Journal of Educational Sciences
Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES

P-ISSN 2581-1657
E-ISSN 2581-2203

# Analysis of Students' Ability at SMP Negeri 1 Sigi in Solving Direct Proportion Problems Based on Learning Styles

**Herawati*, Mustamin Idris, Bakri M, Fajriani**
*Mathematics Education, Faculty of Teacher Training and Education, Tadulako University, Palu, 94148, Indonesia.*

**ARTICLE INFO**

*Article history*:

Received: 04 June 2026
Accepted: 20 July 2026
Available Online: 25 July 2026

*Keywords:*

Analysis,
Direct Proportion,
Learning Styles,
Problem-Solving Ability

** Corresponding author:*

E-mail: heraping210@gmail.com

*Article Doi:*

https://doi.org/10.31258/jes.10.7.p.1066-1086



**A B S T R A C T**

Based on initial observations at SMP Negeri 1 Sigi, 65% of students had not reached the Minimum Mastery Criteria (KKM) due to difficulties in understanding word problems, performing cross-multiplication, and conventional teaching that overlooks diverse learning styles. This study aims to analyze students' mathematical problem-solving abilities on direct proportion topics from the perspective of Visual, Auditory, and Kinesthetic (VAK) learning styles. Employing a descriptive qualitative approach, data were collected using a VAK questionnaire, a written essay test structured around Polya's four steps, and semi-structured interviews. Data were analyzed using the Miles and Huberman model and validated via member checking. The results revealed that the visual subject (MAS) fulfilled all Polya indicators systematically and comprehensively. The auditory subject (VAT) also met all indicators, demonstrating highly meticulous calculations. Conversely, the kinesthetic subject (MN) failed to complete the last two indicators for Problem 2 due to rushed and inaccurate multiplication operations. In conclusion, learning styles significantly influence students' problem-solving abilities, where visual students excel in comprehensive understanding, auditory students dominate in calculation precision, and kinesthetic students are constrained by a lack of meticulousness in abstract calculations.

## 1. Introduction

Mathematics is one of the most fundamental and universally applicable branches of knowledge in human life. It underpins scientific and technological advancement, and its application spans a wide range of daily activities, from market transactions to architectural design and computer programming. As stated by Ni'mah et al., (2024), Mathematics forms the foundation of technological and scientific progress worldwide, as nearly all aspects of everyday life are interconnected with mathematical problems and are structured in an organized and comparative manner.

Given this significance, mathematics is taught at every level of formal education, from kindergarten through higher education. In line with this view, S. Abbas et al., (2025) affirmed that mathematics occupies a central role at every stage of learning, since instructional design at each level must be tailored to how students receive, process, and construct mathematical understanding.

Among the various topics in the school mathematics curriculum, direct proportion is one of the most important and practically relevant concepts for junior high school students. According to Indonesia's Merdeka Curriculum, this topic is taught in the second semester of Grade VII. Rahmawati, (2023) emphasized that mastery of the direct proportion concept is critically important, as it serves as a prerequisite for understanding more advanced mathematical topics such as linear functions, graphing, and trigonometry. Direct proportion describes the relationship between two quantities where an increase in one quantity leads to a proportional increase in the other, and vice versa. This concept is widely applied in real-life contexts such as calculating prices, distances, and resource allocation.

Despite its importance, many students continue to struggle with solving direct proportion problems. Preliminary observations conducted at SMP Negeri 1 Sigi revealed that approximately 65% of students had not yet reached the Minimum Mastery Criterion (KKM). The difficulties encountered by students included confusion in identifying proportional values, errors in performing cross-multiplication operations, and challenges in translating word problems into mathematical models. These findings suggest that students' ability to solve direct proportion problems remains a critical concern that warrants further investigation.

One of the key factors influencing students' mathematical problem-solving ability is learning style. Research by Fransiska et al., (2019), Suggest That found a significant correlation between learning styles and mathematical problem-solving ability, indicating that students whose learning styles are aligned with the instructional methods employed by their teachers tend to achieve better academic outcomes. Research By Yusuf Ain et al., (2023), Suggest That categorized learning styles into three primary types: visual, auditory, and kinesthetic (VAK). Visual learners tend to process information most effectively through visual stimuli such as diagrams and graphs. Auditory learners rely primarily on hearing, preferring verbal explanations and discussion. Kinesthetic learners, by contrast, learn best through direct physical engagement and hands-on experience.

The differentiated nature of these learning styles has important implications for mathematics instruction. Visual learners find it easier to understand proportional concepts through graphs and diagrams, while auditory learners perform better with verbal explanations, and kinesthetic learners benefit most from practical activities. Furthermore, Agus Budi Santosa et al., (2020) found that the use of multimedia learning tools can simultaneously accommodate multiple learning styles and improve students' understanding of direct proportion concepts. Despite the growing recognition of these differences, teaching practices at SMP Negeri 1 Sigi remain predominantly conventional, relying on lecture-based methods and written exercises without adequately accommodating the diversity of student learning

styles. Interviews with mathematics teachers at the school confirmed that this lack of differentiation has contributed to reduced motivation and comprehension among students whose preferred learning styles are not addressed.

Several prior studies have examined related aspects of this issue mathematical problem-solving ability in proportion topics from the perspective of mathematical disposition, finding that higher disposition levels correlated with stronger problem-solving performance. Explored critical thinking skills in solving circle problems based on learning styles, demonstrating that kinesthetic learners fulfilled the most critical thinking indicators. Analyzed mathematical literacy in PISA-type problems by learning style at SMP Negeri 1 Palopo, revealing that kinesthetic learners demonstrated slightly higher literacy levels than visual and auditory learners. Examined students' ability to solve word problems on direct and inverse proportion, concluding that students' abilities remained generally low, particularly in applying formulas and verifying answers. Specifically investigated proportional reasoning among auditory learners, finding that most students reached only the qualitative level of proportional reasoning.

Examined mathematical beliefs in algebra problem-solving viewed from learning styles, finding that self-efficacy patterns differed markedly across visual, auditory, and kinesthetic students. In a study conducted at the same school as the present research, conceptual understanding of the Pythagorean Theorem based on learning styles and found that all three learning-style groups fulfilled the conceptual indicators but exhibited distinct thinking-process characteristics. Differentiated Teams Games Tournament model incorporating Polya's problem-solving stages improved elementary students' mathematics achievement, underscoring the value of aligning instruction with Polya's framework. Research By Ayu et al., (2026) further emphasized, in a literature review of junior high school students' mathematical representation ability, that learning styles are among the key factors influencing how students translate problems into mathematical models. While these studies provide valuable insights, none specifically examine all three VAK learning styles in the context of direct proportion problem-solving using Polya's procedural framework at the junior high school level.

To analyze students' problem-solving ability systematically, this study adopts Polya's four-step procedure, which comprises: (1) understanding the problem, (2) devising a plan, (3) carrying out the plan, and (4) looking back at the result. This framework is widely regarded as the most practical and structured approach to mathematical problem-solving, and its application provides clear and measurable indicators for evaluating student performance at each stage of the solution process.

## 2. Methodology

This study employed a qualitative approach with a descriptive analysis research design. Descriptive qualitative research aims to describe phenomena or existing conditions in a detailed and systematic manner, with emphasis on the context, meaning, and processes involved. The study was conducted at SMP Negeri 1 Sigi,

located at Jalan Karanja Lemba No. 21, Mpanau, Sigi Biromaru District, Sigi Regency, Central Sulawesi, during the second semester of the 2025/2026 academic year.

The research subjects were selected from students of class VII A at SMP Negeri 1 Sigi, totaling 28 students. Subject selection was carried out by grouping students based on their learning style results, namely visual, auditory, and kinesthetic learning styles. The grouping was obtained by administering a learning style questionnaire. From each learning style, the student with the highest score was identified, and the researcher then selected only 3 students one with a visual learning style, one with an auditory learning style, and one with a kinesthetic learning style. To facilitate data collection, the researcher selected high ability students as the sample from each learning style. In determining high ability students, the researcher consulted and requested recommendations from the mathematics subject teacher.

The data collection techniques employed were a learning style questionnaire, written tests, and interviews. The learning style questionnaire used in this study was a closed-ended questionnaire. The written test on proportional reasoning was validated by a mathematics education lecturer, Drs. I Nyoman Murdiana, M.Pd., to ensure content validity and alignment with the four Polya's problem-solving indicators used. The interview guide was also validated to gather clearer information regarding students' ability to solve proportional problems in accordance with Polya's problem-solving steps. The data credibility checking technique in this qualitative research was conducted using member checking, in which each subject was given two written tests, S1 and S2, at different times. These tests were administered to obtain data regarding each subject's ability to solve the problems.

The data analysis technique in this study refers to qualitative data analysis according to Miles and Huberman, namely: Data Condensation, Data Display, and Conclusion Drawing Data condensation refers to the process of selecting, focusing, simplifying, abstracting, and transforming data that approximates the entirety of written field notes, interview transcripts, documents, and empirical materials. Data display is the process of organizing, unifying, and Summarizing relevant information from the existing data. Through data display, complex information can be broken down into a more structured and easily understood form. The conclusion drawing activity in this study was carried out by describing the results of the data display in relation to Polya's problem-solving indicators that had been achieved by the students, which were then analyzed so that conclusions could be drawn from the data presentation (Ningi, 2022).

## 3. Results and Discussion

Prior to the main data collection, the researcher coordinated with the mathematics teacher of class VII A to schedule the research activities. The teacher introduced the researcher to the students and explained the purpose of the study. The researcher

then distributed the VAK learning style questionnaire to all 28 students of class VII A and gave them adequate time to complete it independently. After collecting and analyzing the questionnaire results, the teacher assisted the researcher in identifying one representative student from each learning style category based on both the questionnaire outcomes and the teacher's knowledge of each student's academic and communicative characteristics. The three selected subjects were: subject MAS representing the visual learning style, subject VAT representing the auditory learning style, and subject MB representing the kinesthetic learning style.

The selected subjects then participated in two rounds of written tests on students' ability to solve proportional problems, conducted at different times for member-checking purposes. Following each test, the researcher conducted individual semi-structured interviews with each subject to explore their abilities and verify their written answers. All interview sessions were recorded and transcribed for analysis. The data from the written tests and interviews were then analyzed using the Miles and Huberman model to construct an analysis of each subject's ability based on four indicators: (1) understanding the problem, (2) devising a plan, (3) carrying out the plan, and (4) looking back.

### *Research Results*

Data analysis is adjusted to the student capability indicators used in this study. The data analysis is conducted with the aim of obtaining a description of the students' ability to solve proportional problems. The analysis of student ability is measured using Polya's four indicators, namely understanding the problem, devising a plan, carrying out the plan, and looking back. Based on the presentation of data credibility in the previous section, it was found that MAS, VAT, and MN stated that the answers to problem 1 and problem 2, as well as the interview results, were genuine, thereby confirming the credibility of the data.

### *Analysis of the Ability of the Student with a Visual Learning Style (MAS) in Question 1*

a) Understanding the problem

The written test results of subject MAS in understanding the problem direct proportion problem that has been learned are presented in Figure 1.

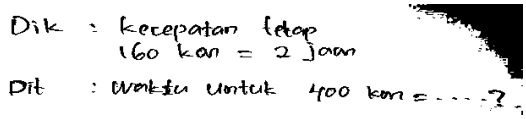


Figure 1. MAS's answer for "Understand the Problem" on Question 1 (visual learner)

Based on Figure 1 the written test results, the subject was able to understand all the information in the problem well by defining the known and asked elements. This indicator emphasizes the students' ability to write down information from the

problem, which aims to measure the extent to which students are capable of understanding the problem and devising a resolution strategy. This analysis is supported by the results of the interview conducted with the visual subject as follows:

PN105 : Alright, can you understand this problem? MAS106 : Yes, I can, ma'am/sir.
PN107 : Alright then, can you explain what you understood on the answer sheet you made?
MAS108 : First, ma'am/sir, what is known is the constant speed 160 km in 2 hours. And what is being asked is how many hours are needed to travel a distance of 400 km.

b) Make a Plan

The written test results of subject MAS in make a plan for a direct proportion that has been learned are presented in Figure 2.

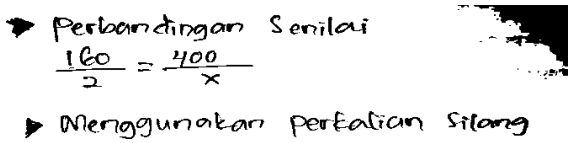


Figure 2. MAS's answer for "Make a Plan" on Question 1 (visual learner)

This analysis is supported by the results of the interview conducted with the visual subject as follows:

PN111 : Alright, after that, what did you do next?
MAS112 : After that, I used a direct proportion, which is:

$$\frac{160}{2} = \frac{400}{x}$$

Then I used cross multiplication.

c) Carry out the Plan

The written test results of subject MAS in carrying out a plan for a direct proportion that has been learned are presented in Figure 3.

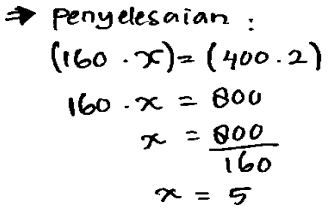


Figure 3. MAS's answer for "Carry out the Plan" on Question 1 (visual learner)

This analysis is supported by the results of the interview conducted with the visual subject as follows:

PN111 : Alright, after that, what did you do next?
MAS112 : After that, I used a direct proportion, which is:

$$\frac{160}{2} = \frac{400}{x}$$

Then I used cross multiplication: 160 . x = 2 x 400
then: x = (2 x 400) / 160 which gives: x = 800 / 160 then dividing it gives x = 5

d) Check again

The written test results of subject MAS in check again at a direct proportion that has been learned are presented in Figure 4.

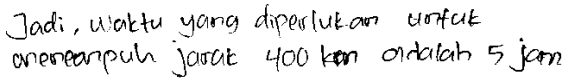
Jadi, waktu yang diperlukan untuk
mereampuh jarak 400 km adalah 5 jam

Figure 4. MAS's answer for "Check Again" on Question 1 (visual learner)

This analysis is supported by the results of the interview conducted with the visual subject as follows:

PN113 : Alright. After getting the answer, can you conclude it?
MAS114 : Yes, I can, ma'am/sir. So the conclusion is, the time needed is 5 hours.

***Analysis of the Abilities of Students with Visual Learning Style (MAS) in Question 2***

a) Understand the Problem

The written test results of subject MAS in understanding the problem direct proportion problem that has been learned are presented in Figure 5.

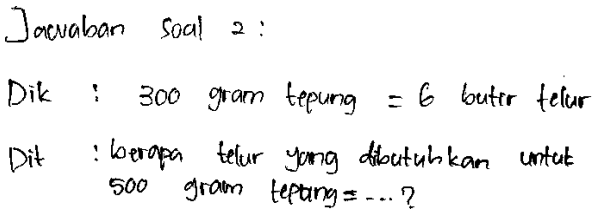
Jawaban Soal 2 :
Dik : 300 gram tepung = 6 butir telur
Dit : berapa telur yang dibutuhkan untuk
500 gram tepung = ... ?

Figure 5. MAS's answer for "Understand the Problem" on Question 2 (visual learner)

Based on the written test results, the visual subject was able to understand all the information in the problem well by defining the known and asked elements. This

indicator emphasizes the students' ability to write down information from the problem, which aims to measure the extent to which students are capable of understanding the problem and devising a resolution strategy for problem 2.

This analysis is supported by the results of the interview conducted with the visual subject as follows:

PN209 : Alright, try to explain what you understood.
MAS210 : First, what is known is 300 grams of flour = 6 eggs.
PN211 : Alright, how did you know that?
MAS212 : From the question in the problem, ma'am/sir.
PN213 : Alright, after that, what did you do next?
MAS214 : After that, I identified what was being asked, ma'am/sir.
PN215 : Alright, what is being asked in the problem?
MAS216 : What is being asked is how many eggs are needed for 500 grams of flour.

b) Make a Plan

The written test results of subject MAS in make a plan for a direct proportion that has been learned are presented in Figure 6.

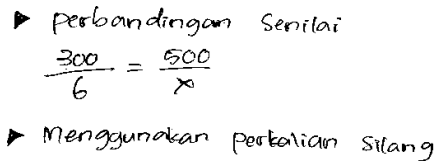


Figure 6. MAS's answer for "Make a Plan" on Question 2 (visual learner)

This analysis is supported by the results of the interview conducted with the visual subject as follows:

PN217 : Alright, after that, what did you do?
MAS218 : After that, I used a direct proportion, which is:

$$\frac{300}{6} = \frac{500}{x}$$

Then I used cross multiplication: 300 . x = 6 x 500

c) Carry out the Plan

The written test results of subject MAS in carrying out a plan for a direct proportion that has been learned are presented in Figure 7.

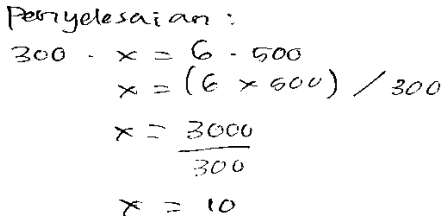


Figure 7. MAS's answer for "Carry out the Plan" on Question 2 (visual learner)

This analysis is supported by the results of the interview conducted with the visual subject as follows:

PN219 : Alright, after that, what else did you do?
MAS220 : Then I substituted: x = (6 x 500) / 300 which gives: x = 3000 / 300 then dividing it gives x = 10.

d) Check again

The written test results of subject MAS in check again at a direct proportion that has been learned are presented in Figure 8.

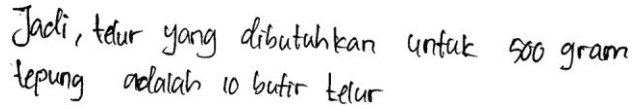


Figure 8. MAS's answer for "Check Again" on Question 2 (visual learner)

This analysis is supported by the results of the interview conducted with the visual subject as follows:

N221 : Alright, so what is the conclusion?
MAS222 : So, the number of eggs needed for 500 grams of flour is 10 eggs.

***Analysis of the Abilities of Students with Auditory Learning Style (VAT) in Question 1***

a) Understand the Problem

The written test results of subject VAT in understanding the problem direct proportion problem that has been learned are presented in Figure 9.

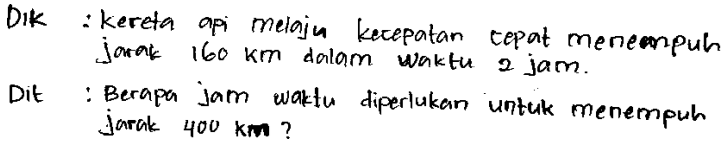


Figure 9. VAT's answer for "Understand the Problem" on Question 1 (auditory learner)

Based on the written test results, the subject was able to understand all the information in the problem well. This indicator emphasizes the students' ability to write down information from the problem, which aims to measure the extent to which students are capable of understanding the problem and devising a resolution strategy. This analysis is supported by the results of the interview conducted with the auditory subject as follows:

PN107 : Alright, can you explain what you understood on the answer sheet you made?
VAT108 : First, ma'am/sir, what is known is the constant speed, which is 160 km in 2 hours. And what is being asked is how many hours are needed to travel a distance of 400 km?

b) Make a Plan

The written test results of subject VAT in make a plan for a direct proportion that has been learned are presented in Figure 10.

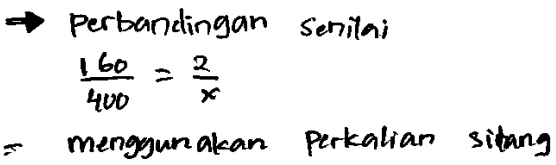


Figure 10. VAT's answer for "Make a Plan" on Question 1 (auditory learner)

This analysis is supported by the interview collected by the researcher with the auditory subject:

PN111 : Alright, after that, what did you do next?
VAT112 : After that, I planned the solution, ma'am/sir.
PN113 : Alright, after planning the solution, what did you do?
VAT114 : I made a direct proportion, which is:

$$\frac{160}{6} = \frac{400}{x}$$

c) Carry out the Plan

The written test results of subject VAT in carrying out a plan for a direct proportion that has been learned are presented in Figure 11.

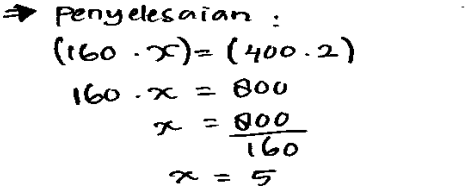


Figure 11. VAT's answer for "Carry out the Plan" on Question 1 (auditory learner)

This can be observed from the interview results collected by the author with the auditory subject:

PN115 : Alright, after that, what was your next step?
VAT116 : The next step, ma'am/sir, I used cross multiplication: 160 . x = 2 x 400 then: x = (2 x 400) / 160 which gives: x = 800 / 160 then dividing it gives x = 5.

d) Check again

The written test results of subject VAT in check again at a direct proportion that has been learned are presented in Figure 12.

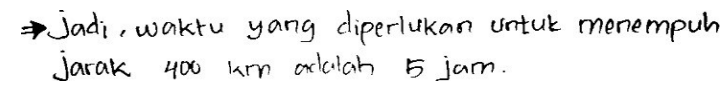


Figure 12. VAT's answer for "Check Again" on Question 1 (auditory learner)

This analysis can be observed from the interview results collected by the researcher with the auditory subject based on:

PN117 : Alright, can you conclude it?
VAT118 : Yes, I can, ma'am/sir. So, the time needed is 5 hours.
PN119 : Alright, are you sure about your answer?
VAT120 : Yes, I am sure, ma'am/sir.

***Analysis of the Abilities of Students with Auditory Learning Style (VAT) in Question 2***

a) Understand the Problem

The written test results of subject VAT in understanding the problem direct proportion problem that has been learned are presented in Figure 13.

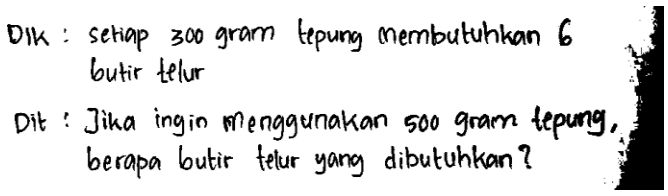


Figure 13. VAT's answer for "Understand the Problem" on Question 2 (auditory learner)

Based on the written test results, the auditory subjects could understand all the information in the question well. This indicator emphasizes the students' ability to write down information from the question, aiming to measure the extent to which students can understand the problem and devise a solution strategy. This analysis is supported by the results of interviews conducted with the visual subject as follows:

PN209 : Alright, what do you understand from problem number 2?
VAT210 : What I understand is the information that is known from the problem, ma'am/sir.
PN215 : Alright, try to explain what you understood.
VAT216 : First, what is known is 300 grams of flour = 6 eggs.

b) Make a Plan

The written test results of subject VAT in make a plan for a direct proportion that has been learned are presented in Figure 14

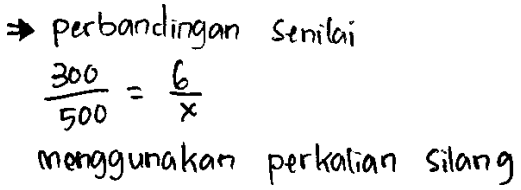


Figure 14. VAT's answer for "Make a Plan" on Question 2 (auditory learner)

This analysis is supported by the interview data collected by the researcher with the auditory subject:

PN219 : Alright, after that, what did you do?
VAT220 : I planned the solution using a direct proportion, which is:

$$\frac{300}{6} = \frac{500}{x}$$

PN221 : Alright, after that, what did you do next?
VAT222 : I used cross multiplication, ma'am/sir.

c) Carry out the Plan

The written test results of subject VAT in carrying out a plan for a direct proportion that has been learned are presented in Figure 15.

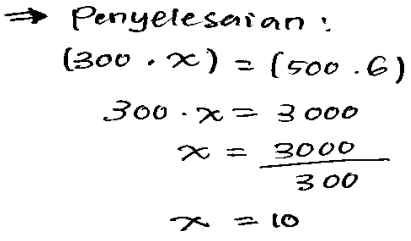


Figure 15. VAT's answer for "Carry out the Plan" on Question 2 (auditory learner)

This analysis can be seen through the interview data collected by the researcher with the auditory subject:

PN223 : Alright, what was your next step?

VAT224 : The next step, I carried out the solution plan, which is: 300 . x = 6 x 500 then: x = (6 x 500) / 300 which gives: x = 3000 / 300 then dividing it gives x = 10.
PN225 : Alright, are you sure this answer is correct?
VAT226 : Yes, I am sure, ma'am/sir.

d) Check again

The written test results of subject VAT in check again at a direct proportion that has been learned are presented in Figure 16

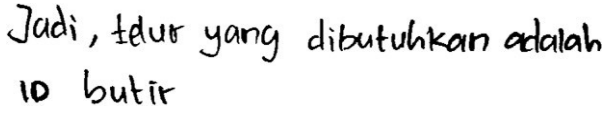


Figure 16. VAT's answer for "Check Again" on Question 2 (auditory learner)

This analysis can be seen through the interview data collected by the researcher with the auditory subject:

PN227 : Alright, so what is the conclusion?
VAT228 : So the conclusion is, the number of eggs needed for 500 grams of flour is 10 eggs.

***Analysis of the Abilities of Students with Kinesthetic Learning Style (MN) in Question 1***

a) Understand the Problem

The written test results of subject MN in understanding the problem direct proportion problem that has been learned are presented in Figure 17

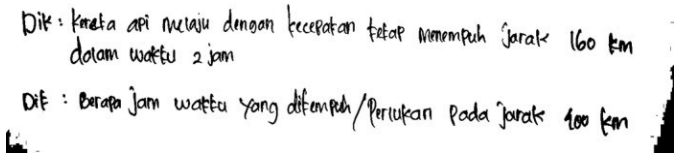


Figure 17. MN's answer for "Understand the Problem" on Question 1 (kinesthetic learner)

This analysis can be seen through the interview data collected by the researcher with the kinesthetic subject:

PN107 : Alright, can you explain what you understood on the answer sheet you made?
MN108 : First, ma'am/sir, what is known is the constant speed, which is 160 km in 2 hours. And what is being asked is how many hours are needed to travel a distance of 400 km?

b) Make a Plan

The written test results of subject MN in make a plan for a direct proportion that has been learned are presented in Figure 18

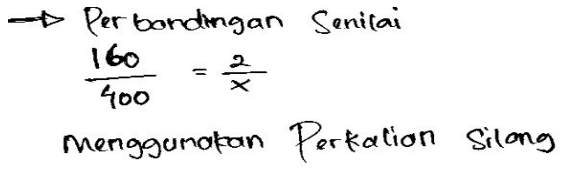


Figure 18. MN's answer for "Make a Plan" on Question 1 (kinesthetic learner)

This analysis can be seen through the interview data collected by the researcher with the kinesthetic subject:

PN111 : Alright, after that, what did you do next?
MN112 : After that, I planned the solution using a direct proportion, ma'am/sir.
PN113 : Alright, after planning the solution using a direct proportion, what did you do?
MN114 : I used cross multiplication, which is:

$$\frac{160}{2} = \frac{400}{x}$$

c) Carry out the Plan

The written test results of subject MN in carrying out a plan for a direct proportion that has been learned are presented in Figure 19.

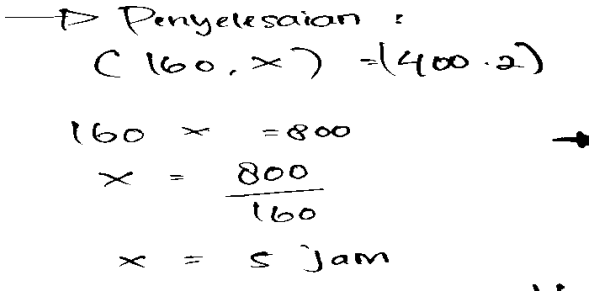


Figure 19. MN's answer for "Carry out the Plan" on Question 1 (kinesthetic learner)

This analysis can be seen through the interview data collected by the researcher with the kinesthetic subject:

PN115 : Alright, after that, what was your next step?
MN116 : The next step, I carried out the solution plan, which is: 160 . x = 2 x 400 then: x = (2 x 400) / 160 which gives: x = 800 / 160 then dividing it gives x = 5.
PN119 : Okay, alright, are you sure about your answer?
MN120 : Yes, I am sure, ma'am/sir.

d) Check again

The written test results of subject Mn in check again at a direct proportion that has been learned are presented in Figure 20.

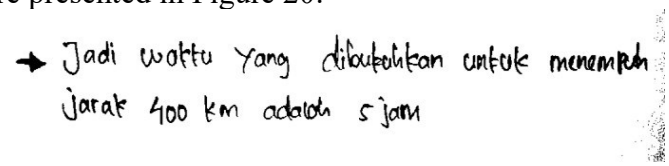


Figure 20. MN's answer for "Check Again" on Question 1 (kinesthetic learner)

This analysis can be seen through the interview data collected by the researcher with the kinesthetic subject:

PN121 : Alright, so what is the conclusion?
MN122 : So the conclusion is, the time needed is 5 hours.

***Analysis of the Abilities of Students with Kinesthetic Learning Style (MN) in Question 2***

a) Understand the Problem

The written test results of subject MN in understanding the problem direct proportion problem that has been learned are presented in Figure 21

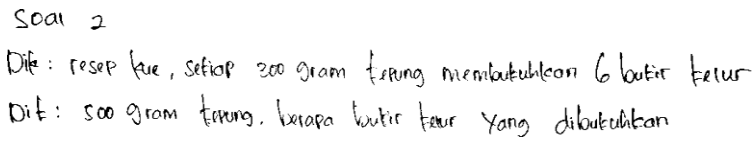


Figure 21. MN's answer for "Understand the Problem" on Question 2 (kinesthetic learner)

Based on the written test results, the kinesthetic subject could understand all the information in the question well. This indicator emphasizes the student's ability to write down information from the question, aiming to measure the extent to which the student can understand the problem and devise a solution strategy. This analysis is supported by the results of the interview conducted with the kinesthetic subject as follows:

PN207 : Alright, try to explain what you understood.
MN208 : First, ma'am/sir, what is known is that 300 grams of flour requires 6 eggs.
PN213 : Alright, what is being asked in the problem?
MN214 : What is being asked is, if you want to use 500 grams of flour, how many eggs are needed?

b) Make a Plan

The written test results of subject MN in make a plan for a direct proportion that has been learned are presented in Figure 22.

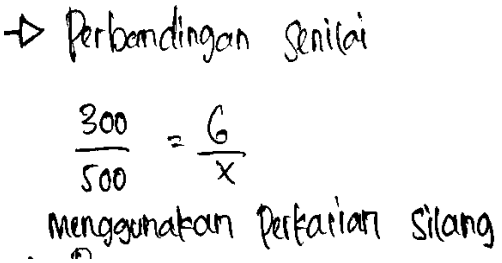


Figure 22. MN's answer for "Make a Plan" on Question 2 (kinesthetic learner)

This analysis can be seen through the interview data collected by the researcher with the kinesthetic subject:

PN215 : Alright, after that, what did you do?
MN216 : I planned the solution using a direct proportion, which is:

$$\frac{160}{2} = \frac{400}{x}$$

PN217 : Alright, after that, what did you do next?
MN218 : I used cross multiplication, ma'am/sir.

c) Carry out the Plan

The written test results of subject MN in carrying out a plan for a direct proportion that has been learned are presented in Figure 23.

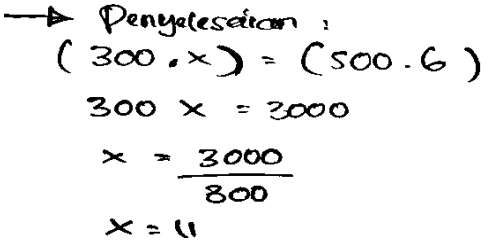


Figure 23. MN's answer for "Carry out the Plan" on Question 2 (kinesthetic learner)

This analysis can be seen through the interview data collected by the researcher with the kinesthetic subject:

PN219 : Alright, after that, what else did you do?
MN220 : After that, I carried out the solution plan, which is: 300 . x = 6 x 500 then: x = (6 x 500) / 300 which gives: x = 3000 / 300 then dividing it gives x = 11.
PN221 : Alright, are you sure this answer is correct?

MN222 : Yes, I am sure, ma'am/sir.

d) Check again

The written test results of subject MN in check again at a direct proportion that has been learned are presented in Figure 24.

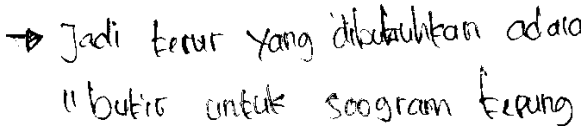


Figure 24. MN's answer for "Check Again" on Question 2 (kinesthetic learner)

This analysis can be seen through the interview data collected by the researcher with the kinesthetic subject:

PN223 : Alright, so what is the conclusion?
MN224 : So the conclusion is, the number of eggs needed for 500 grams of flour is 11 eggs.

***Discussion***

***Analysis of Students' Mathematical Abilities Reviewed from Visual Learning Style***

Based on the data analysis of subject MAS successfully fulfilled all four Polya indicators on both problems. MAS was able to identify known and unknown information, formulate a proportional value comparison and cross-multiplication plan, execute the calculation accurately (yielding x = 5 for Problem 1 and x = 10 for Problem 2), and provide correct conclusions, who state that visual learners generally demonstrate strong understanding when processing information that can be represented systematically, such as through diagrams, tables, or proportional comparisons; in this study, MAS's accuracy on both problems supports the view that visual learners' reliance on sight enables them to comprehend the proportional relationship between quantities holistically before calculating. At the same time, this result only partially aligns who note that visual learners tend to rely on mental imagery rather than verbal instructions and consequently sometimes struggle to transfer information into a precise mathematical model; in the present case, MAS did not exhibit this difficulty, suggesting that the relatively concrete, table-friendly structure of the direct proportion problems used here may have mitigated the verbal-transfer weakness reported in that earlier study.

***Analysis of Students' Mathematical Abilities Reviewed from Auditorial Learning Style***

Based on the data analysis of subject VAT similarly demonstrated competence across all four indicators on both problems. VAT accurately identified the given information, devised a cross-multiplication strategy, executed the calculations

correctly, and drew logical conclusions. Research by Chania et al., (2017) who note that auditory learners, while primarily dependent on verbal comprehension, are generally precise in transferring information into accurate mathematical form once the problem has been understood aurally. VAT's consistent accuracy across both problems supports this pattern and suggests that verbal mediation reading the problem aloud or restating it in one's own words helped the subject construct the correct cross-multiplication strategy and verify the result, reinforcing the pedagogical value of discussion-based scaffolding for auditory learners.

### *Analysis of Students' Mathematical Abilities Reviewed from Kinestetik Learning Style*

Based on the data analysis of subject MN showed different performance across the two problems. On Problem 1, MN fulfilled all four Polya indicators, demonstrating the ability to understand, plan, execute, and conclude correctly. However, on Problem 2, MN made a calculation error during the execution stage, arriving at x = 11 instead of the correct answer of 10, which caused both the third and fourth indicators to go unmet. As noted by Konilah et al., (2022), kinesthetic learners often struggle with precision when reading problems and transferring abstract information into mathematical notation, and their difficulty tends to surface specifically at the calculation and verification stages rather than at the comprehension stage. MN's pattern correct on Problem 1 but miscalculating on Problem 2 is consistent with the characterization of kinesthetic learners as being comfortable with concrete, hands-on engagement with a problem's structure but less consistent in sustaining the careful, step-by-step symbolic manipulation that cross-multiplication requires, particularly as problem complexity increases.

Overall, these findings indicate that learning style significantly influences students' ability to solve proportional value problems. Visual and auditory learners demonstrated consistent competence across both problems, while the kinesthetic learner exhibited strengths in the early stages but encountered difficulties in accurate calculation and conclusion-drawing on the more complex problem. This pattern reinforces who similarly found that structured, comparison-based mathematics tasks reveal differentiated reasoning strengths that closely follow students' preferred modes of processing information, underscoring the need for problem designs and instructional supports that are responsive to these individual differences rather than assuming a uniform path to mastery (Lisnawati & Nirmala, 2024).

These results carry concrete implications for classroom practice. Teachers can accommodate visual learners by presenting direct proportion relationships through tables, diagrams, or graphs that make the proportional structure explicit; support auditory learners through verbal explanation, think-aloud modeling, and peer discussion of the solution steps; and help kinesthetic learners by incorporating manipulative or hands-on activities such as physically arranging quantities or using counting objects paired with explicit practice in checking calculations before concluding an answer.

Designing differentiated learning activities that combine these representations within a single lesson, rather than relying on a single conventional method, would allow each learning-style group to engage with direct proportion problems through the representation that suits it best, while specifically targeting kinesthetic learners' need for structured calculation-checking routines to reduce computational errors on more complex problems. Consistent with this recommendation, Research By Novitasari et al., (2026) demonstrated that carefully structured, model-based learning approaches meaningfully improve students' mathematical learning outcomes, while Mustaqim, (2016) showed that augmented-reality and other interactive visual media can strengthen numeracy performance for students who benefit most from concrete visual representation. For kinesthetic learners specifically, game-based, hands-on activities such as the Team Games Tournament approach studied offer a promising avenue for combining physical engagement with the structured practice needed to build calculation accuracy (Wahida et al., 2025).

## 4. Conclusion

This study analyzed the ability of students at SMP Negeri 1 Sigi in solving proportional value problems based on their learning styles, using the four Polya indicators: understanding the problem, devising a plan, carrying out the plan, and looking back. The findings reveal that learning style significantly influences students' problem-solving ability. Students with a visual learning style successfully fulfilled all four Polya indicators on both problems, demonstrating strong ability to identify relevant information, formulate a solving strategy, execute calculations accurately, and draw correct conclusions. Students with an auditory learning style similarly fulfilled all four indicators on both problems, showing consistent competence in understanding, planning, executing, and concluding their solutions accurately. In contrast, students with a kinesthetic learning style showed varying performance across the two problems. While all four indicators were fulfilled on the first problem, the student made a calculation error on the second problem, resulting in an incorrect answer and leaving the third and fourth indicators unmet. This suggests that kinesthetic learners, despite demonstrating good comprehension and planning skills, tend to struggle with precision in calculation and accurate conclusion-drawing on more complex problems. Overall, visual and auditory learners demonstrated more consistent problem-solving performance compared to kinesthetic learners. These findings highlight the importance of teachers adapting their instructional strategies to accommodate diverse learning styles, particularly by providing more targeted guidance and practice for kinesthetic learners to improve their computational accuracy and systematic reasoning in solving proportional value problems.

## References

Agus Budi Santosa, Muhamad Syariffuddien Zuhrie, P. W. R. (2020). Pengaruh Penggunaan Media Pembelajaran Berbasis Multimedia Interaktif Terhadap

Hasil Belajar Siswa Berdasarkan Gaya Belajar. *Jurnal Pendidikan Teknik Elektro*, 9(3), 639–645. https://doi.org/10.26740/jpte.v9n03.p639-645

Ayu, M., Sari, R., Rahmawati, D., & Andayani, S. (2026). Mathematical Representation Ability in Junior High School. *Journal of Educational Sciences*, 10(3), 832–851. https://doi.org/10.31258/jes.10.3.p.832.851

Chania, Y., Haviz, M., & Sasmita, D. (2017). Hubungan Gaya Belajar Dengan Hasil Belajar Siswa Pada Pembelajaran Biologi Kelas X Sman 2 Sungai Tarab Kabupaten Tanah Datar. *Sainstek : Jurnal Sains Dan Teknologi*, 8(1), 77. https://doi.org/10.31958/js.v8i1.443

Fransiska, C., Masykur, R., & Putra, F. G. (2019). Analisis Kemampuan Pemecahan Masalah Matematis : Dampak Metode Drill ditinjau dari Gaya Belajar. *Desimal: Jurnal Matematika*, 2(2), 131–140. https://doi.org/10.24042/djm.v2i2.4147

Konilah, K., Sunarsih, D., & Purnomo, A. (2022). Analysis of Students' Learning Styles in Mathematics Learning Class V MI. *Jurnal Ilmiah Kontekstual*, 3(2), 141–149. https://doi.org/https://doi.10.46772/kontekstual.v3i02.664

Lisnawati, L., & Nirmala, S. D. (2024). The Effectiveness of Differentiated Learning Strategies on Elementary Students' Mathematical Critical Thinking Ability. *Al-Ishlah: Jurnal Pendidikan*, 16(3), 3882–3895. https://doi.org/10.35445/alishlah.v16i3.5746

Lt. Dr. S. Abbas Dr. M. Sumathi Mr. S. Riyasdeen Dr. A. Dinesh Kumar. (2025). *Contemporary Techniques in Math Education*. www.isbn.gov.in

Mustaqim, I. (2016). Pemanfaatan Augmented Reality Sebagai Media Pembelajaran. *Jurnal Pendidikan Teknologi Dan Kejuruan*, 13(2), 594–605. https://doi.org/10.23887/jptk.v13i2.8525

Ni'mah, M., A., & Supriyo. (2024). Pengembangan media pembelajaran interaktif berbasis ClassPoint pada materi relasi dan fungsi. *Mandalika Mathematics and Education Journal*, 6(1), 384–399. https://doi.org/10.29303/jm.v6i1.7267

Ningi, A. I. (2022). Data Presentation in Qualitative Research: The Outcomes of the Pattern of Ideas with the Raw Data. *International Journal of Qualitative Research*, 1(3), 196–200. https://doi.org/10.47540/ijqr.v1i3.448

Novitasari, A., Prawiyogi, A. G., & Nur DS, Y. (2026). The Effect of the Gamification-Assisted Problem-Based Learning Model on the Learning Outcomes of Elementary School Students. *Journal of Innovation and Research in Primary Education*, 5(2), 3467–3477. https://doi.org/10.56916/jirpe.v5i2.3770

Rahmawati, N. I. (2023). Pembelajaran Matematika Realistik (Pmr) Untuk Meningkatkan Kemampuan Menghitung Perbandingan Senilai Melalui Permainan Mencampur Warna Di Kelas 6 Sdn Pendem 02 Batu. *Jurnal Pendidikan Tamam Widya Humaniora (Jptwh)*, 2(1), 406–430. https://jurnal.humaniora.org

Wahida, Nasruddin, & Musnidah. (2025). Implementasi Model Teams Games Tournament (TGT) dalam Pembelajaran Barisan dan Deret. *Journal of Mathematics Learning Innovation*, 4(1), 43–50. https://doi.org/10.35905/jmlipare.v4i1.11881

Yusuf Ain, Muhammad Makki, & Ahmad Fauzi. (2023). Identifikasi gaya belajar VAK (Visual, Auditorial, Kinestetik) pada siswa kelas V SDN 1 Aikmel Barat. *Journal of Classroom Action Research*, 5(2), 105–110.

How to cite this article:

Herawati., Idris, M., Bakri M., & Fajriani. (2026). Analysis of Students' Ability at SMP Negeri 1 Sigi in Solving Direct Proportion Problems Based on Learning Styles. *Journal of Educational Sciences*, *10(7)*, 1066-1086.