



ARTICLE INFORMATION

Application of the auditory kinesthetic visualization (VAK) model towards the ability to mathematical conceptual understanding

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

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ABSTRACT

This research is motivated by the low level of comprehension of mathematical concepts among seventh-grade students at State Junior High School (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 $0.001 < 0.05$, 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 $t\text{-count} > t\text{-table}$ ($2.031 > 1.670$), 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.

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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 State Junior High School (SMPN) 12 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 12x11 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, 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 State Junior High School (SMPN) 1 2×11 Enam Lingkungan 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

(Fatmi et al., 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		Control	
		Pretest	Posttest	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:

$$\begin{aligned}
 N - \text{Gain} &= \frac{S_{\text{Posttets}} - S_{\text{Pretest}}}{S_{\text{maksimal}} - S_{\text{Pretest}}} \\
 &= \frac{57,14 - 28,57}{100 - 28,57} = \frac{28,57}{67,86} = 0,40
 \end{aligned}$$

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	0.7145
Average	53.45	83.87	
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 $0.70 \leq g \leq 100$ 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:

$$\begin{aligned}
 N - \text{Gain} &= \frac{S_{\text{Posttets}} - S_{\text{Pretest}}}{S_{\text{maksimal}} - S_{\text{Pretest}}} \\
 &= \frac{50 - 39,28}{100 - 32,14} \\
 &= \frac{10,72}{60,72} \\
 &= 0,18
 \end{aligned}$$

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	0.5556
Average	53.23	76.89	
The highest score	75	100	
Lowest Value	32.14	50	

The average N-Gain is 0.55 or is in the range of $0.3 \leq g \leq 0.7$ 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 L_0 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							
Class		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		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

Table 6: Paired Sample Test Output (SPSS)									
Paired Samples Test		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Standard Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest_Experiment - Posttest_Experiment	30,41161	6.95111	1.24846	32.96130	27,86193	24,35930	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 State Junior High School (SMPN) 1 2×11 Enam Lingkungan.

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_{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 10 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_1 accepted 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 11.

Table 11. 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 11, 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 State Junior High School (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 et al. (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 et al. (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 Rahmaniar 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

This study concludes that the Visualization, Auditory, and Kinesthetic (VAK) learning model has a positive effect on seventh-grade students' mathematical concept understanding compared with the expository learning model. The findings indicate that students who participated in VAK-based learning demonstrated greater improvement in their understanding of mathematical concepts than those who received conventional instruction. The effectiveness of the VAK model can be attributed to the integration of visual, auditory, and kinesthetic learning experiences, which provide students with opportunities to engage with mathematical concepts through multiple forms of representation and active learning. These findings suggest that incorporating varied sensory experiences into mathematics instruction can create more meaningful learning experiences and support students in developing a deeper understanding of mathematical concepts.

Based on these findings, the VAK learning model can be considered an alternative instructional approach for mathematics teachers seeking to promote active and engaging learning and strengthen students' conceptual understanding. Students may benefit from the opportunity to participate actively through visual, auditory, and kinesthetic activities. For

schools, adequate support for the implementation of varied learning approaches is recommended. Future researchers could investigate the application of the VAK model across different mathematical topics, educational levels, and learning contexts. Researchers should also consider careful time allocation and instructional planning, as implementing activities that integrate multiple learning modalities may require sufficient classroom time.

REFERENCES

- Agustina, N. (2018). Kemampuan pemahaman konsep siswa SMP pada materi persamaan garis lurus dalam pembelajaran berbasis APOS [Junior high school students' conceptual understanding of straight-line equations through APOS-based learning]. *Histogram: Jurnal Pendidikan Matematika*, 2(1), 12–20. <https://doi.org/10.31100/histogram.v2i1.134>
- Akbar, R., Sukmawati, U. S., & Katsirin, K. (2023). Analisis data penelitian kuantitatif: Pengujian hipotesis asosiatif korelasi [Quantitative research data analysis: Testing the associative correlation hypothesis]. *Jurnal Pelita Nusantara*, 1(3), 430–448. <https://doi.org/10.59996/jurnalpelitanusantara.v1i3.350>
- Amin, M. F., Susanto, A., & Mardika, F. (2024). Komparasi kemampuan pemahaman konsep matematis peserta didik kelas VII SMPN 1 2×11 Enam Lingkung yang belajar dengan model *reciprocal teaching* dan model ekspositori [Comparison of Grade VII students' mathematical conceptual understanding at SMPN 1 2×11 Enam Lingkung taught through reciprocal teaching and expository models]. *Journal Cerdas Mahasiswa*, 6(2), 172–182. <https://doi.org/10.15548/jcm.v6i2.10976>
- Deporter, D., Watson, P., Pharoah, M., Levy, D., & Todescan, R. (1999). Five- to six-year results of a prospective clinical trial using the ENDOPORE dental implant and a mandibular overdenture. *Clinical Oral Implants Research*, 10(2), 95–102. <https://doi.org/10.1034/j.1600-0501.1999.100203.x>
- Eliza, R. (2010). Media pembelajaran sebagai sarana komunikasi matematika di sekolah dasar [Learning media as a means of mathematical communication in elementary schools]. *Ta'dib*, 13(2), 152–159. <https://doi.org/10.31958/jt.v13i2.186>
- Eliza, R., & Susilawati, F. (2019). Kemampuan pemahaman konsep matematis dan kemandirian belajar siswa dengan model pembelajaran inkuiri [Students' mathematical conceptual understanding and learning independence through an inquiry learning model]. *Math Educa Journal*, 3(2), 144–155.
- Fatmi, N., Nadia, E., & Siska, D. (2021). Pengaruh penggunaan modul pembelajaran terhadap hasil belajar kognitif siswa [The effect of using learning modules on students' cognitive learning outcomes]. *Relativitas: Jurnal Riset Inovasi Pembelajaran Fisika*, 4(2), 68–80. <https://doi.org/10.29103/relativitas.v4i2.5257>
- Jannah, M. M., Supriadi, N., & Suri, F. I. (2019). Efektivitas model pembelajaran *visualization, auditory, kinesthetic* (VAK) terhadap pemahaman konsep matematis berdasarkan klasifikasi *self-efficacy* [The effectiveness of the visualization, auditory, and kinesthetic learning model in improving mathematical conceptual understanding based on self-efficacy classifications]. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 8(1), 215–224. <https://doi.org/10.24127/ajpm.v8i1.1892>
- Khasanah, E. K. N., Munawaroh, F., Qomaria, N., & Muharrami, L. K. (2019). Pengaruh model pembelajaran *visual auditory kinesthetic* (VAK) terhadap pemahaman konsep siswa [The effect of the visual, auditory, and kinesthetic learning model on students' conceptual understanding]. *Natural Science Education Research*, 2(2), 105–112. <https://doi.org/10.21107/nser.v2i2.6237>
- Mardika, F. (2019). Upaya meningkatkan hasil belajar siswa SMP dengan pembelajaran kooperatif *Student Team Achievement Division* (STAD) [Efforts to improve junior high school students' learning outcomes through Student Team Achievement Division

- cooperative learning]. *AXIOM: Jurnal Pendidikan dan Matematika*, 8(2). <https://doi.org/10.30821/axiom.v8i2.6343>
- 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>
- Rahmaniar, Nursakiah, & Quraisy, A. (2024). Penerapan model kooperatif tipe VAK terhadap kemampuan pemahaman konsep matematika [The implementation of the VAK cooperative learning model to improve mathematical conceptual understanding]. *Proximal: Jurnal Penelitian Matematika dan Pendidikan Matematika*, 7(1), 94–99. <https://doi.org/10.30605/proximal.v7i1.3135>
- Rahmah, A., Disman, & Supriadi, A. (2024). Implementasi pembelajaran *visual auditory kinesthetic* (VAK) sebagai upaya meningkatkan berpikir kreatif siswa pada pembelajaran IPS [The implementation of visual, auditory, and kinesthetic learning to improve students' creative thinking in social studies]. *Didaktika: Jurnal Kependidikan*, 13(4), 4903–4914. <https://doi.org/10.58230/27454312.1181>
- Roflin, E., & Liberty, I. A. (2021). *Populasi, sampel, variabel dalam penelitian kedokteran* [Population, samples, and variables in medical research]. Penerbit NEM.
- Rosiyani, A. I., Salamah, A., Lestari, C. A., Anggraini, S., & Ab, W. (2024). Penerapan pembelajaran berdiferensiasi dalam Kurikulum Merdeka pada pembelajaran IPAS sekolah dasar [Implementation of differentiated instruction within the Merdeka Curriculum in elementary school science and social studies learning]. *Jurnal Pendidikan Guru Sekolah Dasar*, 1(3), Article 10. <https://doi.org/10.47134/pgsd.v1i3.271>
- Salsabila, G., Septian, A., Inayah, S., Hanifah, N., & Komala, E. (2023). Penerapan model pembelajaran *visualization, auditory, kinesthetic* (VAK) terhadap kemampuan pemahaman konsep matematika siswa [The implementation of the visualization, auditory, and kinesthetic learning model to improve students' mathematical conceptual understanding]. *Intellectual Mathematics Education*, 1(1), 33–39. <https://doi.org/10.59108/ime.v1i1.16>
- Sengkey, D. J., Sampoerno, P. D., & Aziz, A. (2023). Kemampuan pemahaman konsep matematis: Sebuah kajian literatur [Mathematical conceptual understanding: A literature review]. *Griya Journal of Mathematics Education and Application*, 3(1), 67–74.
- Shoimin, A. (2014). *68 model pembelajaran inovatif dalam Kurikulum 2013* [Sixty-eight innovative learning models in the 2013 Curriculum]. Ar-Ruzz Media.
- Sumarmo, U. (2014). Asesmen *soft skills* dan *hard skills* matematik siswa dalam Kurikulum 2013 [Assessment of students' mathematical soft skills and hard skills in the 2013 Curriculum]. In *Seminar Pendidikan Matematika di Sekolah Tinggi Agama Islam Negeri Batusangkar*.
- Zuhri, M. (2019). *Efektivitas model pembelajaran visualization, auditory, kinesthetic berbantuan media PowerPoint dan alat peraga terhadap pemahaman konsep materi kubus dan balok siswa kelas VIII SMPN 31 Semarang tahun pelajaran 2018/2019* [The effectiveness of the visualization, auditory, and kinesthetic learning model assisted by PowerPoint and teaching aids in improving Grade VIII students' conceptual understanding of cubes and rectangular prisms] [Undergraduate thesis, Universitas Islam Negeri Walisongo Semarang]. Walisongo Institutional Repository. <https://eprints.walisongo.ac.id/id/eprint/10397>