the high category, using the GBL method was 81.23 in the high category, and the control class was 74.19 in the high category. Although the average value in the experimental class was slightly higher, the results of the statistical test showed that the difference was not significant. Thus, it can be concluded that traditional learning has the same effectiveness as the VBL and GBL methods in improving students' conceptual understanding abilities.

After conducting descriptive statistical analysis on the pretest and posttest scores in the experimental and control groups, it was seen that the three classes experienced relatively the same increase in scores descriptively. This means that although on average all classes experienced an increase, the difference in increase between the experimental and control classes was not large enough to be said to be statistically different. This explanation can be understood because statistical tests do not only consider the average increase, but also the variability of the data and the number of samples. Therefore, although the average posttest score of the experimental class was slightly higher, the difference was not statistically significant enough to state that the VBL or GBL method was more effective than traditional/conventional learning. Then, the next stage is to test the classical assumptions which include the normality test and the homogeneity test. After both tests are met, a hypothesis test is conducted to determine the significance of the difference in the scores of the experimental class and the control class, as well as to determine the effect of the actions given. Thus, this series of tests is important to ensure the validity and reliability of the research results before drawing conclusions regarding the effectiveness of the treatment in the experimental class compared to the control class.

Normality Test

The normality test is conducted to determine whether the data obtained is normally distributed or not. Based on the normality test using Kologorov-Smirnov and Shapiro-Wilk, the following results were obtained.

Table 7. Normality Test Results

Class			df	*Kologorov-Smirnov* Sig.	*Shapiro-Wilk* Sig.
Experiment	GBL	Pretest	25	0.200	0.212
		Posttest		0.186	0.074
	VBL	Pretest	25	0.200	0.363
		Posttest		0.200	0.324
Control		Pretest	26	0.200	0.259
		Posttest		0.200	0.373

Based on the table, the results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests were obtained, all data in each group, both experimental and control and pretest and posttest have a significance value (Sig.) of more than 0.05. Thus, all data are normally distributed.

Homogeneity Test

The homogeneity test aims to determine whether the three classes in the study are homogeneous or not. Based on the results of the homogeneity test using the Levene Test, the following results were obtained.

Test of Homogeneity of Variances

results of the ability to understand concepts

	Levene Statistic	df1	df2	Sig.
Based on Mean	,379	2	73	,686
Based on Median	,328	2	73	,721
Based on Median and with adjusted df	,328	2	72,058	,721
Based on trimmed mean	,380	2	73	,685

Figure 2. Output of Homogeneity Test Results using SPSS

From the calculation in the image above, it is known that the Sig. value on the Based on Mean (BoM) final test in the experimental group and the control group obtained 0.686 > 0.05, so that the posttest data in both classes are homogeneous or the same.

Hypothesis Testing

In this study, hypothesis testing was conducted based on the final test results of the experimental class and control class. Hypothesis testing used the One Way ANOVA Test. The research hypothesis states: (1) H0 = μ_VBL = μ_GBL = μ_Conventional, and (2) H1 = μ_VBL ≠ μ_GBL ≠ μ_Conventional, then the following results are obtained.

ANOVA

results of the ability to understand concepts

	Squares	df	Mean Square	F	Sig.
Between Groups	856,746	2	428,373	16,183	,000
Within Groups	1932,292	73	26,470		
Total	2789,039	75			

Figure 3. Output of One Way ANOVA Test Results using SPSS

The results of the hypothesis test from the image above show the acquisition of an F value of 16.183> Ftable of 3.12 and a Sig. p value = 0.000 less than 0.05. This indicates that there is a statistically significant difference in the average posttest value between the three learning groups.

Meanwhile, to find out which group has a significant difference, the Tukey HSD Post Hoc test was run. The test results are as follows.

Post Hoc Tests

Multiple Comparisons

Dependent Variable: results of the ability to understand concepts
Tukey HSD

(I) Kelas	(J) Kelas	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Posttest Eksperimen (GBL)	Posttest Eksperimen (VBL)	-,07273	1,45519	,999	-3,5542	3,4087
	Posttest Kontrol	7,04056*	1,44113	,000	3,5927	10,4884
Posttest Eksperimen (VBL)	Posttest Eksperimen (GBL)	,07273	1,45519	,999	-3,4087	3,5542
	Posttest Kontrol	7,11329*	1,44113	,000	3,6655	10,5611
Posttest Kontrol	Posttest Eksperimen (GBL)	-7,04056*	1,44113	,000	-10,4884	-3,5927
	Posttest Eksperimen (VBL)	-7,11329*	1,44113	,000	-10,5611	-3,6655

*. The mean difference is significant at the 0.05 level.

Figure 4. Output of Post Hoc Test Results using SPSS

The test of the image above found no significant divergence in the conceptual understanding ability of students who studied with GBL or VBL (p > 0.05). This finding shows that both are equally effective in improving students' understanding of mathematical concepts, so that both GBL and VBL are able to provide a balanced contribution in helping students understand the material in depth.

However, based on the previous descriptive statistical data, it can be seen that before the treatment, the average initial ability of students in the three groups (GBL, VBL, and control) was in the very low category and relatively equal. After the treatment, all three groups increased to the high category, but the average increase in the experimental group (GBL and VBL) was slightly higher than the control group. Although descriptively this increase appears similar, the results of the inferential statistical test (hypothesis test) revealed a significant difference between the experimental group (both using GBL and VBL) and the control group using traditional/conventional learning methods (p <0.05). This confirms that the increase in the experimental group is statistically stronger, because the statistical test considers data variability and sample size, not just the average value. Specifically, the average ability to understand mathematical concepts in students who took part in learning with the GBL and VBL methods was significantly higher than students in the control group.

The implementation of innovative learning methods such as GBL and VBL has a real positive impact on improving students' conceptual understanding. GBL facilitates learning through interactive and fun educational games, increasing motivation, active involvement, and providing direct feedback that strengthens conceptual understanding. Meanwhile, VBL uses video media as a visual and audio aid that helps students understand abstract concepts more concretely and systematically. Both methods are able to overcome the limitations of traditional learning methods that tend to be passive, so that they can significantly increase the effectiveness of mathematics learning. Thus, both GBL and VBL can be adopted in a balanced manner in the learning process to maximize students' understanding of mathematical concepts.

This finding is in line with various previous studies, namely according to Krath et al. (2021), the application of gamification in the context of learning can increase intrinsic motivation and student involvement through the mechanism of challenges, rewards, and social interactions that are fun. This mechanism has been empirically proven to have a positive impact on students' understanding of concepts and academic achievement. In line with this, Pahmi et al., (2023), suggests that the use of video in learning with dynamic visualization facilitates the understanding of abstract mathematical concepts by providing concrete and intuitive representations of the relationships between concepts, thereby increasing the effectiveness of the internalization process of the material by students.

In the context of mathematics learning which is often considered abstract and challenging, the use of visual media and interactive games greatly helps students in internalizing difficult concepts. Study by Katchabaw (2019), emphasized that educational games provide an active and enjoyable learning experience, which can significantly reduce student boredom and inactivity during the learning process. This finding is reinforced by Sailer et al., (2017), which indicates that game elements in learning significantly increase student engagement, which acts as a major mediator in improving learning outcomes.

In addition, Tokac et al. (2021) dan Norazah Nordin dkk. (2023) confirmed that GBL has a significant positive impact on the cognitive domain, namely mathematical knowledge and skills, as well as affective domains such as student achievement, attitude, motivation, interest, and engagement. Gordillo et al. (2023), also reported that both GBL and VBL are equally effective in improving student knowledge. Although GBL tends to be preferred by students because it provides a more enjoyable and motivating learning experience, statistically no significant difference was found between the two in terms of improving conceptual understanding, so both can be viewed as complementary learning strategies.

Furthermore, the psychological aspects of students also improved through the implementation of these two approaches. White & McCoy (2019) stated that the integration of game elements and visualization in learning significantly increased student engagement, which then contributed to improving mathematics learning outcomes, especially in abstract materials such as statistics. The increase in self-confidence and interest in learning resulting from this method builds a learning environment that is more supportive and conducive to students' cognitive and affective development.

Practically, the results of this study provide important implications for educators. First, teachers can consider adopting GBL and VBL methods as alternative learning plans that are imaginative and relevant to the interests of today's students. Second, the development of learning resources that utilize game elements and visualization needs to be improved to enrich students' learning experiences. Third, training and mentoring for teachers are needed so that these methods can be implemented effectively and sustainably. In addition, continuous evaluation and further research are highly recommended to explore the factors that influence the effectiveness of GBL and VBL in different learning contexts. Therefore, these findings not only provide significant empirical contributions, but also open up opportunities for learning innovations that are more interesting, interactive, and have a positive impact on students' conceptual understanding.

Overall, this study strengthens the opinion that learning involving technology and innovative approaches such as GBL and VBL can improve the quality of learning, especially in encouraging better understanding of concepts. This is in line with 21st century education which demands active, creative, and adaptive learning to technological developments.

CONCLUSION

This study proves that both Video Based Learning (VBL) and Game Based Learning (GBL) methods are significantly able to improve students' understanding of mathematical concepts compared to traditional learning methods. The results of the experiment conducted on grade VII students of MTs Mansyaul Ulum Pati showed a significant increase in the value of understanding mathematical concepts after the two innovative methods were applied. Statistical analysis through One Way ANOVA confirmed that there were significant differences between groups using VBL, GBL, and conventional methods, where VBL and GBL gave better results. Thus, the application of video-based and game-based learning methods can be an effective alternative to overcome students' low understanding of mathematical concepts. Although, this study has limitations, such as the sample being

limited to one school and focusing on general understanding of mathematical concepts without distinguishing specific materials. Therefore, further research is recommended to expand the scope of the sample and explore the effectiveness of the VBL and GBL methods on various mathematical topics and other aspects of learning, such as student motivation and involvement. Thus, VBL and GBL can be used as alternative effective learning methods to improve the quality of mathematics learning. Teachers are expected to be able to integrate these two methods in the learning process in order to create a more interactive, enjoyable, and student-centered learning atmosphere, so as to improve motivation and overall mathematics learning outcomes.

REFERENCES

Agustiani, N., Lukman, H. S., & Setiani, A. (2024). Critical Thinking Ability of Junior High School Students in Game-Based Learning Using Gemas Game. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *13*(2), 485–496. https://doi.org/10.24127/ajpm.v13i2.8623

Alam, S. (2023). *Hasil PISA 2022, Refleksi Mutu Pendidikan Nasional 2023*. Media Indonesia. https://mediaindonesia.com/opini/638003/hasil-pisa-2022-refleksi-mutu-pendidikan-nasional-2023

Alifah, Z. N., & Utami, N. S. (2022). Mengembangkan Media Pembelajaran Matematika Berbasis Videoscribe Untuk Meningkatkan Hasil Belajar Siswa Kelas VIII Smp. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(4), 3399–3411. https://doi.org/10.24127/ajpm.v11i4.6151

Ardani, R. A., & Salsabila, N. H. (2021). Media Pembelajaran Berbasis Game : Dapatkah Meningkatkan Pemahaman Konsep Matematis? *Mathematics Education And Application Journal (META)*, *2*(2), 8–17. https://doi.org/10.35334/meta.v2i2.1832

Astuti, R. I., Sunarso, A., & Isdaryanti, B. (2024). Efektivitas Pembelajaran Matematika Melalui Video Interaktif Berbantuan Quizizz Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Dan Hasil Belajar Siswa Sekolah Dasar. *Pendas : Jurnal Ilmiah Pendidikan Dasar*, *09*(04), 321–336. https://doi.org/10.23969/jp.v9i04.20056

Azzahra, I. S. S., Sobari, T., & Suhara, A. M. (2022). Penerapan Metode Game Based Learning Berbantuan Gather Town Dalam Mata Kuliah Pembelajaran Keterampilan Berbahasa Memirsa. *Parole : Jurnal Pendidikan Bahasa Dan Sastra Indonesia*, *5*(6), 383–392. https://doi.org/10.22460/parole.v5i6.10744

Darwani, Hafriani, & Angkat, Y. (2023). Kemampuan Pemahaman Konsep Matematis Siswa Melalui Model Pembelajaran Flipped Classroom Di SMP/MTS. *Educator Development Journal*, *1*(1), 51–59. https://journal.ar-raniry.ac.id/index.php/edj/article/view/2162/1113

Dewi, L. P. A. F., & Abadi, I. B. G. S. (2022). Contextual Teaching and Learning Berbasis Tri Hita Karana Dijadikan sebagai Model Pembelajaran IPAS di SD. *Jurnal Pendidikan Multikultural Indonesia*, *5*(2), 80–92. https://doi.org/10.23887/jpmu.v5i2.55993

Faraby, M. C. Al, T., J. M. F., & Hakim, R. M. A. P. W. (2021). Inovasi Video Based Learning Dalam Meningkatkan Interaksi Pada Proses Belajar Mengajar. *Kumpulan Karya Tulis Ilmiah Tingkat Nasional*, 43–55. https://journal.ittelkom-sby.ac.id/lkti/article/download/116/86/525

Fitria, D. A., & Nurafni. (2021). Audio Visual Learning Media Based on Microsoft Powerpoint With Materials for Summary and Reduction of Class III Mathematics Courses. *Jurnal Pedagogi Dan Pembelajaran*, *4*(2), 274–280. https://doi.org/10.23887/jp2.v4i2.37019

Giriansyah, F. E., Pujiastuti, H., & Ihsanudin, I. (2023). Kemampuan Pemahaman Matematis Siswa Berdasarkan Teori Skemp Ditinjau dari Gaya Belajar. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *7*(1), 751–765. https://doi.org/10.31004/cendekia.v7i1.1515

Gordillo, A., López-Fernández, D., Tovar, E., & Mayor, J. (2023). A Comparison of the Usefulness of Game-Based Learning and Video-Based Learning for Teaching Software Engineering in Online Environments. *Proceedings - Frontiers in Education Conference, FIE*. https://doi.org/10.1109/FIE58773.2023.10343449

Gusmania, Y., & Wulandari, T. (2018). Efektivitas penggunaan media pembelajaran berbasis video terhadap pemahaman konsep matematis siswa. *Pythagoras*, *7*(1), 61–67. https://doi.org/10.33373/PYTHAGORAS.V7I1.1196

Hermawan, W. (2024). Sosialisasi Pemanfaatan Game Base Learning (GBL) Dalam Pembelajaran Di SMP N 2 Ngronggot. *Communnity Development Journal*, *5*(1), 1263–1269.

Hui, H. B., & Mahmud, M. S. (2023). Influence of game-based learning in mathematics education on the students' cognitive and affective domain: A systematic review. *Frontiers in Psychology*, 1–15. https://doi.org/10.3389/fpsyg.2023.1105806

İlhan, A. (2021). The Impact of Game-Based, Modeling, and Collaborative Learning Methods on the Achievements, Motivations, and Visual Mathematical Literacy Perceptions. *SAGE Open*, *11*(1), 1–7. https://doi.org/10.1177/21582440211003567

Katchabaw, M. J. (2019). A Meta-Analysis of Use of Serious Games in Education over a Decade. *International Journal of Computer Games Technology*, *1*. https://doi.org/10.1155/2019/4797032

Khoirunnisya, M., Anwar, L., & Kusumasari, V. (2024). The Use of Game-Based Learning Media to Support Students' Cognitive Abilities in Mathematics. *Mathline : Jurnal Matematika Dan Pendidikan Matematika*, *9*(2), 559–574. https://doi.org/10.31943/mathline.v9i2.654

Krath, J., Schürmann, L., & Korflesch, H. F. O. von. (2021). Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning. *Computers in Human Behavior*, *125*, 106963. https://doi.org/10.1016/j.chb.2021.106963

Manandhar, N. K., Pant, B. P., & Dawadi, S. D. (2022). Conceptual and Procedural Knowledge of Students of Nepal in Algebra: A Mixed Method Study. *Contemporary Mathematics and Science Education*, *3*(1), ep22005. https://doi.org/10.30935/conmaths/11723

Melinia, T., & Mulyono, B. (2022). Kemampuan Pemahaman Konsep Matematis Peserta Didik Kelas Ix Terhadap Materi Persamaan Kuadrat Menggunakan Model Pembelajaran Berbasis Masalah. *Teorema: Teori Dan Riset Matematika*, *7*(1), 1–12. https://doi.org/10.25157/teorema.v7i1.6642

Murdikah, A., Sudaryana, T., Hardiana, L., & Nurfitriyah, A. (2021). Tinjauan Penerapan Teori Skemp terhadap Pemahaman Fungsi Invers Pada Guru Matematika. *TIRTAMATH: Jurnal Penelitian Dan Pengajaran Matematika*, *3*(2), 125–135. https://doi.org/10.48181/tirtamath.v3i2.11172

Murtiyasa, B., & Sari, N. K. P. M. (2022). Analisis Kemampuan Pemahaman Konsep Pada Materi Bilangan Berdasarkan Taksonomi Bloom. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(3), 2059–2070. https://doi.org/10.24127/ajpm.v11i3.5737

Nur, F., Febrianti, F., Novitasari, W., Rahman, N. R., & Nabila. (2024). Pengembangan Media Video Pembelajaran Interaktif untuk Meningkatkan Kemampuan Pemahaman Konsep Matematis Siswa. *Jurnal BELAINDIKA (Pembelajaran Dan Inovasi Pendidikan)*, *6*(2), 95–106. https://doi.org/10.52005/belaindika.v6i2.185

Nurajijah, M., Khaerunnisa, E., & Hadi FS, C. A. (2023). Kemampuan Pemahaman Konsep Matematis Siswa Berdasarkan Teori Apos Pada Materi Program Linear. *Jurnal Educatio*, *9*(2), 785–797. https://doi.org/10.31949/educatio.v9i2.4800

OECD. (2023). PISA 2022 Results Factsheets Indonesia. *OECD (Organisation for Economic Co-Operation and Development) Publication*, 1–9. https://www.oecd.org/en/publications/pisa-2022-results-volume-i-and-ii-country-notes_ed6fbcc5-en/indonesia_c2e1ae0e-en.html

Pahmi, S., Hendriyanto, A., Sahara, S., Muhaimin, L. H., Kuncoro, K. S., & Usodo, B. (2023). Assessing the Influence of Augmented Reality in Mathematics Education: A Systematic Literature Review. *International Journal of Learning, Teaching and Educational Research*, *22*(5), 1–25. https://doi.org/10.26803/ijlter.22.5.1

Radiusman. (2020). Studi Literasi: Pemahaman Konsep Anak Pada Pembelajaran Matematika. *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika*, *6*(1), 1–8. https://doi.org/10.24853/fbc.6.1.1-8

Ramadina, I., & Nindiasari, H. (2025). Pengaruh Model Pembelajaran Game Based Learning Berbantuan Quizizz terhadap Kemampuan Pemecahan Masalah Matematis Siswa SMK. *Journal on Education*, *07*(02), 9316–9325.

Sailer, M., Hense, J., Mandl, H., & Klevers, M. (2017). Psychological perspectives on motivation through gamification. *Interaction Design and Architecture(s) Journal*, *33*, 28–37. https://doi.org/10.55612/s-2017-3303

Sari, R. N. K., & Ahmad, H. A. (2022). Game-Based Learning: Media Edutainment Matematika Untuk Pembelajaran Mandiri Bagi Siswa Sekolah Dasar. *Prosiding Seminar Nasional Manajemen, Desain & Aplikasi Bisnis Teknologi*, *5*, 99–106.

Sari Rambe, A., Mira Bella Saragih, R., & Hidayah Putri, J. (2024). Upaya Meningkatkan Kemampuan Pemahaman Konsep Matematis Siswa dengan Menggunakan Model Discovery Learning. *Journal on Education*, *06*(02), 12438–12448.

Sembiring, E. H. B., & Listiani, T. (2023). Game Based Learning Berbantuan Kahoot! dalam Mendorong Keaktifan Siswa pada Pembelajaran Matematika. *GAUSS: Jurnal Pendidikan Matematika*, *6*(1), 26–40. https://doi.org/10.30656/gauss.v6i1.5708

Sinaga, A., Lydia, C., Simanjuntak, J. R., Panjaitan, M., Siregar, N., Ikhwani, M., & Tamba, R. A. (2025). Pengaruh Model Pembelajaran Ekspositori Terhadap Pembelajaran Matematika di SMP Negeri 12 Medan. *IJEDR: Indonesian Journal of Education and Development Research*, *3*(1), 219–225.

UPI, H. (2022). *Universitas Pendidikan Indonesia berperan Aktif dalam Studi Utama OECD PISA Tahun 2022*. Portal Berita Universitas Pendidikan Indonesia. https://berita.upi.edu/universitas-pendidikan-indonesia-berperan-aktif-dalam-studi-utama-oecd-pisa-tahun-2022/

White, K., & McCoy, L. P. (2019). Effects of Game-Based Learning on Attitude and Achievement in Elementary Mathematics. *Networks: An Online Journal for Teacher Research*, *21*(1), 1–19. https://doi.org/10.4148/2470-6353.1259

Yulianto, A., Sisworo, & Hidayanto, E. (2022). Pembelajaran Matematika Berbantuan Video Pembelajaran untuk Meningkatkan Motivasi dan Hasil Belajar Peserta Didik. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(3), 403–414. https://doi.org/10.31980/mosharafa.v11i3.731

Yustina, A. F., & Yahfizham. (2023). Game Based Learning Matematika dengan Metode Squid game dan Among us. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *7*(1), 615–630. https://doi.org/10.31004/cendekia.v7i1.1946

Zubaedah, N., & Efendy, R. (2023). Penerapan Pembelajaran Video Based Learning di Madrasah Aliyah Negeri 2 Kota Parepare. *Dialektika : Jurnal Pendidikan Agama Islam*, *2*(2), 1–8. https://doi.org/10.35905/dialektika.v2i2.7495