Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram
https://e-journal.undikma.ac.id/index.php/prismasains/index
e-mail: prismasains.pkpsm@gmail.com

January 2025. Vol. 13, No. 1
p-ISSN: 2338-4530
e-ISSN: 2540-7899
pp. 60-75

Analysis of Student Skills Using Discovery Learning Based on Differences in Learning Styles

[*] Helmi Rahmawati, Fatimatus Solihah, Saiful Fadli, Saadatun Fitriana
Mathematics Education Study Program, Universitas Qamarul Huda Badaruddin Bagu, Indonesia

*Corresponding Author e-mail: helmirahmawati18@gmail.com

Received: November 2024; Revised: December 2024; Published: January 2025

Abstract

Integral is a branch of algebra included in the calculus course, making it essential to master. This research aims to analyze the skills of students with visual learning styles, auditory learning styles, and kinesthetic learning styles using discovery learning on the topic of integrals. The method used in this study is a mixed-method approach with an Explanatory Design. The first stage involves the collection and analysis of quantitative data, which takes priority in answering the research questions. The next stage is the qualitative data collection phase, where three students with different learning styles are interviewed to gain deeper insights. The results of the study indicate that learning using the discovery learning model has a significant effect on students' learning outcomes. The average score improvement of visual, auditory, and kinesthetic students shows positive results through learning using the discovery learning model, with the highest improvement seen in kinesthetic students (23.67) and visual students (22.89). The results of the mean comparison test or ANOVA (One-Way ANOVA) show that the significance value is $0.027 < 0.05$, which means there is a difference in the mean posttest scores of visual, auditory, and kinesthetic students. This study demonstrates the significant impact of the discovery learning model on integral learning outcomes, revealing that visual learners outperform auditory learners, while kinesthetic learners show comparable outcomes to visual learners.

Keywords: Discovery Learning Model, Integral, Learning Styles

How to Cite: Rahmawati, H., Solihah, F., Fadli, S., & Fitriana, S. (2025). Analysis of Student Skills Using Discovery Learning Based on Differences in Learning Styles. *Prisma Sains : Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram, 13*(1), 60-75. doi:https://doi.org/10.33394/j-ps.v13i1.14080

https://doi.org/10.33394/j-ps.v13i1.14080

INTRODUCTION

The success of a learning process is closely related to whether or not a teacher is skilled in managing the learning process. Managing learning requires skills that can help teachers improve the quality of the learning process so that learning objectives can be achieved optimally. Problems may not only come from the teacher, but can also arise from students or a lack of facilities and infrastructure at the school. Many teachers have tried various methods to ensure the learning process runs smoothly and yields optimal results. However, it is not uncommon for teachers to fail in achieving this because they do not take the time to understand the individual characteristics of each student. Assessing the characteristics of students is important in selecting the appropriate teaching methods for them. Therefore, before starting a lesson, teachers should identify existing teaching issues by assessing students, which will help address these challenges.

Students' learning styles, or the way they receive material presented by the teacher, naturally vary. Some may rely more on their sight, known as the visual learning style, others may depend on their hearing, known as the auditory learning style, and some may absorb information more easily through movement, action, and touch, referred to as the kinesthetic learning style. A learning style is the easiest way for an individual to absorb, organize, and process information they receive (Bire et al., 2014). These differences in learning styles undoubtedly affect how well students understand the material. This aligns with the view of Riener, C & Willingham, D (2010) who stated that learners are different from each other, these differences affect their performance, and teachers should take these differences into account. Csapo & Hayen (2006) also stated that understanding learning styles and the role of learning styles in the teaching/learning process is a key component in effective teaching.

Based on the results of an interview with a mathematics teacher at MA Muhajirin Praya, students experience difficulties with the topic of integrals and have low learning motivation. Most students have high egos, making it difficult for them to desire understanding of the material when facing challenges because they are reluctant to ask the teacher for help. However, there are some students who exhibit positive traits, such as actively asking questions, answering questions verbally or even going to the front of the class to solve problems on the board, and actively explaining things to their peers. This is in line with the results of the daily test assessment on the integral material obtained by the students, where many students' scores are still below the Minimum Completion Criteria (MCC) of 70.

Discovery learning is a learning process where not all of the material is provided upfront; instead, students are involved in organizing and developing knowledge and skills for problem-solving (Yuliana, 2018). According to Bruner (Simamora et al., 2019), “Discovery learning was a learning model that uses inquiry-based constructivist learning theory that occurs in problem-solving situations where learners learn through existing knowledge and previous experience to find facts and relationships with new material being studied.” Discovery Learning is a teaching model that uses constructivist inquiry-based learning theory that takes place in problem-solving situations where learners use their existing knowledge and past experiences to discover facts and relationships with new material being studied. While previous studies have examined discovery learning broadly (Magfirah et al., 2022; Sulistyowati et al., 2012; Amrillah et al., 2024), this study uniquely explores its differential impacts on visual, auditory, and kinesthetic learners in the context of integral calculus. Therefore, the author is interested in conducting research with the title: An Analysis of Student Skills Using the Discovery Learning Model Based on Differences in Learning Styles.

METHOD

This research was conducted at MA Darul Muhajirin, located at Jl. Diponegoro 40, Praya, Central Lombok, NTB. The subjects of this study were the students of class XI MIPA 2. The subjects were selected randomly (random sampling). The researcher chose class XI MIPA 2 as the subject of this study based on a recommendation from the mathematics teacher at the school, as this class has learning styles that tend to vary, which had previously been observed by the teacher. Additionally, the students in this class have heterogeneous mathematical abilities. The statistical test used in this study is the ANOVA (Analysis of Variance). The reason the researcher used ANOVA is to test the differences in means across more than two groups, namely the visual, auditory, and kinesthetic student groups. The tool used to determine students' learning styles is the V-A-K learning style questionnaire proposed by Chislett, V & Chapman (2015). This questionnaire consists of 30 statements that students select based on situations that best describe themselves. The type of research used in this study is Mixed Methods research. Mixed methods is a research approach that combines both quantitative and qualitative methods to be used together in a study, so that the data obtained is more comprehensive, valid, reliable, and objective. There are six types of mixed methods research designs. However, this study uses The Explanatory Sequential Design. This design is also known as the Explanatory Design. In this design, there are two sequential/interactive phases. The first phase involves the collection and analysis of quantitative data, which takes priority in answering the research questions. In the next phase, qualitative data collection follows the previous phase. Researchers generally interpret qualitative data to help explain the results obtained in the quantitative phase. Below is a diagram of The Explanatory Sequential Design.

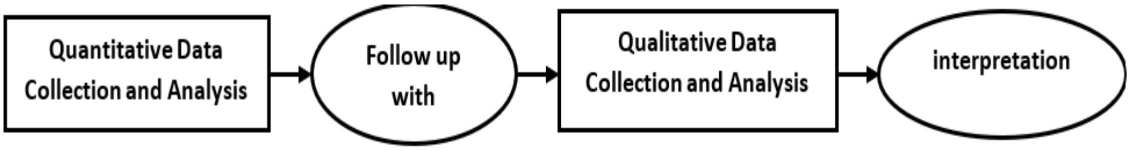

Figure 1. Diagram of the Explanatory Sequential Design (Creswell & Clark, 2011)

The experimental design used in this study is a pre-experimental design. There is no control group in this design. The form of pre-experimental design used is the one-group pretest-posttest design. The selection of the one-group pretest-posttest design is based on the reasoning that it allows for a more accurate understanding of the effects of the treatment, as the researcher can compare the state before the treatment is applied and the state after the treatment.

RESULTS AND DISCUSSION

Results

The learning style test was given before the learning process was conducted. Below are the results of the students' learning style test analysis presented in Table 1.

Table 1. Results of the Learning Style Test Analysis

Learning Style	Number of Students
Auditory	10
Kinesthetic	9
Visual	9
Total Number	**28**

Based on Table 1, it can be concluded that 9 students have a visual learning style, 10 students have an auditory learning style, and 9 students have a kinesthetic learning style. The sample was then separated based on their different learning styles to test the normality of the data for each learning style type.The initial test (pretest) was given before the treatment was applied to the experimental class. The pretest data is presented in Table 2.

Table 2. Analysis of Pre-Test Results for the Experimental Class

No	Explanation	Experimental Class		
		Visual	Auditory	Kinesthetic
1	Average	62.22	66.7	60
2	Highest	80	85	85
3	Lowest	50	55	50

Table 2 shows the pretest scores of students with visual, auditory, and kinesthetic learning styles on the topic of integrals. In the visual learning style group, the highest score was 80, the lowest score was 50, and the average score was 62.22. For the auditory learning style group, the lowest score was 55, the highest score was 85, and the average score was 66.7. In the kinesthetic learning style group, the lowest score was 50, the highest score was 85, and the average score was 60. There is a noticeable difference in the average scores across each learning style group.

The final test (posttest) was conducted after the learning process using the discovery learning model. The test was administered to determine the difference between the pretest and posttest results for the students. The analysis of the posttest results is presented in Table 3.

Table 3. Analysis of Posttest Results for the Experimental Class

Explanation	Experimental class		
	Visual	Auditory	Kinesthetic
Average	85.11	73.6	83.67
Highest	100	100	100
Lowest	76	60	75

Based on Table 3, it can be seen that in the visual learning style group, the average score is 85.11, the highest score is 100, and the lowest score is 76. In the auditory learning style group, the average score is 73.6, the highest score is 100, and the lowest score is 60. In the kinesthetic learning style group, the average score is 83.67, the highest score is 100, and the lowest score is 75. Based on Tables 2 and 3, it is evident that there is an improvement in student learning outcomes on the topic of integrals using the discovery learning model. The average posttest score for each group increased: in the visual group, from 62.22 to 85.11; in the auditory group, from 66.7 to 73.6; and in the kinesthetic group, from 60 to 83.67. The improvement in the average pretest and posttest scores of the experimental class is presented in the following Table 4.

Table 4. The improvement in the average pretest and posttest scores of the experimental class

Aspect	Experimental class					
	Visual		Auditory		Kinesthetic	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Number of students	9	9	10	10	9	9
Average score	62.22	85.11	66.7	73.6	60	83.67
Lowest score	50	76	55	60	50	75
Highest score	80	100	85	100	85	100
Average score improvement	22.89		6.9		23.67	

Table 4 shows that the average score improvement for visual students is 22.89, the average score improvement for auditory students is 6.9, and the average score improvement for kinesthetic students is 23.67. It can be concluded that the average pretest and posttest scores of visual, auditory, and kinesthetic students showed improvement through learning using the discovery learning model. Next, a normality test was conducted for each group.The normality test based on pretest and posttest scores was carried out using the SPSS 16.0 application, as shown in Table 5, it can be shown that both the pretest and posttest data for each group follow a normal distribution. In the Kolmogorov-Smirnov column, the significance value for the pretest in the visual and auditory groups is 0.2 > 0.05 (data follows a normal distribution), while in the kinesthetic group, it is 0.136 > 0.05. The posttest results also show that the significance value in the Kolmogorov-Smirnov column for the visual, auditory, and kinesthetic groups is 0.2 > 0.05. This indicates that the data is normally distributed.

Table 5. Results of the Normality Test for Pretest and Posttest

		Kolmogorov-Smirnov[a]			
Data	Assessment	Statistic	df	Sig.	Explanation
Pre-test	Visual	.224	9	.200*	Normal Distribution
	Auditory	.156	9	.200*	
	Kinesthetic	.242	9	.136	
Post-test	Visual	.205	9	.200*	Normal Distribution
	Auditory	.215	10	.200*	
	Kinesthetic	.209	9	.200*	

Next, a test for equality of means (ANOVA) was conducted with the following research hypotheses:

$H_0 : \mu_1 = \mu_2 = \mu_3$

H_1 : There is a difference in means

The results of the mean equality test can be seen in Table 6.

Table 6. Equality of Means Test (ANOVA)

ANOVA					
Skor					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	757.675	2	378.838	4.174	.027
Within Groups	2269.289	25	90.772		
Total	3026.964	27			

Based on the SPSS output in Table 6, it is obtained that F = 4.174 and significance = 0.027 < 0.05, therefore H_0 is rejected, meaning there is a difference in means. Next, a mean difference test is conducted, as presented in the following Table 7.

Table 7. Mean Difference Test

			Sig
Tukey HSD	Visual	Auditory	.037
		Kinesthetic	.945
	Auditory	Visual	.037
		Kinesthetic	.074
	Kinesthetic	Visual	.945
		Auditory	.074

Based on Table 7, several conclusions can be drawn: there is a significant difference between visual and auditory learners, as the significance value is 0.037 < 0.05. On the other hand, there is no significant difference between visual and kinesthetic learners because the significance value is 0.945 > 0.05. Furthermore, there is a significant difference between auditory and visual learners, as the significance value is 0.037 < 0.05. However, there is no significant difference between auditory and kinesthetic learners because the significance value is 0.074 > 0.05. Likewise, there is no significant difference between kinesthetic and visual learners, as the significance value is 0.945 > 0.05. Similarly, there is no significant difference between kinesthetic and auditory learners, as the significance value is 0.074 > 0.05. Thus, it can be concluded that visual learners are different from auditory learners, visual learners are the same as kinesthetic learners, and auditory learners are the same as kinesthetic learners.

After the quantitative analysis was conducted, the researcher selected three students, one from each learning style, to be interviewed in order to gather more in-depth data. Below are the transcripts of interviews with one visual learner, one auditory learner, and one kinesthetic learner, all of whom have high mathematical abilities. The following are the questions and interview results with students from visual, auditory, and kinesthetic learning styles.

SOAL

1. Tentukanlah hasil dari $\int (2x-1)(x^2-x+3)^3\, dx$
2. Tentukan hasil dari $\int \frac{2x+3}{\sqrt{3x^2+9x-1}}\, dx$
3. Diketahui biaya marginal (M_C) dalam memproduksi suatu barang (Q) setiap bulan adalah merupakan fungsi biaya terhadap banyak produksi barang dengan $M_C = \frac{dC}{dQ} = \frac{2Q+6}{3}$. Tentukan fungsi biaya total C dalam satu bulan !

Figure 2. The question given to the students

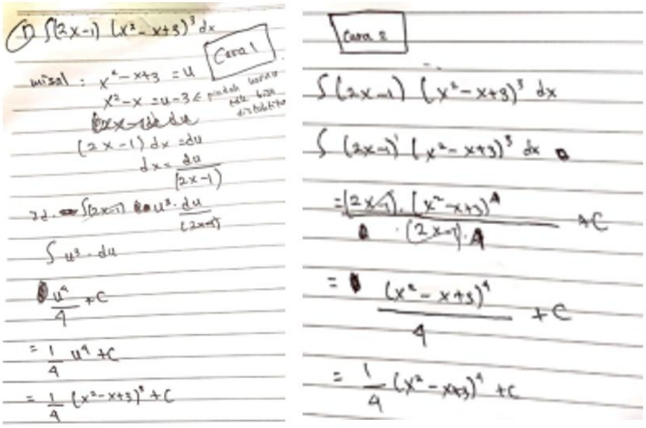

Figure 3. Answer to Question No. 1 by Visual Student (SV)

Interview Transcript:

P : What do you do when you first see the problem?
SV : I recall the solution method
P : And then?
SV : I solve it using two methods
P : What methods do you use?
SV : Substitution method and a trick
P : In method 1, after letting $x^2 - x + 3 = u$, you moved the 3 to the right side, why?
SV : Because it can't be substituted, ma'am.
P : What do you mean?
SV : If the integral problem cannot be solved using the substitution method, then move the constant to the other side, or in other words, change the left-hand side into just x, meaning change it into $x\ = \ldots$
P : Can it be directly differentiated without moving the constant to the other side?
SV : It can be if the problem can be solved with the substitution method, but if the problem cannot be solved using substitution, then the constant must be moved
P : What is the purpose of the substitution?
SV : To make it easier so that the form is the same as the general formula for an indefinite integral.
P : What are the characteristics of a problem that can be solved using the substitution method?
SV : The way is to look at what is raised to a power, look for the more "complicated" part, like something under a square root or inside parentheses and raised to a power, etc. If the "complicated" part is differentiated, and after differentiating, it turns out to match (or is similar to) the part that is not in parentheses (the "simpler" part), then the problem can definitely be solved using the substitution method.
P : Can you explain the third step in your answer for method 2?

SV : First, write the original problem: $(2x-1)(x^2-x+3)^3$, then raise the power inside the parentheses, (x^2-x+3) by 1, so it becomes $(2x-1)(x^2-x+3)^4$, After that, place the power under the expression, so it becomes $\frac{(2x-1)(x^2-x+3)^4}{4}+C$, for $(2x-1)$ below, it comes from the derivative of what's inside the parentheses (x^2-x+3), which is $(2x-1)$ so it becomes $\frac{(2x-1)(x^2-x+3)^4}{(2x-1)4}+C$

P : Can this trick method be used for all types of integral problems?

SV : No, ma'am. Only problems that can be solved using the substitution method can be solved with this trick method.

P : How do you check that the answer you obtained is correct?

SV : The way to check is by differentiating it.

P : Why?

SV : Because an integral is the anti-derivative.

P : Your answer in question 1 is $\frac{1}{4}(x^2-x+3)^4+c$ How did you differentiate it?

SV : $y=\frac{1}{4}(x^2-x+3)^4$

$y'=\frac{1}{4}\times 4(x^2-x+3)^{4-1}\times(2x-1)$

$y'=(x^2-x+3)^3(2x-1)$

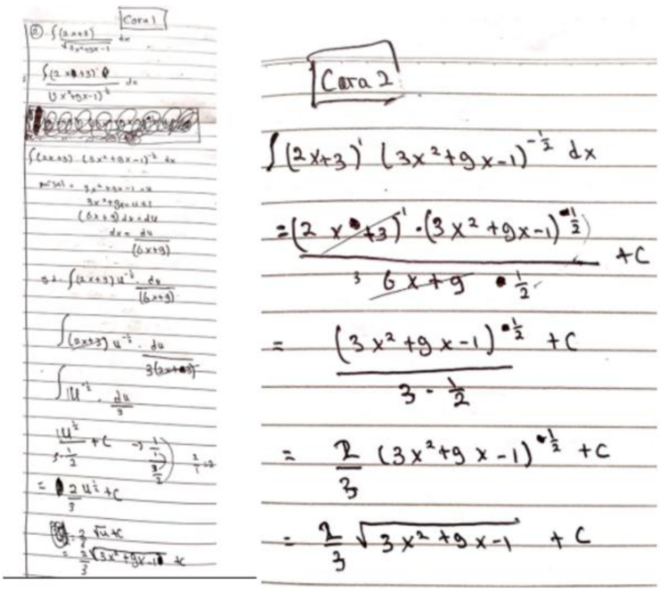

Figure 4. Answer to Question No. 2 Visual Student (SV)

Interview Transcript:

P : In question no. 2, what did you do first?

SV : First, I changed the form to make it the same as question no. 1.

P : How did you do that?

SV : The problem asks to find the integral of $\frac{2x+3}{\sqrt{3x^2+9x-1}}$,

$$\frac{2x+3}{\sqrt{3x^2+9x-1}}=(2x+3)\frac{1}{\sqrt{3x^2+9x-1}}$$
$$=(2x+3)\frac{1}{(3x^2+9x-1)^{\frac{1}{2}}}$$
$$=(2x+3)(3x^2+9x-1)^{-\frac{1}{2}}$$

After that, I let $3x^2+9x-1$ be u, then I solved it using the same method as in question no. 1.

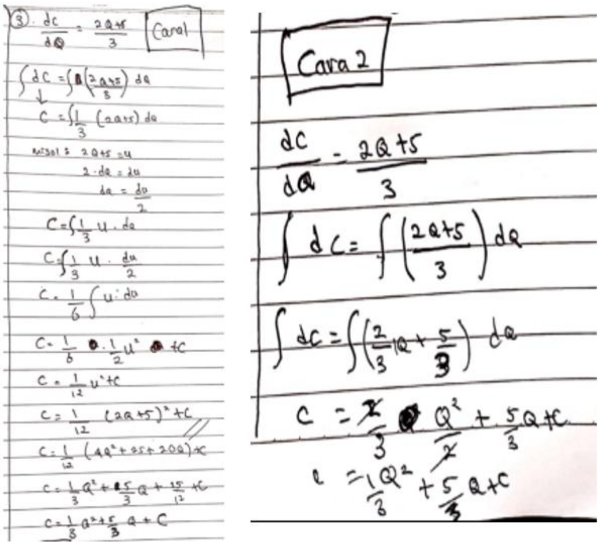

Figure 5. Answer to Question No. 3 Visual Student (SV)

Interview Transcript:

P : What did you think when you saw question no. 3?
SV : The total cost function C in one month.
P : How did you approach it?
SV : First, I integrated both sides.
P : Then?
SV : Then I found the integral on the right side.
P : How did you do that?
SV : i let $2Q + 5$ be u
P : What was the purpose of letting $2Q + 5$ be u?
SV : Because when $2Q + 5$ is differentiated, it results in 2, meaning it no longer contains the variable Q.
P : Why does it matter if the form no longer contains the variable Q?
SV : If it contains the variable Q, then we cannot use the substitution method.
P : How come? What are the requirements for the substitution method to be used?
SV : If the expression we let as u, after differentiation, has a form similar to the one that was not substituted, then the substitution method can be used.
P : Can you give an example from this problem?
SV : In this problem, the derivative of $2Q + 5$ is 2, similar to $\frac{1}{3}$
P : What did you do next?
SV : After letting it be u, the form becomes the same as the general formula for indefinite integrals, then I solved it using the usual integral method, and then I replaced the result back with the variable Q (the one I substituted at the beginning).
P : What about method 2?
SV : In method 2, I directly used the formula for indefinite integrals.
P : Can this method 2 be used for all types of integral problems?
SV : No, ma'am.
P : Why? What type of problem can method 2 be applied to?
SV : because $\left(\frac{2Q+5}{3}\right)$ is raised to the first power, so it can be directly integrated.
P : What if the exponent is greater than 1?
SV : If the exponent is greater than 1, you can still use the substitution method directly.
P : What if the exponent is greater than 1, for example, exponent 2 or 3, etc.? Can you use method 2?

SV : You can use the usual integral formula, but it would be more difficult. It's easier to use the substitution method.

Based on the interview transcript above, the Visual Student (SV) is able to explain the steps they took. SV can provide reasons for each step performed. SV is also able to apply several problem-solving methods for each question. SV understands when to use the method applied to each type of problem given. However, for question number 3, SV incorrectly wrote the problem, so the answer is wrong according to the question. However, based on the solution carried out, SV was still able to solve it correctly.

Referring to the learning syntax based on discovery learning, SV has already performed stimulation, where SV can explore material about integrals to solve problems accurately. Next, for the Problem Statement stage, SV has also done this, as evidenced by SV's ability to identify the problem and design a strategy or method to solve the given problem. Then, for the data collection stage, SV has collected data in the form of steps that can be taken to identify the problem. SV first uses assumption, saying that if the assumed expression, when differentiated, results in a form similar to the one not assumed, then the problem can be solved using the substitution method. SV also mentions that Method 2 is used for simpler problems.

In the data processing stage, SV has done this well, as shown by SV's ability to answer the question correctly. In the verification stage, SV knows how to check if the answer obtained is correct or incorrect. Finally, for the generalization stage, SV can conclude that integration is the reverse of differentiation, so to ensure the answer is correct, the integration can be differentiated again. If it returns to the initial form, the answer is correct.

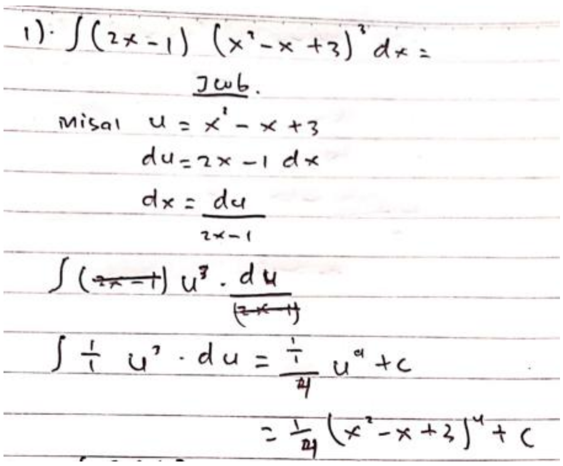

Figure 6. Answer to Question No. 1 Auditory Student (SA)

Interview Transcript:

P : What do you think when you see question number 1?
SA : I assume the one with the exponent as u
P : Why?
SA : To find $dx = \cdots$
P : What did you do next?
SA : Substitute what I got into the problem.
P : Then?
SA : Integrate it, ma'am.
P : What method did you apply in answering this question?
SA : Substitution method.
P : How do you check if the answer you got is correct or not?
SA : I don't know, ma'am.

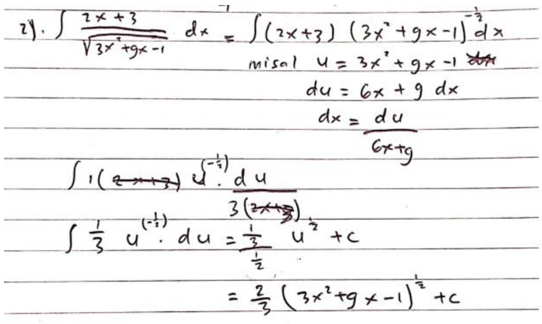

Figure 7. Answer to Question No. 2 Auditory Student (SA)

Interview Transcript:

P : What do you think when you see question number 2?
SA : First, I change the form to be like question number 1.
P : Then?
SA : After the form is the same, I solve it like question number 1.

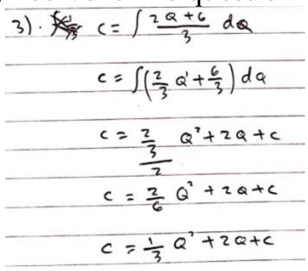

Figure 8. Answer to Question No. 3 Auditory Student (SA)

Interview Transcript:

P : What do you think when you see question number 3?
SA : Find the value of c.
P : How do you do that?
SA : Because both sides contain d, to find the value of c, both sides must be integrated.
P : Why isn't there an integral on the left side?
SA : Oh, right, it should be integrated, but in my answer, I just wrote c directly.
P : Where did you get the c from?
SA : c is obtained from the integral of dc

Based on the interview transcript above, the Auditory Student (SA) was able to answer the questions correctly. In question number 1, SA made an assumption about the function with an exponent, then substituted it into the problem and integrated it. In question number 2, SA transformed the function in the problem that contained a square root into an exponent form, and then changed the problem into the same form as question number 1. After that, SA followed the same steps as in the solution to question number 1. In question number 3, SA integrated the $\boldsymbol{M_C}$ function to find the value of $\boldsymbol{C}$. SA believes that because the function contains $\boldsymbol{d}$, which represents a derivative, the value of $\boldsymbol{C}$ can be obtained by integrating the function.

The stimulation is shown by SA's ability to explore material on integrals, which allowed them to solve the problem using the substitution method. In the Problem Statement phase, SA was able to identify the problem and design a strategy or method to solve the given question. Then, in the data collection phase, SA had already gathered data in the form of steps that could be taken to identify the problem. The data processing phase is demonstrated when SA was able to solve the problem correctly. However, in the verification phase, SA did not realize how to check if the answer obtained was correct or incorrect, using the concept of derivatives. SA also could not make generalizations. There were several steps or actions not written directly by SA, such as in the answer to question number 3. SA directly wrote C without elaborating on the steps.

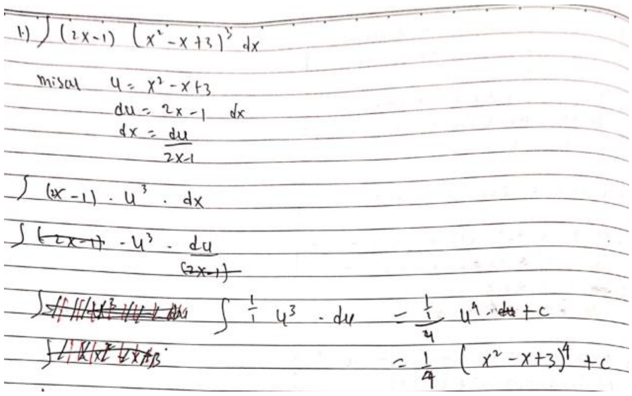

Figure 9. Answer to Question No.1 Kinesthetic Student (SK)

Interview Transcript:

P : What did you do when you first saw question number 1?

SK : I immediately used the substitution method by letting $x^2 - x + 3$ be u (the expression inside the parentheses is what I set as u).

P : Why didn't you set $(2x - 1)$ as u? $2x - 1$ is also inside parentheses.

SV : Because if $2x - 1$ were differentiated, the result would not be the same or of the same type as $x^2 - x + 3$

P : What do you mean by "not of the same type"?

SV : Because the derivative of $2x - 1$ is 2, and 2 does not contain a variable like $x^2 - x + 3$ so $2x - 1$ can't be set as u

P : After you set $x^2 - x + 3$ as u, what did you do next?

SV : After setting it, the problem changed to the variable u, and I solved it using the standard integral formula.

P : Is the answer you got correct?

SV : Yes, ma'am.

P : Are you sure?

SV : Yes, ma'am.

P : How are you so sure?

SV : Yes, ma'am, I have checked it.

P : How did you check it?

SV : I differentiated it, and if the result matches the original problem, then the answer is correct.

P : Why did you use differentiation?

SV : Because the integral is the reverse of differentiation, ma'am.

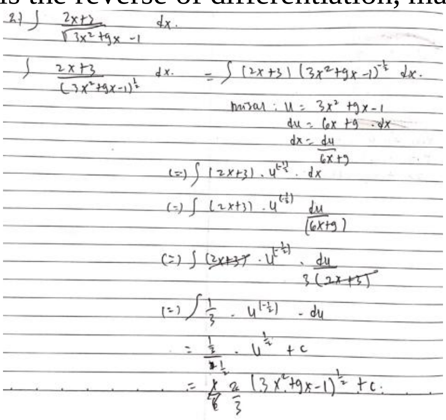

Figure 10. Answer to Question No.2 Kinesthetic Student (SK)

Interview Transcript:

P : What is the first thing you did in question no. 2?
SK : The first thing I did was to convert what's inside the square root into an exponent form.
P : Why exponent $\frac{1}{2}$?
SK : Because the square root is the same as raising to the power of $\frac{1}{2}$
P : Why did it become an exponent of $-\frac{1}{2}$?
SK : Because according to the power rule, if the positive exponent is in the denominator, it becomes a negative exponent.
P : What did you do next?
SK : I set $(3x^2 + 9x - 1)$ as u
P : Then?
SK : I calculated the derivative of u
P : What is the derivative of u?
SK : $6x + 9\ dx$
P : After that, what did you do?
SK : Then I moved dx to the left side.
P : Why?
SK : So that it can be substituted into the equation.
P : What did you do next?
SK : I replaced $3x^2 + 9x - 1$ with u and replaced dx with $\frac{du}{6x+9}$
P : Then?
SK : After that, I factored $6x + 9$ as $3(2x + 3)$, and since $(2x + 3)$ is also in the numerator, it can be cancelled out, leaving $\frac{1}{3}$.
P : What did you do after that?
SK : After that, I integrated using the standard integral formula.

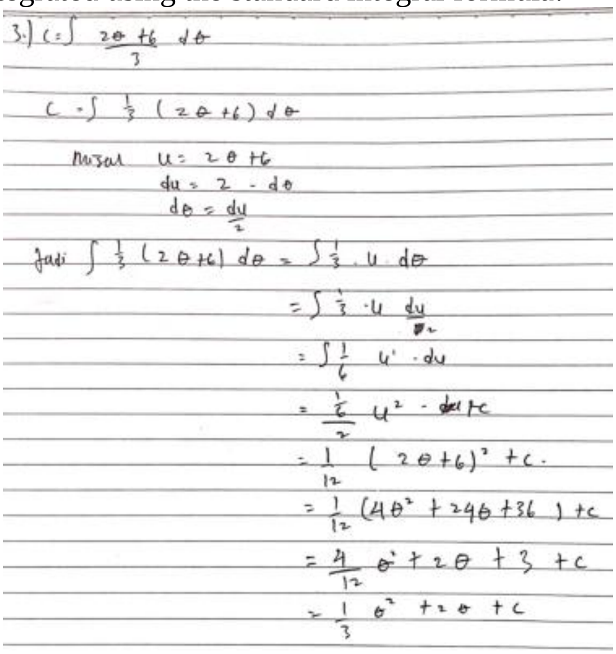

Figure 11. Answer to Question No.3 Kinesthetic Student (SK)

Interview Transcript:

P : What did you think when you saw question no. 3?
SK : To find the value of C.

P : How do you do that?
SK : By integrating it.
P : Why use integration?
SK : Because the problem has a derivative symbol (dC) so to get C, we integrate, since the derivative is the reverse of the integral.
P : Oh, I see. What's the next step?
SK : After that, I let $2Q + 6$ be equal to u, then I calculated the derivative of u, which turned out to be 2, because the 2 matches the one in front of $2Q + 6$, so I could continue using the substitution method.
P : What do you mean by "matches"?
SK : It's the same because there are no variables.
P : What did you do next?
SK : I substituted into the equation, replacing $2Q + 6$ with u and dx with $\frac{du}{2}$
P : Then?
SK : I multiplied $\frac{1}{3}$ by 2
P : Then?
SK : Then I integrated it.

Based on the interview transcript with the Kinesthetic Learner (KL) above, KL demonstrates stimulation by being able to explore the material on integrals, allowing them to solve problems using the substitution method. In the Problem Statement stage, KL is able to identify the problem and design a strategy or method to solve the given question. Then, in the Data Collection stage, KL gathers data regarding the steps that can be taken to identify the problem. The Data Processing stage is shown when KL successfully solves the problem correctly. In the Verification stage, KL knows how to check whether the answer is correct or incorrect by using the concept of derivatives. KL concludes that integration is the reverse of differentiation. This shows that KL has made a generalization.

Discussion

Based on the data analysis results above, the use of the discovery learning model has a significant effect on student learning outcomes, both in the visual, auditory, and kinesthetic groups. The scores of each group increased in the posttest, where the average score for the visual group rose from 62.22 to 85.11, for the auditory group from 66.7 to 73.6, and for the kinesthetic group from 60 to 83.67. The pretest and posttest data for each group are normally distributed, with the significance value for the pretest of the visual and auditory groups being $0.2 > 0.05$ (data is normally distributed), while for the kinesthetic group it is $0.136 > 0.05$. The posttest results also show that the significance values for the visual, auditory, and kinesthetic groups are $0.2 > 0.05$. This indicates that the data is normally distributed. After performing the ANOVA test, it was found that the significance in the homogeneity of variance table was $0.275 > \alpha$, meaning the population variances are homogeneous. Then, in the ANOVA table, it was obtained that $F = 2.142$, significance = $0.027 < \alpha$, so H_o is rejected, indicating that there is a difference in means. Therefore, the use of the discovery learning model affects student learning outcomes.

The Visual Student (VS) has several ways of solving the given problems, where VS solves each problem using two methods. In questions number 1 and 2, VS uses both the substitution method and the quick method. Meanwhile, in question number 3, VS uses the substitution method and direct integration. This is in line with the findings of Puspaningtyas (2019), which explain that students with a visual learning style develop ideas in several ways. The Visual Student knows when to use a method they are familiar with and understands why they use the substitution method, the quick method, or direct integration to solve a problem. This is different from the findings of Trisnaningtyas & Khotimah (2022), which stated that visual learners were unable to explain the justification for the answers they obtained. VS uses the substitution method when they see a function with an exponent, by substituting a more complicated exponent, such as one that involves a square root or is inside parentheses before raising it to a power. VS mentions that if the substituted part is differentiated, and the derivative turns out to be the same (or similar) as the part outside the parentheses, then the problem can definitely be solved using the substitution method. As for the quick method or method 2 used by VS in questions 1 and 2, VS states that this method can only be used for problems that can be solved by the substitution method. VS knows how to check if the answer they obtained is correct. They say the way to check the accuracy of their answer is by differentiating the result they obtained. However, the researcher found that VS was less careful when reading the question because, in the answer to question number 3, VS incorrectly wrote down the function provided in the question, which led to an incorrect answer due to the mistake in writing the problem. Despite this, VS was still able to solve the problem, although with different numbers. A similar situation occurred with auditory student in the study conducted by Tias & Ismail (2023). The error made by auditory student was misreading the question, which led to errors in understanding the problem, errors in transformation, and errors in writing the final answer. The cause of the misreading error among auditory student was their unfamiliarity with reading currency denominations (Rp).

The Auditory Student (SA) is able to solve the problems correctly. SA uses only one method to solve the given problems, which is the substitution method. This is in line with Amir's (2015) findings, which state that the thinking process of auditory subjects involves the subject stating the correct method and answer but only providing one solution method. When the researcher asked how to check if the answer obtained is correct or incorrect, SA replied that they did not know. Looking at the answer sheet, SA skipped many steps in the solution process. SA's answers tend to be brief. This is also in line with the findings of Apipah & Kartono (2017), which state that students with an auditory learning style can write down the problem-solving steps systematically but do not write out the complete solution.

The Kinesthetic Student (SK) is able to answer the questions correctly. SK uses only one method to answer the given questions. SK knows how to check if the answer is correct or incorrect. SK checks the answer by deriving the solution obtained. SK says that if the result of the derivative is the same as the problem, then the answer is correct.

Based on the explanation above, it can be concluded that Visual Students (SV) perform better than Auditory Students (SA) or Kinesthetic Students (SK), The superior performance of visual learners may stem from their ability to internalize visual aids used in discovery learning. This aligns with Csapo & Hayen's (2006) findings on the role of sensory preferences in learning outcomes. Meanwhile, Kinesthetic Students (SK) perform better than Auditory Students (SA). This is in line with the research conducted by Setiana & Purwoko (2020). Setiana & Purwoko (2020) conducted a study on the analysis of critical thinking abilities in relation to students' mathematical learning styles. This study concluded that students' critical thinking abilities vary across different learning styles. This is due to the distinct characteristics of each learning style. The research shows that students with a visual learning style have very good critical thinking abilities, students with an auditory learning style have adequate critical thinking abilities, while students with a kinesthetic learning style have good critical thinking abilities. However, the study conducted by Trisnaningtyas & Khotimah (2022) found different results, where auditory learners outperformed both visual and kinesthetic learners. Auditory learners have high mathematical literacy skills and are able to meet all the indicators of mathematical literacy. In contrast, visual and kinesthetic learners only met some of the indicators of mathematical literacy. However, visual learners performed better than kinesthetic learners.

The results of this study certainly have limitations, such as the limited number of subjects and the limited number of subjects selected for interviews, with only one person from each learning style type, which makes the research results not generalizable. Future research is expected to be conducted in multiple locations and involve more students for interviews in each learning style type so that the results obtained are more valid.

CONCLUSION

Based on the research results and discussion presented above, it can be concluded that learning using the discovery learning model has a significant impact on students' learning outcomes. This study highlights the importance of tailoring discovery learning to accommodate diverse learning styles, particularly emphasizing the strengths of visual learners in integral topics. These findings can provide insights to help educators better understand how to identify and accommodate different learning styles in the classroom. Teachers can be trained in more effective strategies for using visual aids, such as diagrams, charts, or other visual media, to facilitate understanding of complex concepts, especially in integral topics. Additionally, these findings can serve as a foundation for developing a more inclusive curriculum that allows various learning styles to thrive. As a result, tailored discovery learning can improve students' learning outcomes more equitably, optimizing each individual's potential according to their learning style.

RECOMMENDATION

The results of this study are limited to students' skills in the topic of integrals based on differences in cognitive styles, with a limited research sample. Therefore, further research is needed on other topics and aspects with a larger research sample.

ACKNOWLEDGMENT

This study did not receive any specific grants from any funding institutions in the public, commercial, or nonprofit sectors.

REFERENCES

Amir, M. F. (2015). Proses Berpikir Kritis Siswa Sekolah Dasar dalam Memecahkan Masalah Berbentuk Soal Cerita Matematika Berdasarkan Gaya Belajar. *Jurnal Math Educator Nusantara*. Volume 01 Nomor 02.

Amrillah, D., Fatmasari, R., & Santoso, A. (2024). Pengaruh Model Pembelajaran Discovery Learning Terhadap Hasil Belajar Matematika Ditinjau dari Percaya Diri Siswa Sekolah Dasar. Jurnal Studi Guru dan Pembelajaran, Vol.7, No. 2, ISSN 2654-6477.

Apipah, S & Kartono. (2017). Analisis Kemampuan Koneksi Matematis Berdasarkan Gaya Belajar Siswa pada Model Pembelajaran Vak dengan Self Assessment. Unnes Journal of Mathematics Education Research. e-ISSN 2502-4507. 148 – 156

Bire, A. L., Geradus, S., & Bire, J. (2014). Pengaruh Gaya Belajar Visual, Auditorial, dan Kinestetik Terhadap Prestasi Belajar Siswa. JURNAL KEPENDIDIKAN, Volume 44, Nomor 2. 168-174

Chislett, V & Chapman, A. 2005. *VAK Learning Styles Self Assesment Questionnaire.* http://www.businessballs.com. Diakses 24 April 2015.

Creswell JW, Clark VLP, 2011, *Designing and Conducting Mixed Methods Research*, California: SAGE.

Csapo, N & Hayen, R. (2006). The Role Of Learning Styles In The Teaching/Learning Process. Issues in Information Systems. Volume VII, No. 1. 129-133.

Magfirah, I., Ode, R., & Kasriana. (2022). Pengaruh Model Pembelajaran Discovery Learning Terhadap Hasil Belajar Matematika Siswa. *Jurnal Pendidikan dan Konseling*. Vol. 4 No. 6 (2022), E-ISSN: 2685-936X.

Puspaningtyas, N,D.(2019). Proses Berpikir Lateral Siswa Sd Dalam Menyelesaikan Masalah Matematika Open-Ended Ditinjau Dari Perbedaan Gaya Belajar. Majamath. Volume 2 Nomor 2. 80-86.

Riener, C & Willingham, D. (2010). The Myth of Learning Styles, Change: The Magazine of Higher Learning, 42:5, 32-35, DOI: 10.1080/00091383.2010.503139

Setiana, D. S., & Purwoko, R. Y. (2020). Analisis kemampuan berpikir kritis ditinjau dari gaya belajar matematika siswa. Jurnal Riset Pendidikan Matematika, 7(2) 163–177. https://doi.org/10.21831/jrpm.v7i2.34290

Simamora, R. E., Saragih, S., & Hasratuddin. (2019). Improving Students' Mathematical Problem Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context. International Electronic Journal Of Mathematics Education. e-ISSN: 1306-3030. 2019, Vol. 14, No. 1, 61-72 . https://doi.org/10.12973/iejme/3966

Sulistyowati, N., Widodo, A.T., & Sumarni, W. (2012). Efektivitas model pembelajaran guided discovery learning terhadap kemampuan pemecahan masalah kimia. *Chemistry in Education*. ISSN: 2252-6609. 2 (1) (2012), 50-55.

Tias, A. A., & Ismail. (2023). Analisis Kesalahan Siswa SMA dalam Menyelesaikan Soal Cerita Matematika SPLTV Berdasarkan Prosedur Newman Ditinjau dari Gaya Belajar. *MATHEdunesa*. p-ISSN: 2301-9085, Vol. 12 No. 2, 359-371.

Trisnaningtyas, N. O., & Khotimah, R. P. (2022). Analisis kemampuan literasi matematis dalam menyelesaikan soal akm ditinjau dari gaya belajar. *Jurnal Program Studi Pendidikan Matematika*. ISSN 2442-5419, Volume 11, No. 4, 2022, 2714-2724.

Yuliana, N. (2018). Penggunaan Model Pembelajaran *Discovery Learning* Dalam Peningkatan Hasil Belajar Siswa Di Sekolah Dasar. *Jurnal Ilmiah Pendidikan dan Pembelajaran*. *P-ISSN : 1858-4543 E-ISSN :* 2615-6091.