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Analogical Reasoning of Sensing and Intuition Personality Student in Solving Proportion Problem: Two-Variable into Three-Variable Direct Proportion Word Problem

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Abstract

Students' analogical reasoning based on sensing and intuition is a topic that has yet to be studied. Specifically, there is a need to explore how these two personalities types process information and apply analogical reasoning to solve proportional problems. The research aims to describe the reasoning process based on students' personalities, especially as a first step in implementing more effective and tailored teaching. The type of research used is descriptive qualitative. The research involved four students, two with sensing personalities and two with intuition personalities, who were selected from a group of 32 seventh grade (A) students at SMP Negeri 3 Ambulu, Jember, Indonesia. Selecting four students allows the researcher to explore how students with sensing and intuition personalities use analogical reasoning. The selected subjects embody both personality types, guaranteeing the consistency and generalizability of the obtained data in a wider context. The triangulation used is a triangulation technique that compares the results of completing analogical reasoning tests and interviews. The results of this study show that students with sensing and intuition personalities show differences in analogical reasoning on proportion material. Sensing students carry out two stages of analogical reasoning, namely encoding and inferring; they identify all the information in the source and target problems, solve the source problem, and recognize material similarities and the context of snack production. However, they needed help at the mapping and applying stages; focusing on concrete details prevented them from seeing abstract relationships, and thus, they failed to use the concept of solving the source problem to the target problem. Meanwhile, intuition students carry out the four stages of analogical reasoning: encoding, inferring, mapping, and applying. They successfully identified information, concluded the source problem, a problem involving two elements, identified the relationship with the target problem, connected the solution steps from the source problem to the target problem, and applied the proportion concept to a more complex target problem. This research shows that students' analogical reasoning in proportion materials varies depending on their personality type. Therefore, we can potentially use the results of this research as a reference to implement differentiated learning.5

Keywords: Analogical Reasoning, Sensing and Intuition, Proportion.

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Abstrak

Penalaran analogi siswa berdasarkan kepribadian sensing dan intuition merupakan topik yang belum banyak dikaji secara mendalam. Terutama, bagaimana kedua tipe kepribadian ini memproses informasi dan menerapkan penalaran analogi dalam menyelesaikan masalah perbandingan masih menjadi hal yang kurang dieksplorasi. Penelitian bertujuan untuk mendeskripsikan proses penalaran berdasarkan kepribadian siswa khususnya pada sebagai langkah awal dalam melaksanakan pengajaran yang lebih efektif dan disesuaikan. Jenis penelitian yang digunakan adalah deskriptif kualitatif. Banyak subjek dalam penelitian ini adalah 4 siswa dengan rincian 2 siswa kepribadian sensing dan 2 siswa kepribadian intuition yang dipilih dari 32 siswa kelas VIIA SMP Negeri 3 Ambulu. Jember, Indonesia. Memilih empat siswa memungkinkan peneliti untuk mengeksplorasi secara mendalam bagaimana siswa dengan kepribadian sensing dan intuition menggunakan penalaran analogi. Subjek yang dipilih mewakili kedua tipe kepribadian, sehingga data yang diperoleh konsisten dan dapat digeneralisasi dalam konteks yang lebih luas. Triangulasi yang digunakan adalah triangulasi teknik yang membandingkan hasil penyelesaian tes penalaran analogi dan wawancara. Hasil penelitian ini menunjukkan bahwa siswa dengan kepribadian sensing dan intuition menunjukkan perbedaan dalam penalaran analogi pada materi perbandingan. Siswa sensing melakukan dua tahap penalaran analogi yaitu encoding dan inferring, mereka mengidentifikasi semua informasi dalam masalah sumber dan target serta menyelesaikan masalah sumber dan mengenali persamaan materi serta konteks produksi snack. Namun, mereka kesulitan pada tahap mapping dan applying, fokus pada detail konkret membuat mereka tidak melihat hubungan abstrak sehingga gagal menerapkan konsep penyelesaian masalah sumber ke masalah target. Sementara, siswa intuition melakukan keempat tahapan penalaran analogi: encoding, inferring, mapping, dan applying. Mereka berhasil mengidentifikasi informasi, menyimpulkan masalah sumber yang merupakan masalah perbandingan dua unsur dan mengidentifikasi keterkaitan dengan masalah target, menghubungkan langkah-langkah penyelesaian dari masalah sumber ke target, dan menerapkan konsep perbandingan ke masalah target yang lebih kompleks. Secara keseluruhan, penelitian ini menunjukkan bahwa penalaran analogi siswa dalam materi perbandingan bervariasi tergantung pada tipe kepribadian mereka. Oleh karena itu, hasil penelitian ini berpotensi untuk digunakan sebagai referensi dalam menerapkan pembelajaran berdiferensiasi yang mengakomodasi kebeeragaman tipe kepribadian.

INTRODUCTION

Mathematics plays an important role in life and understanding other sciences. This understanding of mathematics can be achieved through quality mathematics learning. There are five process standards in good mathematics learning, including problem-solving, reasoning and proof, connections, communication, and mathematical representation (NCTM, 2000).

Based on these standards, reasoning must be present in mathematics learning. Reasoning is thoughts adopted to produce statements and conclusions in solving problems (Lithner, 2008; Supratman, 2023). There are many types of reasoning that a person can do, one of which is analogical reasoning. This analogical reasoning is known for drawing conclusions based on similar processes or rules (Evans, 2019; Sumarmo, 2011).

Analogical reasoning is a person's way of making decisions about something new in their experience by comparing it with something they already know. Sternberg (1977a) asserts that the application of analogical reasoning in mathematics learning presents students with a new problem (target), which they can solve using the same pattern, structure, and concept as a simple, previously studied old problem (source). Analogical reasoning involves finding a similar problem (source) to the target problem and mapping the solution from the source problem to the target problem (Lee, 1992).

Analogical reasoning in problem-solving involves transferring the explanation or solution procedure from the initial problem (source) to a new problem (target) (Tsoukas, 1991). English (2004) states that students need to adapt or expand the source problem procedure to be able to use it as a target problem-solving procedure. The source problem is easy and moderate, while the target problem is complex (Angraini et al., 2023; Gentner, 1983).

This analogical reasoning process

has several stages. Sternberg states four stages must be present in the analogical reasoning process: encoding, inferring, mapping, and applying (Sternberg, 1977b). This stage can be used to analyze the extent to which students carry out analogical reasoning in solving mathematical problems (Eskridge, 1989; Krstayulta et al., 2020).

This analogical reasoning can be used to understand mathematics and vice versa; mathematics can also be used to practice analogical reasoning (Sakinah & Hakim, 2023; Stevenson et al., 2013). A person cannot be separated from the use of his reasoning power (Wulandari et al., 2021). This means that analogical reasoning here is not only used in solving mathematical problems but can be used in many other things outside of mathematics (Gentner & Maravilla, 2018). This positive reciprocal relationship is vital to implementing mathematics learning based on analogical reasoning.

The explanation above indirectly states that this analogical reasoning involves collecting and processing information, such as the information in the source and target problem. At SMP Negeri 3 Ambulu Jember Indonesia, observations indicate that students have different approaches to solving math problems. Some students tend to focus on concrete details and specific steps in problem-solving, preferring systematic methods and often following clear procedures. This condition suggests there are varying tendencies in information processing. Based on these characteristics, the researcher identifies that these differences may be related to the sensing-intuition personality types. A person's way of taking in and processing information can be different due to differences in a person's characteristics. In the Myers-Briggs Type Indicator (MBTI), a person's differences in taking in, perceiving, and processing information are put into one contrasting personality preference of sensing and intuition (Francis et al., 2020; Makwana, 2023; Myers et al., 1998). Sensing focuses on the reality of a situation as perceived by the senses, while intuition focuses on possibilities, meanings, and relationships (Francis et al., 2020).

Identifying students' analogical reasoning processes based on sensing and intuition personality needs to be done to realize differentiated mathematics learning. Differentiated learning accommodates, serves, and recognizes student diversity in learning according to students's readiness, interests, and preferences (Wulandari, 2022). Knowing the analogical reasoning tendencies of each personality type can be used as a reference in developing learning strategies, especially mathematics learning based on analogical reasoning.

Learning based on analogical reasoning can be applied to all material. Analogical reasoning is a highly effective tool in mathematical thinking (Hardiani & Kristayulita, 2023). One material that can be used is proportion. Proportion or ratio is a mathematical expression that compares two or more numbers (Lamon, 2020). This proportion is material that is often encountered and used in everyday life. The contextualization of this material will train students not only to reason in class but also in real situations. Regarding the research location, it has been outlined that there are differences in information processing methods, including in the material of proportion. Therefore, the researcher aims to further explore how students with sensing and intuition personalities use analogical reasoning and to identify the differences in their approaches to this material.

This research is also motivated by the lack of studies focusing on analogical

reasoning examined through the lens of sensing and intuition personality types, specifically concerning the material of proportion. Putri & Masriyah (2022) stated that students had similar analogical reasoning abilities with auditory and visual learning styles, while kinesthetic learning styles had lower analogical reasoning abilities than the other two learning styles in mathematics learning. Wulandari et al. (2021) state that students' analogical reasoning abilities in the cube and block material are directly proportional to their learning motivation. Sakinah & Hakim (2023) found diversity in students' analogical reasoning on curved-sided geometric shapes in the material. In conclusion, this study seeks to explore the differences in analogical reasoning between students with sensing and intuition personality types, particularly in solving proportion problems, and the results of this research can potentially be used as a reference in implementing differentiated learning.

METHOD

This research used a descriptive-qualitative approach. This approach is used in this study because it allows the researcher to deeply understand the analogical reasoning processes employed by students with sensing and intuition personalities. The research focuses on how students solve proportion problems with different variables, which is a complex context requiring detailed analysis. According to Creswell (2018), the qualitative approach is effective for exploring individual thought processes in real-world contexts, aligning with the objectives of this study. This research was conducted in class VII A of SMP Negeri 3 Ambulu Jember Indonesia in the 2023/2024 academic year with 34 students. The subjects are chosen using a purposive technique based on personality test results and daily test scores on proportion material with the equivalent high category. The results of the questionnaire filled out by 32 students showed that there were 25 students with sensing personalities and 7 students with intuition personalities. Next, 4 subjects were selected, consisting of 2 subjects with sensing personalities and 2 subjects with intuition personalities, based on their equally high scores in proportion material. Selecting four students allows the researcher to explore in-depth how students with sensing and intuition personalities use analogical reasoning to solve problems. With two students from each personality type, the researcher can observe and compare their thinking strategies and problem-solving approaches. The chosen subjects represent both personality types, ensuring that the data obtained is consistent and provides insights that can be generalized to a broader educational context. The reason for selecting subjects with similar high abilities is to ensure that the observed differences in analogical reasoning processes and learning outcomes are not influenced by variations in basic skill levels among students. By choosing subjects with comparable ability levels, the researcher can more accurately assess the impact of personality types on how students process and solve proportion problems. This allows for a clearer focus on the differences caused by personality types without additional variables related to differences in academic ability. The instruments used include a personality-type questionnaire adopted from Keirsey (Keirsey, 1998) and has been translated by Wibisono (Wibisono, 2023), analogical reasoning tests, and interview guides. The analogical reasoning test used in this research consists of one source problem and one target problem with direct proportion material. The

source problem uses two variables or items to be compared, while the target problem uses three variables or items, as in Table 1.

Table 1. Analogical Reasoning Test

Source Problems	Target Problem
PT Citra Rasa is a company that produces snacks; in a day, the company can produce 250 kg of snacks using five units of production machines at the same speed. One day 2 units of production machines were damaged so the company could only use 3 units of its machines, which resulted in a decrease in the company's production output. How many snacks can the company produce that day?	PT Permadi Jaya is a company that produces snacks. The company can produce 200 kg of snacks in 6 hours using four machines with the same speed. One day, one of the production machines was damaged, so it could not be used. If the company's production time is 8 hours daily, how many snacks can be produced that day using the remaining machine?

The data analysis technique follows the Miles, Huberman, and Saldana model, including data condensation, data presentation, and conclusion drawing (Miles et al., 2014). Triangulation techniques were used to ensure the data's validity by comparing test answer sheets and interview results. Data analysis is based on indicators adapted based on Sternberg's analogical reasoning stages (Sternberg, 1977b) developed by English (English, 2004) as in Table 2.

Table 2. Analogical Reasoning Process Indicators

Stages	Indicators
Encoding	1. Identify known information in the source problem and target problem 2. Mention the problem or question asked in the source problem and target problem
Inferring	1. Determine concepts and solve source problems based on the concepts obtained 2. Mention the relationship between the source problem and the target problem
Mapping	1. Linking source problems and target problems 2. Explain or describe the relationship between the concepts used in the source problem and the target problem.
Applying	1. Determine the answer to the target problem 2. Determine the conclusion of the answer to the target problem by using the concept or method of solving the source problem.

RESULTS AND DISCUSSION

Results

The subjects in this study consisted of 4 subjects. Sensing subjects are coded with S1 and S2, while intuition subjects 1 are coded N1 and intuition 2 are coded N1 and N2. The student answer sheet data in this study is presented as a copy written in the same way as the original.

Based on the data analysis results, this research's findings are written in Table 3.

Table 3. Research Findings

Stages	Indicators	S1	S2	N2	N1
Encoding	Identify known information in the source problem and target problem	v	v	v	v
	Mention the problem or question asked in the source problem and target problem	v	v	v	v
Inferring	Determine concepts and solve source problems based on the concepts obtained	v	v	v	v
	Mention the relationship between the source problem and the target problem	v	v	v	v
Mapping	Linking source problems and target problems			v	v

Stages	Indicators	S1	S2	N2	N1
	Explain or describe the relationship between the concepts used in the source problem and the target problem.			v	v
Applying	Determine the answer to the target problem			v	v
	Determine the conclusion of the answer to the target problem by using the concept or method of solving the source problem.			v	v

We can see in Table 3 that the two sensing subjects carry out the same analogical reasoning as the intuition subject. The sensing subject fulfills the indicators of the encoding and inferring stages, while the intuition subject fulfills all the indicators of the analogical reasoning stages.

Analogical Reasoning of Students with Sensing Personalities

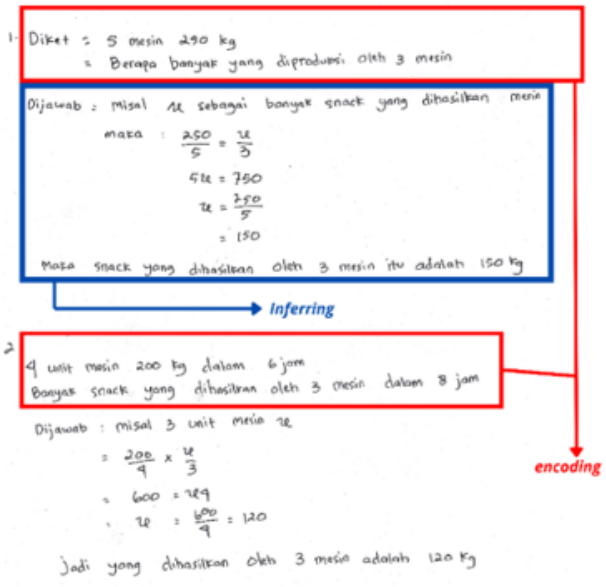
The results of the sensing subject's analogical reasoning test can be seen in Figure 1.

Next, the researcher will present the results of the analysis of analogical reasoning and interviews with sensing students based on the four stages of analogical reasoning proposed by (Sternberg, 1977b) .

Encoding

At this stage, sensing students still need clarification in writing down the information known in the source and target problem; however, sensing students have written it quite clearly in writing the required information. Figure 1 illustrates how sensing students record information from both the source and target problems, often using sentences that require revision or elicit multiple interpretations. Despite their lack of clarity in their writing, the sensing students were able to accurately explain the meaning of their answers during the interview session, as demonstrated in the following quote:

Q: What information do you think is given in terms of sources?
S : Known is that five machines can produce 250 kg of snacks.



Translation:
Known : 5 machines 250 kg
: How much is produced by 3 machines

Answered :
let x be the number of snacks produced by the machine
then $\frac{250}{5} = \frac{x}{3}$
$5x = 750$
$x = \frac{750}{5}$
$= 150$
then the snack produced by the 3 machines is 150 kg

4 units of 200 kg machine in 6 hours
Many snacks produced by 3 machines in 8 hours

Answered : for example, 3 units of machine is x
$\frac{200}{4} = \frac{x}{3}$
$600 = x4$
$x = \frac{600}{4} = 120$

So the output of 3 machines is 120 kg

Figure 1. Analogical Sensing Reasoning Test Answer Sheet

Sensing students can fulfill the indicators at this stage or carry out the encoding stage.

Inferring

At this stage, sensing students succeeded in answering the source problem correctly. Sensing students use the concept of correct proportion calculations. Based on Figure 3, first, the sensing students expressed x as the number of snacks produced by the 3 machines. Next, sensing students create equal proportion equations and carry out calculations by cross-multiplying. From the results of the cross multiplication carried out by sensing students, they produced a linear equation with one variable 5x = 750, so the value of x equals 150. Sensing students also explained the steps for solving it during the interview. During the interview, the sensing student also mentioned the connection between the source problem and the target problem, as in the following quote.

S: Both include direct proportion material, and there's also the same thing about snack production machines, sir.

Sensing students concluded that the connection between the two problems is in the material, which is a proportion of types of direct proportion, and the context of the problem, which is snack production. Therefore, sensing students can fulfill the indicators at this stage or carry out the inferring stage.

Mapping

Sensing students further explain the relationship between source and target problems at this stage. Sensing students stated that both problems asked about snack production results, but the target problem was more difficult because it involved production time. Based on Figure 4, sensing students using the initial steps uses the same concept as the source problem-solving steps. In making students' examples, sensing is still unclear. The sensing student's steps in making a proportion equation were correct, but sensing made a calculation error when determining the value of *x*, which was corrected during the interview. The sensing student's calculations stopped and concluded that the snacks produced by 3 machines were 120 kg. Sensing students need clarification when continuing calculations. This is confirmed based on interview results as in the following quote.

P : Try calculating again, how much is 600 divided by 4?
S : ehh yes sir, 150.
P : Do you can't continue?
S : Yes sir, I'm confused.

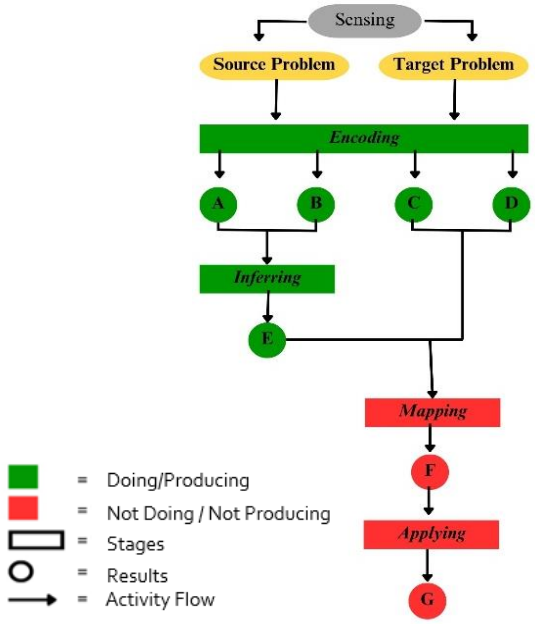
Based on the results of tests and interviews conducted show that sensing students cannot determine and connect source problems and target problems. Sensing students only try to solve the target problem using the same steps as the source problem, even though in the target problem, there are still further steps to determine the answer. Thus, sensing students didn't carry out the mapping stages.

Applying

In solving the problem, the target stops after concluding that the number of snacks produced by 3 machines is 150 kg without mentioning the production time. This conclusion is correct if the sensing student states that 150 kg is the number of snacks produced by 3 machines in 6 hours. Sensing student is unable to solve the given target problem. Therefore, sensing students can't carry out the applying stage.

The diagram in Figure 2 interprets the stages of analogical reasoning carried

out by sensing students.



A = Information known in the source problem
B = Information requested in the source problem
C= Known information in the target problem
D= Information requested in the target problem
E = Answers and conclusions to source problems
F = Relationship between solving source problems and target problems
G = Answers and Conclusions to the target problem

Figure 2. Diagram of Sensing Students' Analogical Reasoning Stages

Analogical Reasoning of Students with Intuition Personality

The results of the sensing subject's analogical reasoning test can be seen in Figure 3.

Next, the researcher will present the results of the analysis of analogical reasoning and interviews with sensing students based on the four stages of analogical reasoning proposed by Sternberg (1977b).

Encoding

At this stage, intuition students identify the information known in the source and target problems well. Intuition students also mention the issues or things asked in the two questions. Intuition Students' answers can be seen in Figure 3. Intuition students are still unclear in writing down the information they know. Intuition students wrote 5 machines = 250 kg for the known information in the source problem while in the target problem wrote 4 units of 200 kg machines in 6 hours. However, the student explained the meaning of his answer during the interview as in the following quote.

S : five units of machines can produce 250 kg sir
P : Good, then what are you known in the target problem?
S : 4 units of machine produce 200 kg in 6 hours, sir

From this, we can conclude students can fulfill the indicators at this stage or carry out the encoding stage.

Inferring

Intuition students use the correct way to create equivalent proportion equations. Next, the intuition students performed proportion calculations using cross multiplication, producing a linear equation with one variable. Then, the intuition students found the value of the variable x that had been assumed previously. When writing the conclusion, the Intuition student did not write down the units for the number of snacks, but during the interview, the Intuition student stated that the answer to the source problem was 150 kg of snacks. Intuition students said both problems were equally related to snack production and comparable material. This was stated by intuition students in the following interview quote.

S : The context of the question is both about snack production, and the material in the question is proportion material.

From here, it means determining the concept, solving the source problem, and clearly stating the relationship between

the two problems. Thus, intuition students fulfill the indicators at this stage or carry out the inferring stage.

Mapping

Based on Figure 3, intuition students do not involve time in their equations in the first step, so intuition students get an x value of 150, which is the number of snacks produced by 3 machines in 6 hours. This data shows that the concepts intuition uses in solving the target problem in the initial step use the same concepts as those used in solving the source problem; however, in the next step, intuition students do not use formal calculations to solve the problem. Intuition students also stated that the solution to the target problem was almost the same as in the following interview excerpt.

S : Almost the same, it can be done using the same concepts and proportion calculations, but the second one is more difficult

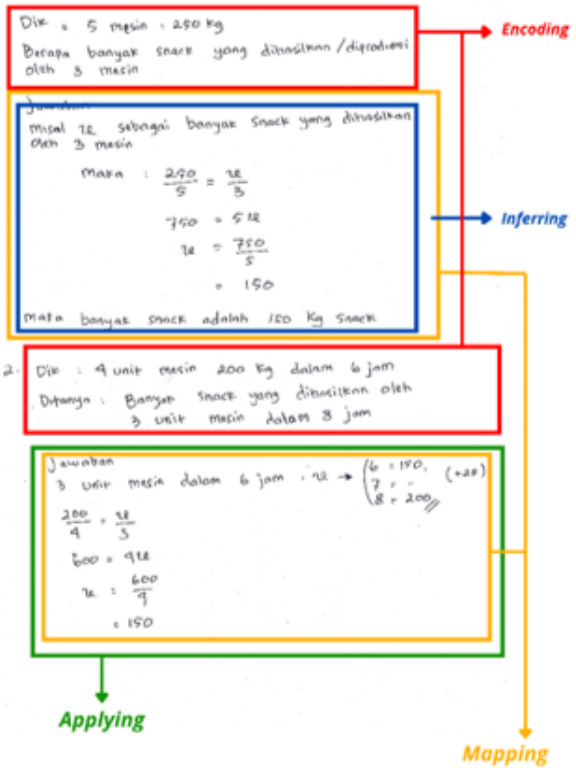
P : What are your steps to solve the target question?

S : First, let me assume that the number of snacks produced by 3 machines in 6 hours is x. Next, I looked for the value of x using the equivalent proportion equation, and the result was that I found the value x = 150. Next, I immediately assume that if 6 hours is 150, that means 1 hour is 150 divided by 6, the result is 25, if what is asked is 8 hours, then 25 multiplied by 8 results in 200.

From this, it is known that students' intuition connects the source problem and the target problem. Intuition students also describe the relationship between the concepts used in the source problem and the target problem. Thus, intuition students can fulfill the mapping stage indicators.

Applying

At this stage, students' intuition correctly determines the target problem's answer. As previously discussed, intuition students use two calculation steps to solve and derive conclusions from the target problem. In the first step, intuition stu-



Translation:
Known : 5 machines 250 kg
How many snacks are created or produced by 3 machines

Answered :
let x be the number of snacks produced by 3 machines
then $\frac{250}{5} = \frac{x}{3}$
$750 = 5x$
$x = \frac{750}{5}$
$= 150$
then the number of snacks is 150 kg of snacks

Known : 4 units of 200 kg machine in 6 hours
Asked: The number of snacks produced by 3 machines in 8 hours.
Answered :
3 units of machine in 6 hours = $x \rightarrow \begin{pmatrix} 6 = 150 \\ 7 = \cdots (+25) \\ 8 = 200 \end{pmatrix}$
$\frac{200}{4} = \frac{x}{3}$
$600 = 4x$
$x = \frac{600}{4} = 150$

Figure 3. Intuition Student Answer Sheet

dents look for the number of snacks produced by 3 machines in 6 hours, as in Figure 3. In the next step, although intuition students do not use formal calculations to determine the number of snacks produced by 3 machines in 8 hours, intuition students use the concept unit calculation, which can also be considered a one-variable linear equation. Based on the interview results presented previously regarding the student's explanation of intuition about the steps to solving the target problem, the informal calculation can be interpreted as the following linear equation.

Intuition students concluded the answer to the target problem during the interview even though the results of their work on the answer sheet did not write their conclusions.

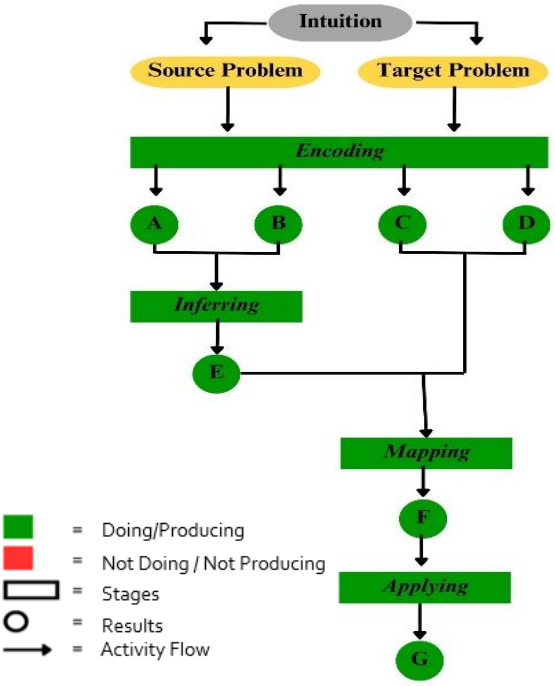
S : So the number of snacks produced by 3 machines takes 8 hours to produce 200kg.

Intuition students conclude that the number of snacks produced by 3 machines in 8 hours is 200 kg of snacks. Intuition students also stated that in the second calculation, they could also use the same calculation as the first calculation or the calculation used in the source question; only the proportion of the number of snacks with production time is used, which can be seen in the following interview quote.

P : OK, if you are looking for a continuation or looking for 8 hours, can you use the same method as the first step?
S : Yes, I think it's possible, sir
P : try to explain!
S : Yes, the first one is a proportion between the machine and snacks, the second one uses time and lots of snacks but uses the snacks calculated earlier, that's how it is, right??

Based on interviews, intuition students fulfill or carry out the stages of applying.

The diagram in Figure 4 interprets the stages of analogical reasoning carried out by students with an intuition personality.



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D= Information requested in the target problem
E = Answers and conclusions to source problems
F = Relationship between solving source problems and target problems
G = Answers and Conclusions to the target problem

Figure 4. Diagram of the Analogical Reasoning Stages of Intuition Students

Discussion

The research results show that the two personality types have different analogical reasoning. The diagrams in Figure 2 and Figure 4 show the stages of analogical reasoning for students of sensing and intuition.

Sensing students only carry out the encoding and inferring stages, they need to carry out the mapping and applying stages. Meanwhile, students of intuition engage in four stages of analogical reasoning. Personality type is one factor that influences students in solving problems, intelligence, and academics (Bardach et

al., 2023). According to Gahi et al. (2023), the problem-solving abilities of sensing and intuition students differ significantly. In line with (Kusumastuti et al., 2021b) intuition students achieve better results than sensing students. Students with an intuitive personality may excel in analogical reasoning due to their tendency to think creatively and identify patterns and relationships that are not immediately apparent. They tend to see the bigger picture and connect information in more complex ways, which can speed up solving proportion problems involving additional variables (Francis et al., 2020).

Analogical Reasoning of Students with Sensing Personality Types in Solving Direct Proportion Problems

Sensing students are responsible for completing the encoding stage. Sensing students are capable of accurately identifying known and requested information in both the source and target problems. Maharani (Maharani, 2020) also found in their research that sensing students can effectively convey the information present in the problem. Susilo (Susilo, 2019) also mentioned that students with sensing personalities carefully understand information.

Sensing students carry out the inferring stage. They define the concept, solve the source problem correctly, and state the connection between the source problem and the target problem. Sensing students observed that both the source and target problems were incorporated into the value proportion material and the context of the snack production problem. According to Nainggolan *et al* (Nainggolan et al., 2022), sensing students can determine the relevance of topics in solving given problems. Furthermore, he clarified that students of the sensing type process information based on what they have learned (facts) and follow systematic steps. Sensing students can write and conclude answers to source problems coherently and clearly, in accordance with the characteristics of someone with a sensing personality. Sensing personalities tend to be able to provide information systematically (Tieger et al., 2017).

During the mapping stage, sensing students often struggle to establish a connection between the source problem and the target problem in terms of the solution. This is due to their tendency to concentrate on specific and concrete details, which prevents them from extending the concept from the source problem to the target problem. According to Nainggolan *et al* (Nainggolan et al., 2022), the sensing type only looks at the data as it is, so finding a connection has yet to be carried out optimally. This issue also arises due to the need to understand the abstract relationship between the two problems. Wijaya *et al* (Wijaya et al., 2019) stated that sensing students really don't like abstract things and prefer concrete things. This causes them to be more comfortable with direct information than theoretical concepts.

Students with sensing personalities also struggle to carry out the application stage. Sensing students did not use the concept of solving the source problem to work on the target problem, sensing students did not find the answer to the target problem. Sensing students only apply the same steps as the source problem, even though the target problem requires expanded steps to solve it here. Rohim and Sari (Rohim & Sari, 2019) assert that we can perceive sensing students as replicators, as they can only integrate and connect topics based on their prior knowledge. Kusumastuti (Kusumastuti et al., 2021a) also stated that sensing students prefer to repeat what they have read and studied. According to Myers (Myers et al., 1998) sensing focuses more

on what can happen and is felt by the five senses.

Analogical Reasoning of Students with the Intuition Personality Type in Solving Direct Proportional Problems

The results of this study show that intuition students carry out the encoding stage. Despite the unclear nature of the information on the answer sheet, the students can identify all the known and requested information. These results are in line with Nazarian and Authary (Nazariah & Authary, 2021). that students with intuition personality identify the information contained in the problem. Intuition students can define problems or can identify information that is known and stated in the problem, Tieger *et al* (Tieger et al., 2017) state that someone with an intuition personality usually conveys information in leaps and bounds.

At the inferring stage, students' intuition correctly determines the concept, solves the source problem, and states the connection between the source problem and the target problem. Students still need to clarify several aspects of their intuition-based calculations in source problems. This is because it is based on one's intuition; according to Francis et al. (2020), intuition doesn't like to spend much time making the job more suitable. When it comes to identifying relationships, students' intuition aligns with what their senses convey. They stated that the source and target problem were included in the proportion material and the context of the problem regarding snack production. Identifying these relationships is easy for an intuitive because intuition processes data based on patterns and relationships (Nugroho et al., 2020), intuition focuses primarily on perceiving patterns and interrelationships (Myers et al., 1998).

Intuition students carry out the mapping stages well. They link the steps of solving the source problem and the target problem. Students of intuition assert that they can solve the target problem using the same proportion calculations as the source problem, but they don't stop there; further calculations are still necessary to solve the target problem. A person's intuition is very reliable in identifying and building patterns and relationships from the information they receive. According to Nainggolon et al. (2022), students connect their intuitive understanding of these concepts to effectively solve problems.

During the applying intuition stage, students use steps or solutions to solve the target problem, which is derived from the source problem. Students with intuition successfully apply the concept of simple equivalent proportions to more complex problems. This research also found that intuitive subjects used instinct without carrying out formal proportion calculations to solve problems. According to Utomo et al. (2023), intuition students prefer to solve problems using their own method, which they believe is shorter and more accurate, while maintaining a structured approach to problem-solving. Someone's intuition is better at using imagination and innovating (Tieger et al., 2017), intuition gives rise to inspiration and skill in understanding implied information (Francis et al., 2020).

Implications of Research

The research can be used as material or a reference in implementing differentiated learning. To achieve maximum learning outcomes, it is important to consider the analogical reasoning of different students, particularly those influenced by sensing-intuition personality factors. You can provide real examples and concrete

exercises to sensing students. Provide visual aids such as diagrams, pictures, or illustrations. This stage allows for increased practice in connecting and applying concepts. For intuition students, they can use questions that challenge creativity. Use these questions to learn about concept exploration. This research can be used as a reference for conducting similar research. Further research can delve into other factors that impact analogical reasoning, investigate alternative materials, and experiment with different methods. This research can also serve as a foundation for the development of teaching materials and learning media tailored to the sensing-intuition personality type, with the goal of enhancing the analogical reasoning skills of sensing students and fostering the analogical reasoning skills of intuition students.

Limitations

The scope of this research is limited to identifying the analogical reasoning process of class VII students with sensing and intuition personality types in relation to proportion material. Therefore, the results of this study may not apply to other mathematics materials or other subjects outside mathematics. We conducted this research with a limited number of subjects. The generalizability of the research results to a broader population may be limited, as the selected subjects may not accurately represent all the characteristics of students with sensing and intuition personalities. The results may not reflect the characteristics of students from other schools or areas. The study did not consider changes in personality or analogical reasoning abilities that may occur over time. Students may show different personality characteristics or analogical reasoning at different times.

CONCLUSION

The research and analysis reveal that students' analogical reasoning on proportional material aligns with their sensing and intuition personalities. Students with sensing and intuition personalities show differences in carrying out analogical reasoning on proportion material. Sensing students carry out the encoding stage by identifying all the information in the source and target problems involving production quantities, number of machines, and production times. They also perform the inferring stage by solving source problems, recognizing material similarities, and understanding the context of snack production problems. However, students require assistance during the mapping and application phases. During the mapping stage, students often concentrate on concrete and specific details, failing to recognize the connection between abstract solutions. Consequently, they struggle to connect the concept of solving the source problem to the target problem. During the sensing stage, it failed to apply the solution concept to the target problem. Meanwhile, students with intuitive personalities carry out the four stages of analogical reasoning: encoding, inferring, mapping, and applying. At the encoding stage, they identified information despite the unclear presentation. During the inferring stage, we determine the source problem, which involves comparing two elements. At the mapping stage, students' intuition connects the steps in solving the source problem to the target problem. At the application stage, students successfully apply proportion concepts from source problems to more complex target problems, demonstrating creativity and becoming innovative problem-solvers.

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