JURNAL PENDIDIKAN MATEMATIKA (JPM)
Vol. 11, No. 2, 2025, pp 59–70 e-ISSN: 2656–4564
https://doi.org/10.33474/jpm.v12i1.25062
online at: https://riset.unisma.ac.id/index.php/jpm/article/view/25062

APPLICATION OF THE AUDITORY KINESTHETIC VISUALIZATION (VAK) MODEL TOWARDS THE ABILITY TO MATHEMATICAL CONCEPTUAL UNDERSTANDING

Putri Amalia Harahap[1*], Rivdya Eliza[2], Fitria Mardika[3], Abderrahim El-Amrani[4], Elsi Fitria[5]
[1, 2, 3]Universitas Islam Negeri Imam Bonjol Padang, Indonesia
[4]National Institute of Statistics and Applied Economics, Morocco
[5]Riau University, Indonesia
Email: [1]putriamalia1204@gmail.com, [2]rivdyaeliza@uinib.ac.id, [3]fitriamardika@uinib.ac.id, [4]aelamrani@insea.ac.ma, [5]elsi.fitria@lecturer.unri.ac.id

ABSTRACT
This research is motivated by the low level of comprehension of mathematical concepts among seventh-grade students at SMPN 1 2×11 Enam Lingkung. One cause is that the learning model used has not improved students' conceptual understanding. The effort was to apply the Visual-Auditory-Kinesthetic (VAK) learning model. The objectives of this study are: To determine the significant difference in the average mathematical concept comprehension abilities of students between before and after the implementation of the VAK model, To determine the increase in mathematical concept comprehension abilities of students taught with the VAK model compared to students taught using the expository model, To analyze significant differences in mathematical concept comprehension abilities between classes using the VAK model and classes using the expository model. The study showed that the paired-sample t-test for the experimental class yielded a Sig. value of 0.000 < 0.05, so there was a significant increase in mathematical concept understanding between before and after the implementation of the VAK model, The average N-gain score of the experimental class (VAK model) was 0.7145 (High category), higher than the control class (expository model) of 0.5556 (Medium category), which indicates that the VAK model is more effective in improving mathematical concept understanding, The results of the independent t-test t-count > t-table (2.031 > 1.670), which means there is a significant difference in the ability to understand mathematical concepts between students taught with the VAK model compared to the expository model. Thus, the application of the VAK learning model has a positive and significant influence on students' ability to understand mathematical concepts at SMPN 1 2×11 Enam Lingkung.

Keywords: VAK Model, Mathematical Concept Understanding, Mathematics learning, Social arithmetic

*** Corresponding Author Email:** putriamalia1204@gmail.com

Submission	Revised	Accepted	Published
February 18, 2026	April 8, 2026	April 22, 2026	May 3, 2026

How to cite (in APA style):
Harahap, P. A., Eliza, R., Mardika, F., Amrani, A. E., & Fitria, E. (2026). Application of the auditory kinesthetic visualization (VAK) model towards the ability to mathematical conceptual understanding. *Jurnal Pendidikan Matematika (JPM)*, *12*(1), 59–70. https://doi.org/10.33474/jpm.v12i1.25062

INTRODUCTION

Mathematics is a discipline that plays a central role in the development of science and technology. One of the primary goals of mathematics learning in secondary schools is to enable students to develop conceptual understanding. Mathematical conceptual understanding is a crucial foundation because mathematics is not simply a collection of memorized formulas, but rather a series of logically interrelated ideas. According to Lestari & Yudhanegara (2017), conceptual understanding is the ability to deeply absorb mathematical ideas, enabling students to present them in various forms.

However, the reality on the ground shows that students' conceptual understanding is still relatively low. Based on initial observations at SMPN 1 2 x11 Enam Lingkung, many seventh-grade students have difficulty redefining mathematical terms or classifying objects according to the concepts they are learning, particularly in Social Arithmetic. Students tend to focus on calculation procedures without understanding the meaning behind the symbols.

This lack of understanding is often triggered by the use of a one-way or expository learning model. In the conventional model, the teacher is the center of information (teacher-centered), so students with different learning styles (visual, auditory, or motor) are not properly accommodated. This results in low student interest and retention in the subject matter.

To address these issues, a learning model is needed that can engage all students' senses in the concept-construction process. The Visual, Auditory, Kinesthetic (VAK) learning model offers a multisensory approach. This model emphasizes that learning will be more effective if students see (visual), hear (auditory), and carry out their learning activities themselves (kinesthetic). As stated by (Shoimin, 2014) The VAK model can optimize brain potential by simultaneously stimulating sight, hearing, and movement.

Previous studies, such as those conducted by Salsabila et al., (2023) and Kristanti et al., (2023) , have shown that the VAK model significantly improves conceptual understanding. By implementing this model at SMPN 1 2×11 Enam Lingkung, it is hoped that students will not only be able to answer questions but will also fully master mathematical concepts and apply them to their daily lives.

Auditory learning models Kinesthetic Learning (KLE) is a learning model that optimizes these three learning modalities to make learning more comfortable. KLE represents three modalities possessed by every human being. These three modalities are known as learning styles. Learning style is a combination of how a person absorbs, then accepts, and processes information (Deporter, 1999) .

According to Deporter et al., in VAK learning, learning focuses on direct experience and study, and is enjoyable. Learning experience in a way that is direct with method: Study with seeing (visualization), learning by hearing (auditory), and learning by movement and emotion (kinesthetic). De Porter mentions activities that can be implemented in learning to accommodate students' respective learning styles, namely visual, auditory, and kinesthetic.

Understanding is the ability to describe a situation or problem as it is occurring. According to Novitasari, understanding is the ability to grasp the meaning of a concept. Understanding can also be defined as the ability to express a definition in one's own words. Students are said to understand if they can explain what they are learning using their own words, distinct from those found in textbooks (Eliza, R., & Susilawati, 2019).

Indicators understanding draft according to Sumarmo (2014) namely, Declaring a repeated concept; Classifying objects according to certain properties; Providing examples and non-examples of the concept; Presenting a draft in various mathematical representations; Developing conditions, needs, or conditions; Using, utilizing, and selecting procedures or operations; Applying a draft or algorithm to solve a problem.

Conceptual Understanding Ability: One of the goals of learning mathematics is the ability to understand mathematical concepts well. The materials in mathematics subjects are highly interrelated. To learn the material, students must understand the prerequisite material. Therefore, in learning mathematics, students do not just memorize; they study it. According to the Big Indonesian Dictionary, the term "understand" refers to the state of understanding correctly, while "comprehension" is defined as the process or effort to understand and to help others understand something. Understanding can also be defined as a person's ability to explain or interpret a problem or situation (Amin, MF, Susanto, A., & Mardika, 2019) .

METHOD

This type of research is a quasi-experiment with a Pretest-Posttest Control Group Design. Random sampling technique. The study population includes all seventh-grade students at SMPN 1 2×11 Enam Lingkung in the 2025/2026 academic year, comprising 8 classes and 234 students, with a sample of class VII. A as the experimental class (VAK model) and class VII.B as the control class (expository model). The research instrument used was a concept mathematical comprehension ability test consisting of 7 essay questions. Data analysis techniques used include calculating the N-Gain score to assess improvement, as well as hypothesis testing using a paired-samples t-test to assess the difference in the average treatment effect in the experimental class and an independent-samples t-test to compare the difference in improvement between the two classes. Before the hypothesis test was conducted, the prerequisite analyses were performed, including the normality test and the homogeneity test.

RESULT

Pretest-Posttest Results of Experimental Class

The pretest in the experimental class aimed to assess students' initial abilities and was administered before the learning process began. The posttest aimed to determine students' final abilities and was conducted after process learning, that is, after applying the Visualization, Auditory, Kinesthetic (VAK) Learning Model. A pretest-posttest was done on the experimental class, namely class VII A. The results of the calculation pretest-posttest can be seen in Table 1 below:

Table 1. Description Data Pretest-Posttest Ability Mathematical Understanding of Experimental Class Students

No	Statistics	Pretest	Posttest
1	N	31	31
2	Mark Max	6 4.28	100
3	Mark Min	28.57	5 7.14
4	$\sum x$	1 657.06	2,599.92
5	$\bar{x}$	53.45	8 3.87
6	S	17.60	1 2.50
7	S^2	309.97	1 56.37

Based on Table 1, the average initial test (pretest) for students in the class experiment is lower than the average final test (posttest). Matter means that the students' scores on the posttest were higher than the students' scores on the pretest. Seen from range (range), posttest own range Which more smaller than pretest. Big small range can used For looking at the diversity of a distribution. The larger the range, the less varied, less diverse and homogeneous the distribution. Conversely, the smaller the range, the more so its distribution the more diverse, varies and heterogeneous (Rahardja et al, 2023).

Based on table can concluded that posttest own mark Which less diverse than the pretest. The pretest has more diverse values, which causes mark variance pretest more tall than posttest. The more large variance so, the more big also distribution data around average (Nuraini Fatmi, Dessy Siska, 2021) . Matter This means pretest own data Which more spread than the posttest. Judging from the standard deviation, the standard deviation is the same as the mean. The larger the standard deviation, the more heterogeneous the data diversity. (Roflin, E., & Liberty, 2021) . Based on table in on, It can be seen that the posttest has a smaller standard deviation than the pretest. This means that the diversity of data in the pretest is more heterogeneous than the posttest. Or it can be interpreted that the diversity of data in the posttest is more homogeneous than the pretest.

Pretest-Posttest Results of Control Class

The pretest conducted in the control class aimed to determine students' initial abilities and was conducted before the learning process began. The posttest aimed to determine students' final abilities and was conducted after the learning process, namely after implementing the expository learning model. The pretest and posttest were conducted in the control class, class VII B. Conclusion results calculation pretest-posttest the can seen on table 1.2 is noisy :

Table 2. Description Data Pretest-Posttest Ability Mathematical Communication of Control Class Students

No	Statistics	Pretest	Posttest
1	N	32	32
2	Mark Max	75	100
3	Mark Min	32.14	50
4	$\sum x$	1703.47	2460.65
5	$\bar{x}$	53.23	76.89
6	S	11.94	14.63
7	S^2	142.68	213.94

Based on Table 2, it can be seen that the average test The initial (pretest) average of students in the control class was lower than the final test (posttest) average. This means that mark student on posttest more tall compared to mark student on pretest. Judging from the range, the posttest has a smaller range. than the pretest. The size of the range can be used to see the diversity of a distribution. The larger the range, the less varied, less diverse and homogeneous the distribution. Conversely, the smaller the range, the distribution the more diverse, varies And heterogeneous (Rahardja et al, 2023).

Based on the table, it can be concluded that the posttest has less diverse values than the pretest. The pretest has more diverse values, resulting in a higher variance in the pretest than the posttest. The greater the variance, the greater the spread of the data around the mean. (Akbar et al., 2023) . This means that the pretest data is more spread out than the posttest. Judging from the standard deviation, the standard deviation is the same as the mean. The larger the standard deviation, the more heterogeneous the data. (Roflin, E., & Liberty, 2021) . Based on table in on, It can be seen that the posttest has a smaller standard deviation than the pretest. This means that the diversity of data in the pretest is more heterogeneous than the posttest. Or it can be interpreted that the diversity of data in the posttest is more homogeneous than the pretest.

From the results of understanding ability Students' mathematical concepts were obtained from the pretest and posttest. This mathematical concept comprehension test consisted of 7 questions with 7 indicators of mathematical communication skills. The average students' mathematical concept comprehension ability in the pretest and posttest can be seen in Table 4.5 below:

Table 3. Average Indicator Ability Conceptual Understanding Mathematical Experimental Class And Control Class

No	Indicator conceptual understanding ability mathematical	Mark Average Experiment Pretest	Posttest	Control Pretest	Posttest
1	State repeat a concept	71.77	95.16	71.87	94.53
2	Classifying objects according to certain properties (according to the concept)	62.90	94.35	63.28	88.28
3	Give example And No example from draft	51.61	87.90	50	84.37
4	Serve draft in various forms representation mathematical	48.38	83.06	50	76.56
5	Developing necessary or sufficient conditions of a concept.	49.19	79.03	46.82	73.43
6	Using, utilizing, and choose procedure or certain operations.	43.54	75.80	44.53	64.06
7	Applying draft or problem-solving algorithm	41.93	67.74	42.18	57.03
	Average	52.76	83.29	52.67	76.89

Table 3, is a comparison of the ability to understand mathematical concepts in the pretest and posttest reviewed from the average of seven indicators of mathematical concept understanding abilities. Based on Table 3, it can be seen that the average of each indicator of mathematical concept understanding for the pretest-posttest of the experimental class is higher than the pretest-posttest of the control class.

the pretest and posttest data results the mathematical communication skills of students in the sample class were analyzed statistically. Before hypothesis testing is first carried out by the N-gain test. This N-gain test aims to For see size improvement ability conceptual understanding mathematical remainder on class experiment And class control. After done test N-gain Next, normality tests and homogeneity tests were carried out on the samples.

N-gain test

a. Experimental Class

One of the N-gains of students in the experimental class is as follows:

$$\mathbf{N-Gain=\frac{S_{Posttets}-S_{Pretest}}{S_{maksimal}-S_{Pretest}}}$$

$$\mathbf{=\frac{57,14-28,57}{100-28,57}}$$

$$= \frac{\mathbf{28,57}}{\mathbf{67,86}}$$

$$= \mathbf{0,40}$$

This resulted in an N-gain of 0.40, which is included in the moderate category. The N-gain score obtained by each student is presented in Table 4 below:

Table 4. Results of Students' N-Gain Score Test

Respondents	Pretest	Posttest	N-gain
Amount	1657.06	2599.92	
Average	53.45	83.87	0.7145
The highest score	89.29	100	
Lowest Value	28.57	57.14	

The average N-Gain is 0.7145 or is in the range of 0.70 ≤ g ≤ 100 so it is concluded that the N-Gain value is in the high category.

b. Dick Class
   One of the N-gains of students in the control class is as follows:

$$\mathbf{N - Gain} = \frac{\mathbf{S_{Posttets} - S_{Pretest}}}{\mathbf{S_{maksimal} - S_{Pretest}}}$$

$$= \frac{\mathbf{50 - 39,28}}{\mathbf{100 - 32,14}}$$

$$= \frac{\mathbf{10,72}}{\mathbf{60,72}}$$

$$= \mathbf{0,18}$$

This resulted in an N-gain of 0.18, which is in the low category. The N-gain score obtained by each student is presented in Table 5 below:

Table 5. Results of Students' N-Gain Score Test

Respondents	Pretest	Posttest	N-gain
Amount	1703.47	2460.65	
Average	53.23	76.89	0.5556
The highest score	75	100	
Lowest Value	32.14	50	

The average N-Gain is 0.55 or is in the range of 0.3 ≤ g ≤ 0.7 so it is concluded that the N-Gain value is in the medium category.

Based on Table 4 and Table 5, it shows that the average value of the N-gain score for experimental class (Visualization, Auditory, Kinesthetic (VAK) Learning Model with Differentiated Learning) is 0.7 145 is included in the high category. With a minimum value of 40 and a maximum of 100. Meanwhile, the average N-gain score for the control class (expository learning model) is 0.5 565 included in the category moderate. With a minimum score of 18 and a maximum of 100. It can be concluded that the VAK model is more effective in improving understanding of mathematical concepts than the expository model.

Improvement Hypothesis Test

Normality Test

After done test N-gain furthermore done test normality, Which The aim is to see whether the two samples are normally distributed or **not**. The normality test of students' mathematical communication abilities can be carried out using the Liliefors test. The results Liliefors test can be seen in Table 6 below:

Table 6. Comparison L_0 and L_{table} N-Gain Capability conceptual understanding Mathematical

No	Class	L_0	L_{table}	Conclusion	Information
1	Experiment	0.1388	0.1591	$L_0 < L_{table}$	Normal Data
2	Control	0.1023	0.1566	$L_0 < L_{table}$	Normal Data

Based on Table 6, it is explained that the L0 value in both sample classes is smaller than the L_{table}, meaning that both sample classes of students are normally distributed. To prove whether the data is normally distributed or not, a normality test can also be carried out using SPSS. The results are presented in Table 7 below:

Table 7. Tests of Normality N-Gain Ability Understanding Mathematical Concepts

Tests of Normality

		Kolmogorov-Smirnov [a]			Shapiro-Wilk		
	Class	**Statistics**	**df**	**Sig.**	**Statistics**	**df**	**Sig.**
N_Gain_Score	Experiment	0.102	31	0.200 *	0.955	31	0.209
	Control	0.114	32	0.200 *	0.963	32	0.333

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on table 7 Overall class sample have level significant > 0.05. Matter This means both classes sample distribution normal.

Hypothesis Testing Influence (Paired Sample Test)

Based on the N-gain test, normality test, and homogeneity test samples that have been done previously, it was seen that second class sample own average increase, and normally distributed as well own homogeneous variance. So that for determine whether hypothesis accepted or rejected, then Paired Sample T-test was used for class experiment.

Based on calculation obtained $t_{hitung} = 24{,}328 > t_{0{,}05;31} = 2{,}039$concluded for reject H_0= There is no significant difference in the average ability of students to understand mathematical concepts between before and after the application of the Visualization, Auditory, Kinesthetic (VAK) model, which means that it is rejected and H_1 accepted H_1 : There are there are difference in average ability understanding draft mathematical participant significant education between before and after Application of the Visualization, Auditory, Kinesthetic (VAK) model In addition to the t-test above, the SPSS program was also used, resulting in the output shown in Table 8 below:

Table 8. Paired Sample Test Output Use SPSS

Paired Samples Test

	Paired Differences							
	Mean	Standard Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
				Lower	Upper			

Pair 1	Pretest_Experiment - Posttest_Expriment	30,41161	6.95111	1.24846	32.96130	27,86193	24,359	30	0,000

Based on Table 8, it can be seen that it has a significance level of 0.00 < 0.05, meaning that there is a significant difference in the average ability to understand mathematical concepts between students before and after. application of Visualization, Auditory, Kinesthetic learning models (VAK) class VII SMPN 1 2×11 Enam Lingkung.

Difference Hypothesis Test (Comparison)
Normality Test

After done test N-gain furthermore done test normality, Which The aim is to see whether the two samples are normally distributed or not. The normality test of students' mathematical communication abilities can be carried out using the Liliefors test. The results Liliefors test can be seen in Table 9 below:

Table 9. Comparison L_0 and L Capability $_{table}$ conceptual understanding Mathematical

No	Class	L_0	L table	Conclusion	Information
1	Experiment	0.0985	0.1591	$L_0 < L_{table}$	Normal Data
2	Control	0.0991	0.1566	$L_0 < L$ table	Normal Data

Based on Table 9, it is explained that the L_0 value in both sample classes is smaller than the L_{table}, meaning that both sample classes of students are normally distributed. Homogeneity Test.

After the normality test is carried out, the next step is the homogeneity test, which aims to see whether the two sample classes have homogeneous variances or not. The homogeneity of variance test is carried out using the Bartlett test. The test criteria are as follows: accepted H_0 accepted If $X^2_{hitung} < X^2_{tabel}$ with $\alpha = 0,05$. Based on the calculation above, it is obtained that $X^2_{hitung} < X^2_{tabel}$ $(1.4551 < 3.841)$ then H_0 is accepted. Thus, it can be concluded that the sample has a homogeneous variance at a 95% confidence level. From testing use SPSS obtained output like Table 10 following:

Table 10. Output Test Homogeneity Ability Concept Understanding Mathematical

Test of Homogeneity of Variances

		Levene Statistics	df1	df2	Sig.
Results	Based on Mean	0.564	1	61	0.455
	Based on Median	0.673	1	61	0.415
	Based on Median and with adjusted df	0.673	1	59,567	0.415
	Based on trimmed mean	0.598	1	61	0.442

Based on Table 11 seen that mark probability (significant) > 0.05 means the sample has a homogeneous variance.

Independent Samples T- Test Hypothesis Test

To compare the significant differences in conceptual understanding abilities in experimental class with VAK model and control class with exposition model . Because both sample classes are normally distributed and have homogeneous variance, to find out whether the hypothesis is accepted or rejected, a t - test with the Independent Sample T- Test is used.

Based on the calculation obtained $t_{count} > t_{table}$ (2.031 > 1.6702) concluded to reject H_0= There is no significant difference in the ability to understand mathematical concepts between students taught with the VAK learning model and students taught with the expository learning model rejected and H_1accepted meaning H_1 : There is a significant difference in the ability to understand mathematical concepts between students taught with the VAK learning model and students taught with the expository learning model. In addition to the t-test above, the SPSS program was also used, namely the output obtained in Table 12.

Table 12. Independent Samples Test Output

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Standard Error Difference	95% Confidence Interval of the Difference Lower	Upper
Results	Equal variances assumed	0.564	0.455	2,031	61	0.047	6.97307	3.43347	0.10742	13.83873
	Equal variances not assumed			2,036	60,083	0.046	6.97307	3.42487	0.12250	13.82365

Based on Table 12, it can be seen that the significance level is 0.00 < 0.05, meaning that there is a significant difference in the ability to understand mathematical concepts between students who use visualization, auditory and kinesthetic learning models. (VAK) with students who use the expository learning model for class VII SMPN 1 2×11 Enam Lingkung.

DISCUSSION

Based on the results of the data analysis that have been presented, this study shows that the application of the Visualization, Auditory, Kinesthetic (VAK) learning model has a significant impact on improving students' mathematical concept understanding abilities. The success of the application of the Visualization, Auditory, Kinesthetic (VAK) model in improving mathematical concept understanding at SMPN 1 2×11 Enam Lingkung is strongly supported by various scientific literature. The main finding of this study, which shows the N-Gain value of the experimental class (VAK model) is in the high category with an average N-Gain score of 0.71. This figure far exceeds the control class that uses the expository model with an average of 0.55 (medium category), in line with research by Salsabila et al. (2023). The active involvement of students in exploring material through various senses has been proven to be able to minimize conceptual errors, which can be seen from the accuracy of grade VII students in completing posttest questions. This is reinforced by Khasanah (2019) who concluded that the auditory modality provides a discussion space for students to explore abstract concepts in depth, so that the understanding formed is in-depth, not just temporary memorization.

The implementation of this model also has a positive impact on affective and psychological aspects. Jannah & Supriadi (2019) emphasized that the effectiveness of VAK goes beyond cognitive aspects by increasing student self-efficacy. In the field, researchers observed that students who were initially passive became more confident during the visualization and kinesthetic stages. This condition creates a lively learning atmosphere, which according to Rahmah et al. (2024) is effective in reducing mathematical anxiety. This pleasant atmosphere triggers the optimization of the entire brain's potential, both the left brain for analysis and the right brain for creativity, as explained by Shoimin (2014) regarding the advantages of innovative learning models.

Technically, each stage of VAK addresses specific indicators of conceptual understanding. The visualization stage, supported by Zuhri (2019), plays a crucial role in sparking students' interest and focus early in learning, so that mathematics is no longer perceived as intimidating. Harahap (2025) adds that visual stimulation accelerates the process of decoding mathematical symbols into understandable meanings. Furthermore, in the auditory stage, students learn to express their opinions in their own words. Fitriana (2024) emphasizes that the ability to accurately re-explain material is an indication of conceptual maturity. This pattern was also found by Quraisy et al. (2024) who reported a significant increase in understanding through cooperative interactions in the VAK type.

Implementation of VAK at SMPN 1 2×11 Enam Lingkung is form real from learning differentiated. Rosiyani et al. (2024) linked matter This with demands Independent Curriculum, where teachers must accommodate difference style Study For achieve the target of understanding in a way evenly. As foundation thinking, improvement understanding draft This become the main capital student in finish questions reasoning complex (Agustina, 2018). In general, approach holistic in the VAK model it is proven give far- reaching results more meaningful compared to method One the direction that tends ignore modality Study student certain (Sengkey et al., 2023).

Based on results relevant research and the results research that was found, then can concluded that ability understanding draft mathematical participant students who are taught with learning models Visualization, Auditory, Kinesthetic (VAK) more increase than ability understanding draft mathematics taught with learning expository to participants educate Class VII of SMPN 1 2×11 Enam Lingkung.

This study, which examined the application of the Visualization, Auditory, and Kinesthetic (VAK) learning model to the mathematical concept comprehension skills of seventh-grade students at SMPN 2×11 Enam Lingkung, has several limitations: This study was conducted solely on social arithmetic, as it allows students to group according to their learning styles; this study should ideally provide balanced treatment between the experimental and control classes; and discussions using the VAK learning model require more time, leaving little time for presenting discussion results and reflecting on learning.

CONCLUSION AND SUGGESTIONS

Research on the implementation of the Visualization Auditory Kinesthetic (VAK) learning model at SMPN 1 2×11 Enam Lingkung concluded that this model has a positive and significant influence on improving the mathematical concept understanding ability of seventh grade students compared to the expository model. Based on the results of data analysis, there is a real difference in understanding ability between before and after the implementation of the VAK model with a significance value of 0.000, where its effectiveness can be seen from the average achievement of the N-gain of the experimental class of 0.7145 which is included in the "High" category, while the control class only achieved 0.5556 in the "Medium" category. The superiority of this model is strengthened by the results of the independent t-test which shows the value of $t_{count} > t_{table}$ (2.031 > 1.670), so it can be ascertained that the integration of visual, auditory, and kinesthetic aspects in learning is much more effective in strengthening students' mathematical concept understanding than conventional methods.

Based on the conclusions above, this study recommends the following: For students, this study is expected to provide a fun, effective, and engaging learning experience that can improve learning outcomes and mathematical concept understanding; For educators, this study is expected to provide alternative mathematics learning models that teachers can implement to improve students' mathematical concept understanding; For researchers, this study is expected to provide additional experience in implementing the Visualization Auditory Kinesthetic (VAK) learning model on the mathematical concept understanding of seventh-grade students at a junior high school (SMP). It can also serve as a source of information and reference material for future research. Furthermore, researchers are expected to plan time allocation optimally, as this learning model requires time.

REFERENCES

Akbar, R., Sukmawati, U. S., & Katsirin, K. (2023). Quantitative research data analysis: Testing the correlation associative hypothesis. *Pelita Nusantara Journal*, 1(3), 430-448. https://doi.org/10.59996/jurnalpelitanusantara.v1i3.350

Amin, M. F., Susanto, A., & Mardika, F. (2024). Comparison of mathematical concept understanding ability of grade vii students of smpn 1 2x11 six environments who learned using reciprocal teaching model and expository model. *Smart Student Journal,* 6(2), 172-182. https://doi.org/10.15548/jcm.v6i2.10976

Agustina, N. (2018). Junior high school students' conceptual understanding ability on straight line equation material in apos-based learning. *HISTOGRAM: Journal of Mathematics Education, 2(1), 12-20.* https://doi.org/10.31100/histogram.v2i1.34

Deporter, D. (1999). Five- to six-year results of a prospective clinical trial using the ENDOPORE® dental implant and a mandibular overdenture. https://doi.org/10.1034/j.1600-0501.1999.100203.x

Eliza, R. (2010). Learning media as a means of mathematical communication in elementary schools. *Ta'dibJournal,* 13 (2). https://www.academia.edu/104566942/PENDIDIKAN_SEBAGAI_TADIB

Eliza, R., & Susilawati, F. (2019). Mathematical concept understanding ability and student learning ındependence with ınquiry learning model. *Math Educa Journal, 3(2), 144-155.* http://ejournal.uinib.ac.id/index.php?journal=mej

Kristanti, E., Khasanah, N., Munawaroh, F., Qomaria, N., & Muharrami, L. K. (2019). The effect of the visual auditory kinesthetic (VAK) learning model on students' concept understanding . 2 (2), 105–112. https://doi.org/10.21107/nser.v2i2.6237

Mardika, F. (2019). 'Student team achievement division (STAD) cooperative learning. AXIOM: *Journal of Education and Mathematics, 8 (2)*. http://dx.doi.org/10.30821/axiom.v8i2.6343

Muthiah J, Nanang S, FIS (2019). The effectiveness of the visualization auditory kinesthetic (VAK) learning model on mathematical concept understanding based on self-efficacy classification. : *Journal of Mathematics Education Study Program , 8 (1), 215–224.* https://ejournal.radenintan.ac.id/

Nuraini F, Dessy S, EN (2021). The effect of using learning modules on students' cognitive learning outcomes. *Innovation Research Journal*. https://doi.org/10.29103/relativitas.v4i2.5257

Quraisy, A., Matematika, P., Makassar, UM, & Konsep, P. (2024). Application of the VAK type cooperative model . 7 , 94–99. https://doi.org/10.30605/proximal.v7i1.3135

Rahardja, U. (2023). The economic impact of cryptocurrencies in Indonesia. *ADI Journal on Recent Innovation, 4 (2), 194-200.* https://doi.org/10.34306/ajri.v4i2.869

Rahmah, A., Disman, & Supriadi, A. (2024). Implementation of visual auditory kinesthetic (VAK) learning as an effort to ımprove students' creative thinking in social studies learning. Didaktika: *Jurnal Kependidikan*, 13 (November 4), 4903–4914. https://www.jurnaldidaktika.org/contents/article/view/1181

Roflin, E., & Liberty, IA (2021). Roflin, E., & Liberty, IA (2021). Population, sample, variables in medical research. Pekalongan: *NEM Publisher. Book* , 9 (April), 1–159. https://doi.org/10.55933/jpd.v9i2.633

Rosiyani, AI, Aqilah Salamah, Lestari, CA, & Anggraini, S. (2024). Implementation of differentiated learning in the ındependent curriculum in elementary school science learning. *Journal of Elementary School Teacher Education, 1 (3), 10.* https://doi.org/10.47134/pgsd.v1i3.271

Salsabila, G., Septian, A., Inayah, S., Hanifah, N., & Komala, E. (2023). Application of the visualization, auditory, kinesthetic (VAK) learning model to students' mathematical concept understanding ability. 1 (1), 33–39. https://doi.org/10.59108/ime.v1i1.16

Sengkey, DJ, Sampoerno, PD, & Aziz, A. (2023). Mathematical concept comprehension ability: a literature review . 3 , 67–74.

Shoimin, A. (2014). Shoimin, A. (2021). 68 innovative learning models in the 2013 curriculum. In Ar Ruzz Media. https://arruzzmedia.com/

Sumarmo, U. (2014). Assessment of students' soft skills and hard skills in mathematics in the 2013 curriculum. *Seminar on mathematics education in higher education*. https://id.scribd.com/document/857041237/adoc-pub-asesmen-soft-skill-dan-hard-skill-matematik-siswa

Susanto, A. (2019). Mathematical concept comprehension ability of reciprocal teaching (RT) model and air auditory intellectualy repetition (AIR) model. *Math Education Journal, 3 (2), 219–230.* http://ejournal.uinib.ac.id/index.php?journal=mej

Susanto, A., & Syaveta, RA (2018). Mathematical problem-solving abilities of students taught with the missouri mathematics project (MMP) learning model accompanied by the think-talk-write (TTW) strategy at SMP negeri 2 lengayang pesisir selatan. *Math Educa Journal, 2 (1).* http://ejournal.uinib.ac.id/index.php?journal=mej

Susanto, A., Yanti, YD, & Fitriza, R. (2021). Efforts to ımprove students' understanding of mathematical concepts using google classroom (doctoral dissertation, antasari state islamic university). https://www.neliti.com/publications/477686/

Zuhri, M. (2019). The effectiveness of visualization, auditory, kinesthetic learning model assisted by power point media and teaching aids on the conceptual understanding of cube and block material of class VIII students of SMPN 31 semarang in the 2018/2019 academic year. Walisongo state islamic university semarang. https://eprints.walisongo.ac.id/id/eprint/10397