MATHE*dunesa*
Jurnal Ilmiah Pendidikan Matematika *Volume 11 No.2 Tahun 2022*
ISSN :2301-9085

PROFILE OF STUDENTS' MATHEMATICAL CONNECTION ABILITY IN SOLVING MATHEMATICS PROBLEMS BASED ON VISUALIZER AND VERBALIZER COGNITIVE STYLE

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Abstract

Mathematical connection ability is the ability of students to connect mathematical ideas and concepts in a structured way to solve various problems both inside and outside mathematics. Mathematical connection ability plays an important role in the process of solving mathematical problems. Cognitive style is one of the factors that affect mathematical connection abilities. This research is a qualitative descriptive study that aims to describe students' mathematical connection skills with visualizer and verbalizer cognitive styles in solving mathematics problems. The research subjects consisted of two grade IX students who had visualizer and verbalizer cognitive styles consecutively. The instrument used were the researcher herself, VVQ (visualizer verbalizer questionnaire), a mathematical connection ability test, and interview guidelines. In this study, the material of plane area and Pythagorean Theorem are used to test mathematical connection skills. The results obtained are students with visualizer cognitive style get a good category for their mathematical connection ability in solving mathematics problems because they meet seven good indicators and one sufficient indicator from the mathematical connection ability in solving problems indicator, while students with verbalizer cognitive style get sufficient categories because they meet three good indicators, four sufficient indicators, and one less indicator from mathematical connection ability in solving problems indicator. Therefore, teachers are expected to be able to train students with questions in the context of daily life that have a higher level of mathematical connection so that they can improve their connection skills and also expected to could get used to various exercises presentation so student with each cognitive style can be trained to understand the given problem.

Keywords : Mathematical Connection Ability, Mathematical Problem Solving, Visualizer Cognitive Style, Verbalizer Cognitive Style.

Abstrak

Kemampuan koneksi matematis adalah kemampuan siswa untuk menghubungkan ide dan konsep matematika secara terstruktur untuk menyelesaikan berbagai permasalahan baik di dalam maupun di luar matematika. Kemampuan koneksi matematis berperan penting dalam proses pemecahan masalah matematika. Gaya kognitif merupakan salah satu faktor yang mempengaruhi kemampuan koneksi matematis siswa. Penelitian ini merupakan penelitian deskriptif kualitatif yang bertujuan untuk mendeskripsikan kemampuan koneksi matematis siswa dengan gaya kognitif visualizer dan verbalizer dalam memecahkan masalah. Subjek penelitian terdiri dari dua siswa kelas IX yang masing-masing memiliki gaya kognitif visualizer dan verbalizer. Instrumen yang digunakan adalah peneliti sendiri, angket VVQ (visualizer verbalizer questionnaire), tes kemampuan koneksi matematis, dan pedoman wawancara. Dalam penelitian ini digunakan materi luas bangun datar dan teorema Pythagoras untuk tes kemampuan koneksi matematisnya. Hasil yang didapatkan adalah siswa dengan gaya kognitif visualizer mendapatkan kategori baik untuk kemampuan koneksi matematisnya dalam memecahkan masalah karena memenuhi tujuh indikator baik dan satu indikator cukup dari indikator kemampuan koneksi matematis dalam memecahkan masalah, sedangkan siswa dengan gaya kognitif verbalizer mendapatkan kategori cukup karena memenuhi tiga indikator baik, empat indikator cukup, dan satu indikator kurang dari indikator kemampuan koneksi matematis dalam memecahkan masalah. Oleh karena itu, guru diharapkan dapat melatih siswa dengan soal-soal dengan konteks kehidupan sehari-hari yang memiliki tingkat koneksi matematis lebih tinggi sehingga dapat meningkatkan kemampuan koneksi matematis siswa, serta guru membiasakan soal dengan beragam bentuk penyajian sehingga siswa dengan gaya kognitif masing-masing dapat terlatih untuk memahami masalah yang diberikan.

Kata Kunci : Kemampuan Koneksi matematis, Pemecahan Masalah Matematika, Gaya Kognitif Visualizer, Gaya Kognitif Verbalizer.

INTRODUCTION

One of the subjects that exist at all levels education is mathematics. This is related to mathematics which is seen as a human activity (Heuvel-panhuizen et al., 2014). Mathematics will always be involved in various things in life so that there will be many problems that can be solved using mathematical concepts. Therefore, it is hoped that students will understand and apply the mathematics they have acquired. Mathematics is a science that consists of the connection of several elements, such as principles, concepts, procedures, ideas, and facts (Baiduri et al., 2020). Supported by Brunner's viewed, that concepts and operations in mathematics are related to each other (Siregar & Surya, 2017). Due to the concepts and procedures in mathematics are interrelated, so in learning mathematics it takes an ability called mathematical connection ability.

Mathematical connection is the relationship between mathematical topics, the relationship between mathematics and other sciences, and the relationship between mathematics and daily life (NCTM, 2000). Mathematical connection consists of two aspects, namely internal and external aspects. The internal aspect includes the relationship between concepts in mathematics and the external aspect includes the relationship between mathematics and other sciences and daily life (Islami et al., 2018). Mathematical connection ability is the ability of students to use mathematics in various ways, including things inside and outside mathematics (Yumiati & Haji, 2018). In this study, it will be described about how students' abilities in connecting ideas and concepts in mathematics and connecting mathematics with daily life will be discussed.

One of the standard mathematical processes on how students should use their mathematical knowledge is the ability to connect mathematically (Agustini et al., 2017). Mathematical connection ability is also a focus in mathematics learning (NCTM, 2018: 106). It can be said that mathematical connection skills are needed by students. Learning mathematics will be more meaningful when students have mathematical connection skills because students are easier to understand prerequisite material so it will be easier to understand more complex material. NCTM (2019:34) stated that linking concepts and procedures can influence the student's understanding. It can be said that students will have difficulty in learning mathematics without the ability to connect mathematically. The indicators used to measure the mathematical connection ability according to NCTM (2000) are:

1. Identify and utilize the relationships between ideas in mathematics.
2. Understand how mathematical ideas relate to and underlie each other.
3. Using mathematics in contexts outside of mathematics.

Siregar & Surya (2017) stated that students' mathematical connection abilities only meet the low category because students have not been able to find the relationship between objects and mathematical concepts. The inability of students to connect objects with mathematical concepts will affect the students' problem solving process. This is because the ability of mathematical connections is a tool to solve problems.

Problem solving is the process of student to find problems solution which the strategy is not clear. Fitria & Siswono (2014) stated that problem solving as an individual process to overcome difficulties when the method or answer is not yet clear. Singh & Kumar (2021) also argued that problem solving is the formulation of new answers that are no simpler than the principles or concepts that have been studied to create a problem solution. The problems that are solved are not routine questions or problems that are commonly encountered by students. Mathematical problems that can be solved by the solving process have their own characteristics. The characteristics of the problem according to Carifio (2015) are that it has several interrelated elements but some are not, requires additional elements that are in accordance with the problem, several stages are needed to solve it, and have several alternative answers. In addition, the situation is said to be a problem if the individual already has the prerequisite knowledge material for the given situation, knows that the situation requires action, and the steps to resolve it do not have to be clear (Siswono, 2008: 34).

In the process of solving problems, it takes the ability to find specific facts and their relationship to other facts (Carifio, 2015). In addition to finding specific facts and their relationships, students also need to find connections with appropriate mathematical concepts. Baiduri et al (2020) stated that problem solving need appropriate principles, concepts, and procedures to find the right solution. Students will be able to remember concepts and procedures and their relationship with their mathematical connection abilities. With their mathematical connection skills, students can apply mathematical concepts appropriately in the problem solving process (Apipah et al., 2018). In other words, students' mathematical connection abilities will determine the success or failure of the problem solving (Pambudi et al., 2018).

There are several steps in the solving process according to Polya (2004), namely "(1) Understanding the problem, (2) Devising a plan, (3) Carrying out the plan, and (4) Looking back". Based on these steps, the activities that students must do in solving problems are: the first stage, students must understand the problems to be solved, identify information and existing problems. In the second stage, students must find the relationship between the existing information and the problem to be solved and develop a settlement plan. In the third stage, students must apply any previously prepared plans and identified information to solve. The fourth stage, students must check the accuracy of the ideas, concepts, and procedures that have been used (Polya, 2004). These activities show that in the process of solving problems, mathematical connection skills are needed.

Based on indicators of mathematical connection ability and the process of problem solving, the indicators of students' mathematical connection abilities in solving problems are shows in the table 1.

Table 1. Indicators of Mathematical Connection Ability in Solving Problems

Problem Solving Stage	Indicator of Mathematical Connection Ability in Troubleshooting	Code
Understanding the problem	1. Identify data/facts and problems in the questions.	U1
	2. Identify and utilize the relationship between ideas in mathematics based on data/facts and existing problems.	U2
Devising a plan	1. Planning concepts and procedures to solve problems.	P1
Carrying out the plan	1. Implement pre-planned concepts and procedures.	A1
	2. Understand how mathematical ideas relate to and underlie one another.	A2
	3. Using mathematics in the context of everyday problems.	A3
Looking back	1. Evaluate the concepts and procedures used.	E1
	2. Evaluate the mathematical operations used.	E2

Mathematical connection ability is called high if students can connect mathematical ideas or concepts logically and solve problems correctly (Pambudi et al., 2018). However, the mathematical connection ability of each student is not same because students' cognitive abilities are different. Research by Habel and Susilowaty (2021) showed that the mathematical connection ability of students with different cognitive styles shows different results. Students' cognitive style will affect the problem solving process. Supported by Hasan (2019) which stated that students' strategies to solve problems are influenced by cognitive style. It can be said that cognitive style is one of the influential factors in the problem solving process. Several studies have found that the average mathematical connection ability of grade VII, VIII, and IX students is still in the low category (Angelina et al., 2021; Astridayani, 2017; Nazaretha et al., 2019). So, it can be said in general the mathematical connection ability of junior high school students is still weak. This is because students still cannot meet the indicators of mathematical connection ability. In this study, it will be explained how the mathematical connection abilities of junior high school students with different cognitive styles will be described.

Cognitive style is defined as an individual's way of storing, processing, and using information to respond to a given task (Hasan, 2019). In addition, cognitive style is seen as a permanent individual characteristic that can be used to identify how behavior appears in the face of various given stimuli (Margunayasa et al., 2019). In short, it can be said that cognitive style relates to the way students organize the information they receive. In learning mathematics itself, the information or material given to students is mostly presented in the form of words or pictures. The process of students' understanding of the information will vary according to their cognitive style. Although sometimes individuals also have these two cognitive styles, only one of them stands out. Cognitive styles related to pictures or words are visualizer and verbalizer cognitive styles.

Visualizer and verbalizer cognitive styles are grouped based on human senses by Ewan & Reynolds (2007). In this case the sense in question is the sense of sight, which involves visual and verbal understanding of what he sees. Visualizer and verbalizer cognitive styles are defined as the way students manage the information they receive through pictures or words. Visualizer and verbalizer cognitive styles also have an influence in the learning process (Koć-Januchta et al., 2017). The characteristic of visualizer cognitive style is that it tends to be easier to receive, manage, and use visually oriented information. The characteristics of verbalizer cognitive style are easier to receive, manage, and use word-oriented information (Hasan, 2019). Students with visualizer cognitive style will be more interested in understanding something by watching someone do it. On the other hand, students with verbalizer cognitive style are more interested in understanding something by reading independently.

One of the branch in mathematics is geometry (Siregar & Surya, 2017). Geometry has a big role in daily life. Many problems in daily life can be solved using geometry. Azizah (2020) stated that geometry has many applications in daily life. The branch of geometry contains a lot of mathematical material in it, one of them is the material of plane area. Plane area material is one part of geometry that is always used at all levels of education. In addition to having many branches of science, mathematics also own many abstract ideas, among them is concepts, procedures, and principles (Yumiati & Haji, 2018). One of the relationships between ideas in mathematics is the relationship between the concept of a right triangle and the Pythagorean Theorem. Students' ability to solve Pythagorean Theorem problems was made dimensions content in the TIMSS assessment framework (Sholeha et al., 2021). It shows that Pythagorean Theorem is essential material in mathematics. Plane area and Pythagorean Theorem material have been learned by grade VII and VIII. However, students in junior high school has formal operation (at least 12 years old) cognitive development stage, where they will think more abstract, logical, and idealist so that the thinking quality will look clearer in the process of solving problem (Marinda, 2020). Students who are in the formal stage can be invited to use their minds to solve problems that require the ability of understanding, connecting, testing, analyzing, and deciding (Syahbana, 2012).

Based on the description above, a research conducted on the mathematical connection ability of junior high school students which is influenced by their cognitive style on the concepts of plane area and Pythagorean Theorem. Therefore, the researcher selected the title "Profile of Students' Mathematical Connection Ability in Solving Mathematics Problems Based On Visualizer and Verbalizer Cognitive Style".

METHOD

This is the descriptive qualitative research which aims to describe students' mathematical connection skills with visualizer and verbalizer cognitive styles in solving mathematical problems. The research subjects were used students of IX class junior high school that consist of one student with visualizer cognitive style and one student with verbalizer cognitive style. The subject were selected in IX class of junior high school because they had studied about plane area and Pythagorean Theorem.

The research subjects were selected based on the following criteria: (1) Having visualizer or verbalizer cognitive style, (2) Having equal mathematical ability, and (3) Having the same gender. The research by Julaeha et al (2020) found that students who have different mathematical abilities will also have different mathematical connection abilities. The research by Pambudi et al (2018) found that male and female students have different mathematical connection abilities. This shows that mathematical ability and gender also affect students' mathematical connection abilities. Therefore, this study considers the criteria for mathematical ability and gender of the subject to avoid the assumption that the results are influenced by mathematical ability and gender of the subject. The subject's mathematical ability is seen based on the results of the average mathematics score in the odd semester with the difference between subjects not more than 10 and based on the teacher's recommendation.

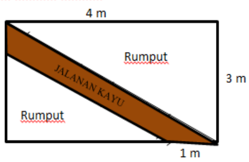
The instrument used were the researcher herself, the VVQ (visualizer verbalizer questionnaire), mathematical connection ability test, and interview guidlines. The VVQ questionnaire was adopted from Mendelson (2004). The questionnaire consists of 20 statements, each 10 statements for visualizer and verbalizer cognitive styles . Each cognitive style has 5 favorable statements and 5 unfavorable statements (Lestari & Yudhanegara, 2015). VVQ questionnaire was used to determine students' cognitive style. The VVQ questionnaire will be analyzed based on sequential scoring with a value of 5,4,3,2,1 for favorable statements and vice versa for unfavorable statements. Subjects were selected based on the highest VVQ value for each cognitive style. Because if the VVQ score between the visualizer and verbalizer cognitive styles is not the highest, it is feared that the subject's cognitive style is both of cognitive styles. Table 2 shows the grouping of cognitive style by Mendelson (2004).

Table 2. The Category of Cognitive Style

Score	Cognitive Style
Score visual ≥ 40 and Visual-Verbal ≥ 20	Visualizer
Score verbal ≥ 40 and Visual-Verbal ≥ 20	Verbalizer

The mathematical connection ability test was prepared by researchers based on indicators of mathematical connection ability in solving mathematical problems which are shown in table 1. The mathematical connection ability test was used to determine students' mathematical connection abilities in solving problems. The test results will be analyzed based on indicators of mathematical connection ability in solving problems and then the category of students' mathematical connection ability in solving problems will be determined.

The figure 1 shows the mathematical connection ability test that made by researcher.


Perhatikan gambar berikut!

Pak Adi memiliki lahan kosong di depan rumahnya dengan ukuran 4mx3m. Pak Adi bersama anaknya akan membangun taman di lahan kosong tersebut. Ditengah taman tersebut akan diberi jalan selebar 1 m dan diberi potongan kayu yang memiliki lebar 20 cm diukur dari garis terpanjangnya. Di sekitar jalan berkayu tersebut juga akan ditanami rumput. Jika harga per satuan kayu Rp 37.000 dan harga rumput Rp 20.000/m^2, Tentukan berapa Biaya yang harus dikeluarkan oleh Pak Adi untuk membangun taman tersebut?

Figure 1. Mathematical Connection Ability Test

Table 3 shows the categories of students' mathematical connection abilities by Samo (2017).

Table 3. Category of Mathematical Connection Ability

Good	Sufficient	Less
At least 3 good categories	At least 3 categories are sufficient or 2 categories are good	At least meet 3 less categories

The categorization is based on rubric of mathematical connection abilities in solving problems indicators in the table 4.

Table 4. Rubric for Mathematical Connection Ability in Solving Problems

Problem Solving Stage	Category		
	Good	Sufficient	Less
Understanding the problem	Identify data/facts and existing problems completely and correctly	Identify some of the data/facts and problems that exist correctly	Wrong/does not identify or data/facts and existing problems.
	Identify and utilize the relationship between mathematical ideas completely and correctly based on data/facts and existing problems.	Identify and utilize some of the relationships between mathematical ideas based on data/facts and existing problems correctly.	Wrong/not Identify and utilize the relationship between mathematical ideas based on data/facts and existing problems.
Devising a plan	Planning concepts and procedures to solve problems completely and correctly	Planning some concepts and procedures to solve problems correctly	Worng / not planning concepts and procedures to solve problems.
Carrying out the plan	Implement concepts and procedures completely and correctly as previously planned.	Implement some of the concepts and procedures as previously planned correctly.	Wrong / not Implementing concepts and procedures as previously planned
	Understand how mathematical ideas relate to and underlie each other completely and correctly.	Understand how some mathematical ideas relate to and underlie one another correctly.	Wrong/not Understand how mathematical ideas relate to and underlie one another.
	Using mathematics in the context of everyday problems correctly.	Using mathematics in the context of everyday problems partially correctly.	Wrong / Not using mathematics in the context of everyday problems.

Looking back	Evaluate the concepts and procedures used completely and correctly	Evaluate some of the concepts and procedures used correctly	Wrong/Not Evaluate the concepts and procedures used
	Evaluate the mathematical operations used completely and correctly	Evaluate some of the math operations that were used correctly.	Wrong/Not Evaluate the mathematical operations used

RESULTS AND DISCUSSION

Results

Based on the results of research on 15 grade IX students, it was found that 9 students had a visualizer cognitive style and 6 students had a verbalizer cognitive style. The table 5 shows the data of the selected subject's based on cognitive style grouping.

Table 5. Selected Subject

Cognitive Style	Selected Subject	VVQ	Math Score (mean)	Gender
Visualizer	IPL	48	85	P
Verbalizer	AD	40	85	P

The following is an analysis of the mathematical connection ability test and interviews of the selected research subjects.

1. **Analysis of Student's Mathematical Connection Ability With Verbalizer Cognitive Style in Solving Mathematical Problems**

a. Understanding the problem

The following is an excerpt from the interviewed with the IPL subject.

R : "Explain the problem and information that you understand in the question!"

IPL: "The problem is Mr Adi's cost to build the park. The information that is known are the vacant land size is 4mx3m, the width of the road is 1m, the width of the wood is 20cm, the price of wood is Rp. 37,000, and the price of grass is Rp. 20,000/m2. "

R : "What is the relation of the information that you mentioned before with the problem?"

IPL : "The total cost of gardening can be found by adding up the cost of the grass and the cost of the required wood."

The process of understanding the problem by IPL was not shown on the answer sheet. IPL did not write down the data/facts and problems in the questions at all. However, based on the interviewed, IPL can state what data/facts and problems are known in the questions completely and correctly but do not use her own language. She only read as the questions given. This showed that IPL can meet the U1 indicator. IPL was also able to explain the use of existing information to solve problems. However, IPL does not explain what other ideas she used to solve the problem except the way to find the total cost. So, it can be said that IPL is less able to meet the U2 indicator.

b. Devising a plan

The following are excerpts from interviewed with IPL subject.

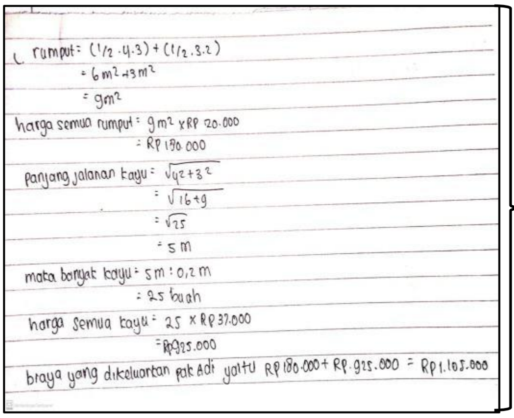
R : "Explain the mathematical concept that you will use to solve the problem!"

IPL : "I add up the areas of two different-sized triangles to find the area of the grass, Pythagoras to find the length of the side of the wooden path that will be used to find the amount of wood, and the sum to find the total cost."

Based on the interviewed result, IPL planned to solve the problem by using the concept of the area of a triangle and the Pythagorean Theorem. Based on the IPL explanation, it can be seen that the IPL can meet the P1 indicator.

c. Carrying out the plan

The figure 2 shows the IPL's answer.



A1

Figure 2. IPL Answer

The following are excerpts from interviewed with IPL subject.

R : "Why do you use triangle area and Pythagorean Theorem ?"

IPL : "Because the land that is planted with grass is right triangle and the side of the road to be wooded is the hypotenuse of the triangle. So, when looking for an unknown roadside length, I use the Pythagorean Theorem, while for find a lot of grass using the concept of the area of a triangle."

R : "What is the size of each triangle?"

IPL : "The first triangle has a base and height of 4m and 3m respectively according to the size of the land, while the size of the second triangle has a base and height of 3m and 2m respectively due to the presence of a 1m wide road. "

IPL solved the problem by using the concept of the area of a triangle and Pythagorean Theorem as previously planned, shown in figure 2. Although, IPL did not write the formula for the area of a triangle and Pythagorean Theorem but symbol and the procedures used by IPL were correct. IPL was also able to equalize the unit between the length of the curb and the width of the wood. IPL solved the problem completely and correctly as previously planned. This shows that the IPL can meet the A1 indicator.

Based on the interviewed result, IPL can explain the relationship between the concept of the area of a triangle and the Pythagorean Theorem that she used. In addition, IPL was also able to determine the size of each triangle. It can be said that the IPL meets the A2 indicator. The concepts, procedures, and arithmetic operations used by IPL were correct. So are the results. This shows that IPL can apply mathematics to solve everyday problems correctly. Thus, IPL is said to be able to meet the A3 indicator.

d. Looking back

The following are excerpts from interviewed with IPL subject:

R : "Have you checked the results of your answers and the method you used?"

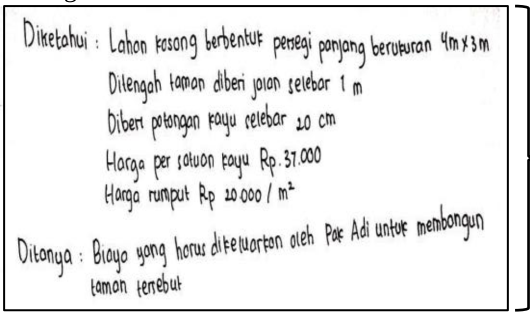
IPL : "Yes, I have checked everything"

Based on the interviewed result with IPL, she stated that she had Evaluated the concepts and procedures she had carried out. She admitted that she had Evaluated it at all. This can be seen in the concepts, procedures, and calculations used are correct and according to the plan. This shows that IPL can meet indicators E1 and E2.

2. **Analysis of Student's Mathematical Connection Ability With Verbalizer Cognitive Style in Solving Mathematical Problems**

a. Understanding the problem

The figure 3 shows the AD's answer.


Diketahui : Lahan kosong berbentuk persegi panjang berukuran 4m x 3m
Ditengah taman diberi jalan selebar 1 m
Diberi potongan kayu selebar 20 cm
Harga per satuan kayu Rp. 37.000
Harga rumput Rp 20.000 / m²
Ditanya : Biaya yang harus dikeluarkan oleh Pak Adi untuk membangun taman tersebut

U1

Figure 3. AD Answer

The following is an excerpt from an interviewed with the subject of AD.

R : "Explain the problem and what information that you understand in the question!"

AD : "The question being asked is the total cost needed by Mr. Adi to build the park. The known information is the vacant land area measuring 4mx3m, the width of the road in the middle of the park is 1m, the width of wood is 20cm/pcs, the price of wood is Rp. 37,000/unit, and the price of grass is Rp. 20,000/m2. "

R : "What is the relation of the information that you mentioned before with the problem?"

AD : "The known area of land and the price of grass are used to determine the cost of the grass, while the length of the roadside, the width of the wood, and the price of the wood are used to determine the cost of the wood used. The total cost of gardening will be obtained by adding up the cost of the wood and the cost of the grass."

AD write down all the data/facts and problems contained in the questions completely and correctly as shown in figure 3. Based on the interviewed, AD can also stated the data/facts and problems that exist correctly according to the answer sheet in her own language. This shows that AD can meet the U1 indicator. AD can also explained the use of the data/facts that have been mentioned in the problem. Based on AD's explanation, it can be said that AD meets the U2 indicator.

b. Devising a plan

The following is an excerpt from an interviewed with the subject of AD.

R : "Explain the mathematical concept that you use to solve the problem!"

AD : "I use a triangle area because the area to be planted with grass is triangle. I looking for the amount of wood using rectangular area. Because the wood is measured from the longest line, I use the Pythagorean formula."

Based on the interviewed result, AD explained that she would solve the problem by using the concepts of the area of a triangle, the area of a rectangle, and the Pythagorean Theorem. AD used the area of a rectangle because she thinks the road to be built is rectangular. The plan prepared by AD is not completely correct, there are still conceptual errors. So it can be said that AD is less able to meet the P1 indicator.

c. Carrying out the plan

The figure 4 shows the AD's answers.

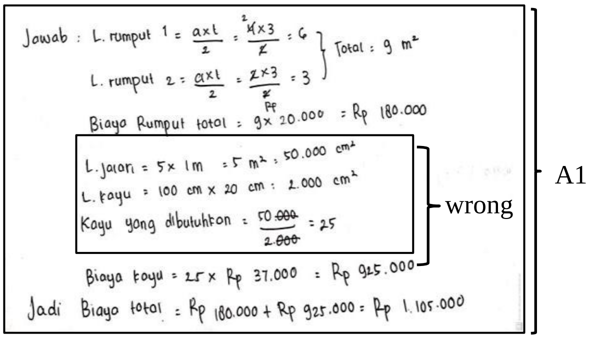


Figure 4. AD Answer

The following is an excerpt from an interview with the subject of AD.

R : "Why do you use triangle area, rectangle area, and Pythagorean Theorem ?"

IPL : "I use a triangular area because the land planted with grass is a triangle, so when looking for a lot of grass, I can find using the area of the triangle. I use the area of the rectangle to find the area of the road and the area of the wood because the road is rectangular. I use Pythagorean Theorem to find the length of the curb which is the hypotenuse of a right triangle.

R : "What is the size of the triangle?"

AD : "The base and height of the first triangle are 4m and 3m respectively, while the second triangle has a base and height of 3m and 2m respectively because it is cut by a road."

AD solved the problem as previously planned. AD used the concept of triangle, the Pythagorean Theorem, and the area of rectangle which is shown in Figure 4. However, there is an error in determining the amount of wood by using the area of the rectangle. This is because AD incorrectly assumed that the road being built is rectangular. Therefore, it can be said that AD is less able to meet the A1 indicator. Based on the interviewed result, there are still error in AD's explanation and problem solving. So it can be said that AD is unable to meet A2 and A3 indicators.

d. Looking back

The following is an excerpt from an interviewed with the subject of AD.

R : "Have you checked the results of your answers and the method that you used?"

AD : "Yes."

R : "Are you sure about your answer?"

AD : "I'm sure."

Based on the interviewed result, AD stated that she was sure of the answers obtained and had re-checked the solution. Even though AD's calculations and answers are correct, there are still conceptual errors that she used. This shows that AD is wrong in Evaluate the concepts and procedures. Therefore, it can be said that AD meets the E2 indicator, but cannot meet the E1 indicator.

Discussion

The following is a discussion of students' mathematical connection abilities with visualizer and verbalizer cognitive styles in solving mathematics problems based on the results of the test analysis above.

1. Profile of Student's Mathematical Connection Ability with Visualizer Cognitive Style in Solving Mathematical Problems

At the stage of understanding the problem, student with visualizer cognitive style did not write down data/facts and existing problems. However, during the interviewed being able to explain it exactly like the questions completely and correctly. So it can be said that student with visualizer cognitive style get good categories on indicators of identifying data/facts and problems that exist in questions. This is in line with Hasan (2019)'s thinking which stated that individuals with a visualizer cognitive style can identify existing information and problems. However, it does not explained in its own language. Although only partially, student with visualizer cognitive style can explain the relationship between data/facts and existing problems correctly. So that it can be said that student with visualizer cognitive style get sufficient categories on indicators identifying and utilizing relationships between ideas in mathematics based on data/facts and existing problems.

At the stage of devising a plan, student with visualizer cognitive style was able to plan concepts and procedures completely and correctly to solve problems, by using the concept of triangle area and Pythagorean Theorem. At this stage student claims to be helped by the pictures provided so that they can develop a plan of completion correctly. This is in accordance with the characteristics of the visualizer's cognitive style which is easier to manage information through pictures or illustrations (Ewan & Reynolds, 2007). So that it can be said that student with visualizer cognitive style get good categories on indicators for planning the concepts and procedures to solve problems.

At the stage of carrying out the plan, student with visualizer cognitive style was able to solve problems according to the previously prepared plan completely and correctly, so that get a good category on indicators of implementing concepts and procedures as previously planned. Explanations by student with visualizer cognitive style regarding each solution along with the relationship between the concepts used are also correct and logic. This shows that student with visualizer cognitive style are able to fulfill the indicators of understanding how mathematical ideas are interrelated and underlie each other with good categories. This is in accordance with the opinion of Hasan (2019) which stated that student with visualizer cognitive style can write down solutions correctly and structured according to the previous plan. Student with visualizer cognitive style was able to use mathematics in the context of everyday problems, which is indicated by the correct solutions. Therefore, it can be said that student with visualizer cognitive style get a good category on indicators using mathematics in the context of everyday problems.

At the stage of looking back, student with visualizer cognitive style was able to evaluate the concepts, procedures, and arithmetic operations used. This is known in the suitability of the interview results which state that they have evaluated from beginning to end with the correctness of the completion. So, it can be said that student with visualizer cognitive style get good categories on indicators of evaluating concepts, procedures, and arithmetic operations used.

The table 6 shows the results of categorizing student's mathematical connection abilities with visualizer cognitive style on each indicator.

Table 6. Recapitulation of students' mathematical connection abilities with visualizer cognitive style in solving mathematical problems.

Indicator Code	Category		
	Good	Sufficient	Less
U1	√		
U2		√	
P1	√		
A1	√		
A2	√		
A3	√		
E1	√		
E2	√		

The table above shows that student with visualizer cognitive style get 7 good indicators and a sufficient indicator. Therefore, it can be said that the mathematical connection ability of student with visualizer cognitive style meets the good category.

2. Profile of Student's Mathematical Connection Ability with Verbalizer Cognitive Style in Solving Mathematical Problems

At the stage of understanding the problem, student with verbalizer cognitive style wrote and explained information/facts and problems that exist in the problem correctly through their own language. This happens because individuals with verbalizer cognitive style are able to play with words (Mendelson, 2004). It can be said that student with verbalizer cognitive style get good categories on indicators of identifying information/facts and existing problems. Explanations by student with verbalizer cognitive style regarding mathematical ideas used to solve problems based on data/facts and existing problems are also complete and correct. so that it can be said that student with verbalizer cognitive style get good categories on indicators of Identifying and utilizing ideas in mathematics based on data/facts and existing problems.

However, at the stage of devising a plan, there was a conceptual error in the completion plan. Student with verbalizer cognitive style assumed that the road to be built is rectangular. This is because students are less able to imagine and understand the existing images. In accordance with the characteristics of the verbalizer's cognitive style, it is easier to manage information in the form of words (Ewan & Reynolds, 2007). Thus, the concepts and procedures planned by student with verbalizer cognitive style are not entirely correct. This has an impact on the stage of carrying out the plan. It can be said that student with verbalizer cognitive style get sufficient categories on indicators of compiling concepts and procedures to solve problems because the concepts and procedures planned by student with verbalizer cognitive style are not entirely correct.

Student with verbalizer cognitive style was able to solve problems according to their plans. However, due to the inadequate planning, the concepts and procedures used are also inaccurate. However, the answer she got was correct. It can be said that student with verbalizer cognitive style get a sufficient category on the indicators of implementing the concepts and procedures that have been planned previously. Student with verbalizer cognitive style can explained the solution and the reasons for using the concept clearly. However, there is an error in his explanation of the concept of the area of a rectangle that she used. Thus, student with verbalizer cognitive style get sufficient categories on indicators of understanding how mathematical ideas are interrelated and underlie each other. Although the calculations and final results made by student with verbalizer cognitive style was correct, there are still conceptual errors in the process, so it can be said that student with verbalizer cognitive style get sufficient categories on indicators using mathematics in the context of everyday problems.

At the stage of looking back, student with verbalizer cognitive style could not evaluate correctly because she stated that she had evaluated and believed in the answers. But in the process there are still conceptual errors, even though the calculation was correct. So it can be said that student with verbalizer cognitive style get a less category on the indicators of evaluating the concepts and procedures used, and get a good category on the indicators of evaluating the operations used.

The table 7 shows the results of categorizing student's mathematical connection abilities with verbalizer cognitive style on each indicator.

Table 7. Recapitulation of students' mathematical connection abilities with verbalizer cognitive style in solving mathematical problems.

Indicator Code	Category		
	Good	Sufficient	Less
U1	√		
U2	√		
P1		√	
A1		√	
A2		√	
A3		√	
E1			√
E2	√		

The table above shows that student with verbalizer cognitive style get a good category on 3 indicators, sufficient category on 4 indicators, and good category on 1 indicator. Therefore, it can be said that the mathematical connection ability of student with visualizer cognitive style meets sufficient indicators.

3. Summary of Similarities and Differences Student's Mathematical Connection Ability with Visualizer and Verbalizer Cognitive Styles in Solving Problems.

The table 8 shows the similarities and differences of student's mathematical connection abilities with visualizer and verbalizer cognitive styles in solving mathematical problems.

Table 8. Similarities and Differences in Students' Mathematical Connection Ability with Visualizer and Verbalizer Cognitive Styles in Solving Problems.

Problem Solving Stage	Visualizer	Verbalizer
Understanding the problem	- Do not write down the information and problems that exist, but can explain it completely and correctly. - Can identify and utilize relationships between ideas in mathematics based on data/facts and existing but incomplete problems.	- Write and explain information and problems correctly using their own language completely and correctly. - Can identify and utilize relationships between ideas in mathematics based on data/facts and existing problems completely and correctly.
Devising a plan	- Planning concepts and procedures to solve problems completely and correctly	- Plan concepts and procedures to partly solve problems correctly.
Carrying out the plan	- Carry out the completion according to the previous plan completely and correctly. - Able to explain how the mathematical ideas used are interrelated and underlie each other completely and correctly. - Able to apply mathematics to solve everyday problems correctly.	- Carry out the completion according to the previous plan but not quite right. - Able to explain how some of the mathematical ideas used are interrelated and underlie one another. - Able to apply mathematics to solve everyday problems, even though some of the concepts used are not correct.
Looking back	- Able to evaluate the concepts, procedures,	- Unable to evaluate the concepts and

	and mathematical operations used.	procedures used. - Able to evaluate the mathematical operations used.

Students who have visualizer and verbalizer cognitive styles, both are able to understand existing information and problems. Also, identify and utilize mathematical ideas. This can happen because it is possible for individuals to have these two cognitive styles. However, what stands out is one of them. Verbal and visual systems that exist in individuals can store and manage information received simultaneously (Ewan & Reynolds, 2007). Thus, when information is presented in verbal and visual forms, both can manage it. In addition, there are also differences between the mathematical connection abilities of visualizer students and verbalizer students. Visualizer students have better mathematical connection skills than verbalizer students. This can be seen in the polya process: planninh, implementing, and evaluating. Student with visualizer cognitive style make mistakes because they are not able to understand the images presented. This difference can occur because individuals with visualizer cognitive style are more prominent in the visual system while individuals with visualizer cognitive style are more prominent in the verbal system (Ewan & Reynolds, 2007). The differences that occur can also be caused by the level of student focus on information and problems. Hasan (2019) argues that the level of focus of student with visualizer cognitive style on important information needed in problems is higher than student with verbalizer cognitive style. Thus, when connecting information and problems with mathematical concepts, there is very little chance for errors to occur.

CONCLUSION

Based on the results of the analysis that has been carried out by the researchers, the results show that the profile of student' mathematical connection abilities with visualizer cognitive style in solving mathematical problems is able to meet 7 good indicators and 1 sufficient indicator. At the stage of understanding the problem, students with visualizer cognitive style are able to identify data/facts and existing problems even though they are not written down, but are less able to identify and utilize relationships between ideas in mathematics based on existing data/facts and problems. At the planning stage, students are able to plan concepts and procedures to solve problems. At the implementing stage, students are able to implement concepts and procedures that have been planned previously, understand how mathematical ideas are interrelated and underlie each other, able to use mathematics in the context of everyday problems. At the evaluating stage, students are able to evaluate the concepts, procedures, and arithmetic operations used. Visualizer students' mathematical connection abilities are in the good category.

While the profile of students' mathematical connection abilities with verbalizer cognitive style in solving mathematical problems is able to meet 3 good indicators, 4 sufficient indicators, and 1 less indicator. At the stage of understanding the problem, students with cognitive verbalizer style are able to identify data/facts and problems, and are able to identify and utilize relationships between ideas in mathematics based on existing data/facts and problems. At the planning stage, students are less able to plan concepts and procedures to solve problems because there are still conceptual errors in the plan. At the applying stage, students are less able to implement the concepts and procedures that have been planned previously, less able to understand how mathematical ideas are interrelated and underlie each other and less able to use mathematics in the context of everyday problems. At the evaluating stage, students are able to re-evaluate the arithmetic operations used, but are unable to evaluate the concepts and procedures used. The weakness found in students with verbalizer cognitive style is that they cannot understand and use the images presented. However, the mathematical connection ability in solving mathematics problems of students with verbalizer cognitive style is in the sufficient category.

SUGGESTION

Based on the research results obtained, the researchers gave the following suggestions:

1. Teachers are expected to be able to train students with questions in the context of daily life that have a higher level of mathematical connection so that they can improve their connection skills and also expected to could get used to various exercises presentation so student with visualizer and verbalizer cognitive styles can be trained to understand the given problem.
2. This research was conducted on female students only. Further research is needed to identify differences in mathematical connection abilities in solving mathematical problems with different genders in terms of visualizer and verbalizer cognitive styles.

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