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Analysis of the Mathematical Visualization Process of Female Students in Solving Contextual Problems Based on Cognitive Style

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Abstract

The purpose of this study was to describe the process of mathematical visualization of female students in solving contextual problems in terms of differences in cognitive styles. This type of research is a qualitative research with a descriptive approach. The research subjects consisted of two 8th grade students with SPFI and SPFD cognitive styles. Data collection methods consist of tests and interviews based on test results. The research instrument consisted of TKM, GEFT, TVM. The validity of the data using time triangulation. Data analysis through data reduction, data exposure, data verification and drawing conclusions. The results showed that field independent female subjects explored objects from only one point of view, from the side they produced 3D objects and were divided into 4 parts. SPFI uses an object-partition strategy. SPFI scans objects in both 3D and 2D. SPFI performs object manipulation in the form of rotation. While SPFD explores objects in 2D, because it uses the point of view from the side of the object. SPFD identifies the presence of blocks, and triangles. SPFD uses an object partitioning strategy. SPFD manipulates objects in the form of rotation of triangular objects by 1800 clockwise. It can be concluded that the visualization of SPFI is more complex and more detailed than SPFD. Furthermore, SPFI pays more attention to the spatial (spatial) aspect of an object than SPFD. Therefore, teachers need to pay attention to the strategies carried out by students in terms of gender and cognitive style in solving cognitive problems so that students can perform optimally.

Keyword: mathematical visualization, female, cognitive style.

Analisis Proses Visualisasi Matematis Siswa Perempuan dalam Menyelesaikan Masalah Kontekstual Berdasarkan Gaya Kognitif

Abstrak

Tujuan penelitian ini untuk mendeskripsikan proses visualisasi matematis siswa perempuan dalam menyelesaikan masalah kontekstual ditinjau dari perbedaan gaya kognitif. Jenis penelitian ini adalah penelitian kualitatif dengan pendekatan deskriptif. Subjek penelitian terdiri dari dua siswa kelas 8 dengan gaya kognitif SPFI dan SPFD. Metode pengumpulan data terdiri dari tes dan wawancara berbasis hasil tes. Instrumen penelitian terdiri dari TKM, GEFT, TVM. Keabsahan data menggunakan triangulasi waktu. Analisis data melalui reduksi data, pemaparan data, verifikasi data dan penarikan simpulan. Hasil penelitian menunjukkan bahwa subjek perempuan field independent mengeksplorasi objek hanya dari satu sudut pandang, dari samping menghasilkan objek 3D dan terbagi menjadi 4 bagian. SPFI menggunakan strategi partisi-objek. SPFI memindai objek dalam bentuk 3D maupun 2D.

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SPFI melakukan manipulasi objek berupa rotasi. Sedangkan SPFD mengeksplorasi objek dalam bentuk 2D, karena menggunakan sudut pandang dari samping objek. SPFD mengidentifikasi adanya bangun balok, dan segitiga. SPFD menggunakan strategi partisi objek. SPFD melakukan manipulasi objek berupa rotasi objek segitiga sebesar 180^0 searah jarum jam. Hal ini dapat disimpulkan bahwa visualisasi SPFI lebih kompleks dan lebih detail dibandingkan SPFD. Lebih lanjut, SPFI lebih memperhatikan aspek keruangan (spasial) suatu objek dibanding SPFD. Oleh karena itu, guru perlu memperhatikan strategi yang dilakukan oleh siswa ditinjau dari gender dan gaya kognitif dalam menyelesaikan masalah kognitif supaya siswa dapat melakukan secara maksimal.

Kata kunci: visualisasi matematis, perempuan, gaya kognitif.

INTRODUCTION

Cognitive processes during solving mathematical problems related to everyday life can not only be seen from the results of the answers, but also need to be considered from the process or stages of work carried out by students (Basar et al., 2021; Hamid & Kamarudin, 2021; Utomo et al. al., 2017). The stages of solving mathematical problems must of course be seen in a complex manner starting from how students understand the elements of the problem, linking the solution to previous knowledge, using and determining operating rules, using appropriate and creative strategies, determining final results and convincing themselves from obtaining final answers.

However, not a few students rely more on memorizing mathematical procedures and operations when solving mathematical problems without a thorough understanding of what is meant by the problem, so that the results of the solution are not correct (Kibar & Akkoyunlu, 2016; Nemirovsky & Noble, 1997; Utomo et al., 2018). In addition, students tend to memorize during completion, not connecting the knowledge they have to understand the problem. One of the impacts is that students experience difficulties or errors while solving math problems.

Regarding mathematical problems, visualization is one thing that has an important role during the process of solving mathematical problems (Nemirovsky & Noble, 1997; zkan et al., 2018; Utomo et al., 2017). According to (Yilmaz & Argun, 2018) visualization has a significant role to develop understanding, mathematical thinking in transitioning concrete to abstract thinking models related to solving problems of everyday life. Visualization can give meaning to mathematical concepts and their relationship in exploring mathematical problems (Latour, 2017). Visualization is also defined as the process of transforming the information (concrete) obtained into the form of perception

(abstract) so that the results presented appear to have a relationship between data/information (Li, 2010). In addition, visualization is the most commonly used technique in the process of geometric representation of mathematical concepts (Utomo et al., 2018). According to (Huang et al., 2009) visualization is the ability to identify and understand problem situations. This means that visualizing a situation or object involves mental manipulation with various alternative solutions to solve problems related to a situation or object without involving concrete manipulation.

In this study, the visualization indicators are generation, inspection, scanning and transformation. According to (Utomo et al., 2018) that generation is a cognitive activity in identifying objects (algebraic images/symbols) according to the perception of mathematical ideas. Inspection is a cognitive activity in examining and selecting certain visual ideas as mathematical ideas in the form of visual, symbolic forms (pictures, algebraic symbols) used to solve problems. Scanning is a cognitive activity in presenting objects to obtain simpler objects to facilitate solving mathematical problems. Transformation is a cognitive activity in manipulating the results of the representation that has been made to be used in the process of solving mathematical problems.

Gender also affects a person's visualization in solving mathematical problems (Huang et al., 2009; Latour, 1984; Utomo et al., 2017). Gender is an individual identity that refers to biologically male or female as well as characteristics that are complex in influencing the way they interact as men or women which are developed based on the conditions of the surrounding social and cultural environment (Dorisno, 2019). In other words, gender is gender which refers to the socio-cultural dimensions of a person as male and female with characteristics that tend to be masculine for the male gender and tend to be feminine for the female gender. In this study, the research subjects complained about the female gender.

Each student has a different model or characteristic during problem solving. As for identifying the differences between each student in solving problems, it can be seen from the psychological aspect, such as cognitive style (Triaca et al., 2019). Through the identification of students' cognitive styles, teachers can be helped to understand how a person organizes and represents information. With regard to representing information, of course, it cannot be separated from how students express it in the form of pictures or mathematical expressions. Cognitive style also has an important role during mathematical

visualization, especially how to receive information to use information in solving problems (Utomo et al., 2017). Cognitive style is an individual characteristic that consistently functions in mental actions in the cognitive field, including thinking, remembering, solving problems, developing represent, organize, process and information (Purnomo et al., 2017; Ulya, 2015; Utomo et al., 2018). To identify a person's cognitive style, the Group Embeded Figure Test (GEFT) measuring instrument is used. In this study, the subject's cognitive style was divided into two types, namely the type of field independent (FI) and the type of field dependent (FD).

Mathematical visualization ability is significantly influenced by gender or gender differences, this is in accordance with the results of several studies which state that there are significant differences between men and women in terms of mathematical spatial visualization abilities (Yilmaz, 2009; Fu'adiah, 2016; Listiani, 2020). According to Nemeth (2007) mathematical visualization ability is not inherited genetically but as a result of a long learning process. Cahyono (2017; 2019) states that there is no significant difference between men and women in the aspect of intelligence in general, although in certain aspects there are differences between boys and girls. Based on the description of the studies above, gender is still a good predictor for measuring mathematical visualization. Cognitive style has an important role in the mathematical visualization process, especially in the part of how a person receiving information uses the information in solving problems (Presmeg, 1986; Zimmermann, 1991; Utomo et al., 2017). So the purpose of this study was to analyze the process of mathematical visualization of female students in solving geometry problems in terms of differences in field independent and field dependent cognitive styles.

RESEARCH METHODS

This type of research is a qualitative research using a descriptive approach. Qualitative research has the aim to describe in depth related to the phenomena shown by the research subject (Cresswell, 2013). The number of respondents from grade 8 was 32 students, where there were 22 female students and 10 male students. Furthermore, the subject of this study consisted of 2 8th grade female students of SMPN 1 Jombang by purposive sampling. The subject consisted of 1 female student with field independent cognitive style and 1 female student with field dependent cognitive style. To determine

the type of cognitive style, researchers have conducted a GEFT test by controlling for the same mathematical ability. The research instrument consists of the main and supporting instruments. The main instrument is the researcher, while the supporting instruments consist of the Mathematical Ability Test (TKM), Mathematical Visualization Test, GEFT and Interview Guidelines. The Mathematical Visualization Test (TVM) consists of one problem related to geometry which is shown as follows.

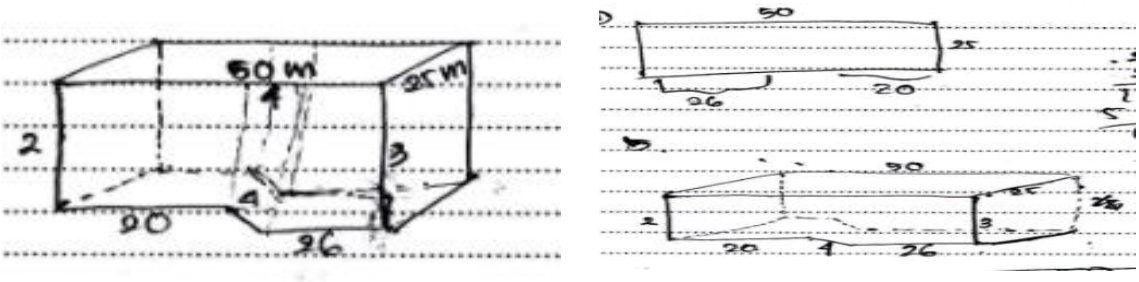
> *A swimming pool has a length of 50 m and a width of 25 m with a depth that is divided into 2, namely the depth for adults and the depth for adolescents. The depth of the pool for adults is 3 m along 26 m. The depth of the pool for remajas is 2 m along 20 m, while the bottom limiting the two depths is made sloping. How many liters of water are needed to fill the pool? Explain your answer clearly!*

The data collection technique of this research consisted of giving the TKM followed by the GEFT test. Furthermore, prospective subjects are selected based on the scores that have been obtained from the Mathematical Ability Test and GEFT. The results of the TKM on the subject of the independent field and the dependent field are considered the same as the controller, where the difference in the TKM score is not more than 5 points. After obtaining the subject according to the specified criteria, the TVM is given and the interview is task-based and coded. The triangulation carried out in this study is time triangulation. The data analysis carried out in this study consisted of data reduction, data exposure, data interpretation, data verification, and drawing conclusions (Creswell, 2013).

The mathematical visualization indicators in this study consist of generation, inspection, scanning and transformation. Indicator generation is the stage of identifying the elements of an object, and exploring objects that have been made according to perception. The inspection indicator is the stage of investigating the object in accordance with the knowledge possessed, establishing a strategy as an alternative possible solution. The scanning indicator is the stage of paying attention to objects that are re-represented according to perception, setting aside or developing objects according to their goals. Finally, the transformation indicator is manipulating objects (rotation/translation/dilation/reflection) as an alternative solution (Utomo et al., 2017).

RESULTS AND DISCUSSION

Based on the TVM results that have been given to field independent female subjects (SPFI) and field dependent female subjects (SPFD) with reference to the indicators of generation, inspection, scanning and transformation, the following results are obtained. The results of the SPFI subject's research on generation indicators related to cognitive activity in object identification (algebraic images/symbols) according to the perception of mathematical ideas are shown in Figure 1 below.



(a) (b)

Figure 1. SPFI results in the generation process

Based on the results of Figure 1 above, it is obtained that (a) when the SPFI gives it represents the problem in the form of an image, while (b) when the SPFI shows the result of the representation on a scribble sheet. SPFI shows a 2D image on a scribble sheet as a representation of a swimming pool. In addition, SPFI represents a swimming pool in 3D. SPFI reveals that the object is a geometric shape, so that the object has volume. SPFI divides the object into 3 parts, namely the adult, juvenile, and constraint parts. On the delimiter, SPFI provides a shading mark. SPFI reveals that the representation of the swimming pool is an object viewed from the side. SPFI revealed that there are several geometric shapes from the swimming pool representation that have been made. SPFI revealed that swimming pools for adults and youth categories are in the form of blocks, because they have different ribs and side areas. SPFI revealed that these side differences can be seen in the swimming pool. In other words, SPFI assumes that it is in the pool to see the difference in the size of the sides. SPFI does not know the exact name of the barrier structure, only certain parts can be identified.

The results of interviews between researchers and SPFI related to generation indicators are shown in Table 1 below.

Table 1. Results of researcher interviews with SPFI in indicator generation

Code		Researcher questions and subject answers
P	:	Why would you describe a swimming pool like this?
SPFI	:	Make it easy to see
P	:	How does that mean?
SPFI	:	Yes, this picture is from the side, so it's easier to see if the swimming pool is built in space, because it has contents and you can see the ribs.
P	:	Please explain this scribbled sheet image (while pointing to Figure b)
SPFI	:	Ooo, I was planning to just draw the surface of the pool, but it didn't happen
P	:	So what is this dotted line?
SPFI	:	You build a space, and this is the dividing part of the adult and youth pool, because it's inside the swimming pool, that's why I put a dotted line
P	:	What part do you mean?
SPFI	:	I divided the pool into 3 parts, so it's easy to see, the pool section for the adult category, the pool section for the juvenile category, and a section for the barrier between the two categories.
P	:	Why cuboid?
SPFI	:	If you look at it, the ribs are not the same, the length, width and height are not the same, then the sides are also not the same
P	:	Earlier you said the limiting part, please explain!
SPFI	:	Yes, this is the limiting part of adults and remajas, the shape from the front is like a trapezoid because there is a slope
P	:	Why is it shaped like a trapezoid?
SPFI	:	Yes, because there is a slope, if you look at it from the inside, it's tilted, but the trapezoid shape is on this side (while showing the front) and this is it
P	:	How do we know if it's a trapezoid?
SPFI	:	Yes from the inside, so for example we are in the middle of the barrier, then we can see the shape of the wall in front of us and behind us is a trapezoid shape

The results of the SPFI subject's research on inspection indicators related to cognitive activity in examining and selecting certain visual ideas as mathematical ideas in the form of visual, symbolic forms (pictures, algebraic symbols) used to solve problems are shown in Figure 2 below.

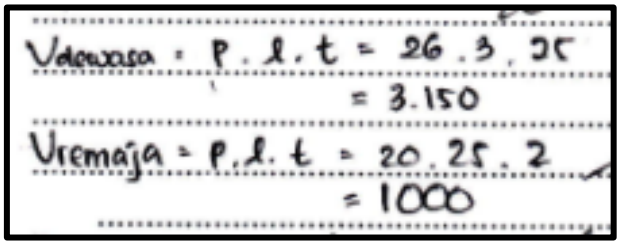


Figure 2. SPFI results in the inspection process

Based on Figure 2 above, SPFI determines the volume of the swimming pool by searching for each part of the specified swimming pool, namely the adult category swimming pool is written as Vdewasa and the juvenile category pool is written by Vremaja. In both adult and juvenile category pools, SPFI sets the bar formula to find the

volume of both categories. This is because SPFI emphasizes the elements of the object, where the object has different lengths, namely length, width and height. Furthermore, SPFI will add up the results of each part of the pool with the boundary part which is assumed to be trapezoidal to determine the overall volume of the pool.

In changing the obtained units to suit the desired problem, SPFI uses the ladder rule for length units by analogizing the ladder rules for volume units. SPFI revealed that from meter to dm it goes down by 1, then it will be multiplied by 10, because this is cubic, so every time it goes down 1 is multiplied by 1000, and 1 liter is equal to 1 dm3. However, this is done when the final result of the desired answer is obtained, not on every result from the adult volume and the adolescent volume.

The results of the SPFI subject research on scanning indicators related to cognitive activity in presenting objects to obtain simpler objects to facilitate solving mathematical problems are shown in Figure 3 below.

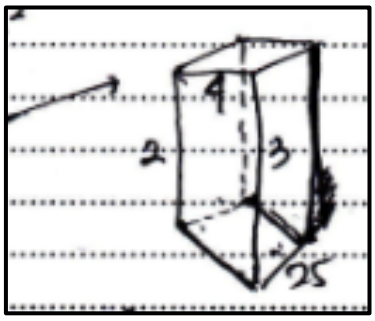


Figure 3. SPFI results in the scanning process

While the results of interviews between researchers and SPFI are shown in Table 2.

Table 2. Results of researcher interviews with SPFI on scanning

Code		Researcher questions and subject answers
P	:	Eem, you said it was a trapezoid, didn't you?
SPFI	:	Yes, because it is shaped like a trapezoid, the sloping part becomes a sloping part and the surface of this pool becomes flat, so it looks like a right-angled trapezoid.
P	:	But earlier you said find the volume huh
SPFI	:	Yes
P	:	Ooo, then why is this a dotted line? (while pointing to the image element)
SPFI	:	Right, this is building space, so if you build a space, if there are ribs behind it, it will be broken up
P	:	What does behind mean?
SPFI	:	It's actually not visible because it's covered on the front side, that's why I broke it up
P	:	Then why does the picture look like the 3rd one is longer?

Code		Researcher questions and subject answers
SPFI	:	(smiling) it's already in size, so I think it's okay
P	:	Ooo, it's okay huh
SPFI	:	The original one (pointing to rib of size 25) is longer than this one (pointing to rib of size 3), this 4 should also be longer than 2 and 3 (while smiling)

Based on the results of written answers and interview excerpts, SPFI performs the transfer of an object. The object transfer aims to make it easier to find the volume of the barrier. The delimiter part is the object that is represented by SPFI elsewhere. SPFI re-represents the shape of the boundary according to the original, which is 3-dimensional. However, SPFI can only recognize the shape of the object from one side which is a flat shape, namely a trapezoid. SPFI shows the dotted line as a spatial characteristic. In addition, SPFI provides information on the representation made in the form of the size of each element. SPFI does not match the size of the created representation.

The results of the SPFI subject's research on Transformation indicators related to cognitive activity in manipulating the results of representational forms that have been made to be used in the process of solving mathematical problems are shown in the results of the interviews in Table 3 below.

Table 3. Results of researcher interviews with SPFI in transformation

Code		Researcher questions and subject answers
P	:	What is this looking for?
SPFI	:	I'm looking for the limiting volume, because it's a trapezoidal shape, you have to find the area of the trapezoid first because it's in a sleeping position
P	:	You mean sleep?
SPFI	:	Yes the position is from standing (while demonstrating) then it becomes like this (sleeping position by demonstrating)
P	:	How come?
SPFI	:	Yes because I turn (with a smile)
P	:	What's playing?
SPFI	:	Yes trapezoid
P	:	Is there a picture?
SPFI	:	Nothing (smiling)
P	:	Why there is no?
SPFI	:	Yes because it's easy, so I'm just imagining it

Yes, because it's easy, so just say. Based on the interview snippet above, when determining the volume limiter the SPFI rotates the created object. The object rotation performed by SPFI is related to the trapezoidal shape which is the front side of the barrier. SPFI rotates the trapezoid shape to determine its area. SPFI rotates the object accompanied by a rotation of the answer sheet, so that it is not represented on the answer

sheet. The purpose of SPFI rotating a trapezoidal shape is to make it easier to identify its elements, such as the height of the trapezoid and parallel sides.

The results of the SPFD subject research on generation indicators related to cognitive activity in object identification (algebraic images/symbols) according to the perception of mathematical ideas are shown in Figure 4 below.

just imagine

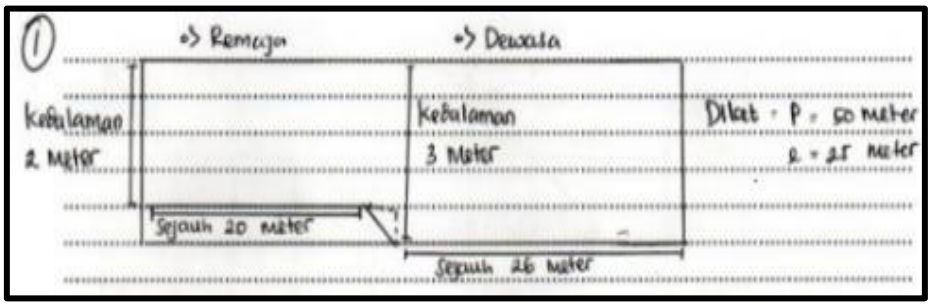


Figure 4. SPFI results in the generation process

The results of interviews between researchers and SPFD regarding the generation indicators are shown in Table 4 below.

Table 4. Results of interviews between researchers and SPFD regarding indicator generation

Code		Researcher questions and subject answers
P	:	Why is the picture like this? (pointing to picture 4)
SPFD	:	So easy to see
P	:	Is it easy to see what you mean?
SPFD	:	I saw it from the side, so the swimming pool looks like this (pointing to the picture)
P	:	What about this dotted line?
SPFD	:	This is the part that is under the remaja, like a triangle because there is a slope on it, so it is tilted like a triangle
P	:	Why is it like this?
SPFD	:	Because this is the juvenile section, until this line is 20 meters, then I add it with a dotted line, so that the juvenile's length is 24 meters because 50 is reduced by 26 meters.
P	:	Earlier, you said that the section is under remajas, how many sections are there, Ms.
SPFD	:	Three parts sir
P	:	Whatever?
SPFD	:	This section (while pointing to the juvenile category), this section 26 meters (while pointing to the adult category), and this small one (while pointing to under the youth section)
P	:	If this one?
SPFD	:	This is not part of the swimming pool, because there is nothing in it
P	:	Ooo, so there are three huh

Code		Researcher questions and subject answers
SPFD	:	Yes, three parts
P	:	Why do you divide the pool into three parts?
SPFD	:	To make it easier to calculate the volume later

Based on Figure 4 and Table 4, the SPFD identifies the known and asked elements. SPFD shows an easy-to-understand representation of the pool. SPFD provides size information on objects, such as the length, width and depth of the swimming pool. SPFD divides objects into three parts, namely the juvenile category swimming pool, the juvenile category swimming pool, and the section below the youth category pool. The SPFD revealed that the juvenile pool length was 24, due to the difference between the overall length and the adult length. SPFD reveals that the pool object is viewed from the side, so SPFD presents the object as 2D. In addition, SPFD reveals that the created object does not have a width element, because it is influenced by the position of the point of view.

The results of the SPFD subject's research on inspection indicators related to cognitive activity in examining and selecting certain visual ideas as mathematical ideas in the form of visual, symbolic forms (pictures, algebraic symbols) used to solve problems are shown in Table 5 below.

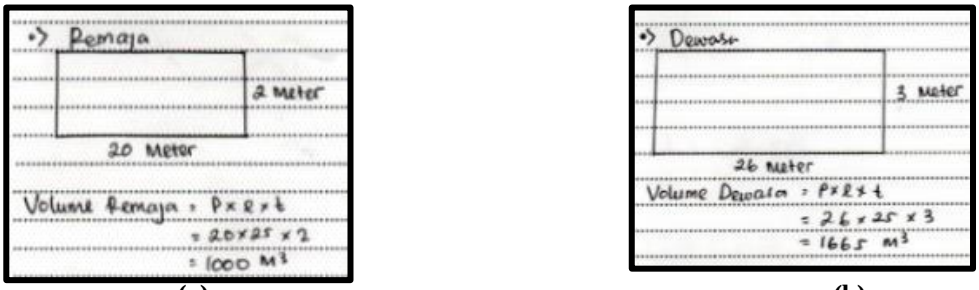
Table 5. Results of interviews between researchers and SPFD regarding inspection indicators

Code		Researcher questions and subject answers
P	:	What does this remaja look like? (while pointing to the picture)
SPFD	:	block
P	:	What is this block?
SPFD	:	From this picture, it's not a block but a rectangle, because I see it from the side it looks like a rectangle
P	:	Then which block?
SPFD	:	Nothing, I'm just imagining it (smiling)
P	:	Oooo, why is it shaped like a block, sis?
SPFD	:	Because this is a geometric shape, it has volume and the edges are not the same, 2 meters, 24 meters and 25 meters
P	:	What is the shape of the youth category swimming pool below?
SPFD	:	Triangular prism
P	:	Why is the shape of a triangular prism?
SPFD	:	Yes, because there is this triangle, which slopes down (pointing to the picture)
P	:	How are you going to calculate it?
SPFD	:	I'll count one by one later
P	:	What does that mean?
SPFD	:	Yes, I first calculate the juvenile volume, then the adult volume and the bottom volume of the juvenile pool, then I add them all up
P	:	Why use that way?

Code		Researcher questions and subject answers
SPFD	:	Let's make it easy

Based on Table 5, SPFD reveals that the partitioned objects have different shapes. SPFD identifies objects that are rectangular and triangular. The rectangular shape refers to the adult and juvenile pool, while the triangular shape refers to the object below the juvenile pool. In addition, SPFD revealed that the actual shape of the object that has been made is a block shape and a triangular prism, because these shapes have volume. In other words, SPFD realizes that the object is a shape. SPFD sees that the object has different edge sizes. To find the volume of the pool, SPFD accumulates the volume of each predefined section, because SPFD makes it easier to understand the shape of each object.

The results of research on SPFD subjects on Scanning indicators related to cognitive activity in presenting objects to obtain simpler objects to facilitate solving mathematical problems are shown in Figure 5 below



(a) **(b)**

Figure 5. SPFD results in the scanning process

Based on Figure 5, SPFD scans objects that represent the front of the juvenile category (a) and the adult category (b). SPFD scans objects in the form of rectangles. SPFD scans objects to simplify adult volume calculations. The scanned object is created the same as before. That is, SPFD pays attention to the position and shape of the object that has been scanned (scanning), so that the object is easily identified. On rectangular objects, SPFD does not pay attention to the size and representation created. In other words, SPFD emphasizes the information that accompanies the element rather than the form of the element. Finally, the SPFD defines the block formula to find the volume of an adult category swimming pool.

The results of the SPFD subject research on Transformation indicators related to cognitive activity in manipulating the results of the representations that have been made to be used in the process of solving mathematical problems are shown in the results of the interviews in Figure 6 below.

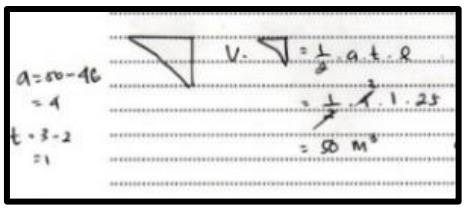


Figure 6. SPFD results in the transformation process

Based on Figure 6, the SPFD shows a triangular representation which is the object under the juvenile pool. An object representation is created to calculate the volume of the section under the juvenile pool. SPFI looks for the length of one side by finding the difference between the overall length and the accumulated length of the two pools, which is a=50-46. After getting one of the elements, SPFD manipulates the object, namely rotating an object that is 4 m in size. Where an element measuring 4 m is initially at the top, then rotated so that it is at the bottom. This was done in relation to the formula for the area of a triangle, where the SPFD wanted to show the existence of a triangular base element. However, SPFD does not serve objects that are the result of a rotation. In other words, SPFD rotates the object through what has been envisioned.

The similarities and differences in aspects of generating objects, aspects of inspecting objects, aspects of scanning objects, and aspects of transforming objects are shown by field independent and field dependent female subjects in solving contextual problems. Field independent and field dependent female subjects identify the elements of the information provided, such as what is known. The two subjects showed several parts of the swimming pool, namely the adult and juvenile sections. Both subjects provide information on each element to make it easier to understand the object. Field independent and field dependent female subjects positioned themselves to see the swimming pool from the side. This is in accordance with the opinion (Purnomo et al., 2017; Ulya, 2015; Utomo et al., 2017a) which states that female students more clearly present their answers in detail and accurately. The difference is that field independent female subjects show a swimming pool representation in 3D, while field dependent female subjects show a 2D representation of a swimming pool, where the object shows the elements of the length and depth of the pool without showing the width of the swimming pool. Field independent female subjects divided the pool into 3 parts, namely the adult category swimming pool, juvenile category swimming pool and the barrier section of the pool, while the field dependent female subject divided the swimming pool into 3 parts, namely the adult category swimming pool, the juvenile category swimming pool. and a section under the

juvenile category. This shows the difference in exploration between field independent and field dependent female subjects. The difference is shown in the representation, object partition, and point of view used in viewing the object (Huang et al., 2009).

Field independent female subjects detected 2 shapes that represent swimming pools, namely beams and trapezoidal prisms. Field independent female subjects identify the shape of the barrier based on elements that are easy to understand, as well as positioning themselves in the swimming pool. Meanwhile, field dependent female subjects detected 2 shapes representing the swimming pool, namely rectangles and triangles. On the other hand, field dependent female subjects imagine the existence of a rectangular prism and block. Field independent female subjects changed the units obtained to suit the problem, while field dependent female subjects did not change the units obtained to suit the problem. This shows that there are differences in aspects of object inspection between female subjects, field independent and field dependent. The difference is shown in the representation, and the experience used in seeing in different perspectives (Latour, 1984; Li, 2010; Utomo et al., 2018). In accordance with the results of research (Triaca et al., 2019; Utomo et al., 2017b, 2017a) that it can be said that people who have a field independent cognitive style have a tendency to respond to stimuli using their own perceptions, are more analytical and analyze patterns based on components. components, while people who have a field dependent cognitive style have a tendency to respond to a stimulus using environmental conditions as a basis for their perception, and a tendency to view a pattern as a whole, not separating its parts.

CONCLUSION

Field independent female subjects explore objects only from one point of view, namely from the side of the object. View from the side produces 3D objects and is divided into 4 parts. The subject develops the information in the problem. Field independent female subjects used an object-partition strategy. Field independent female subjects pay attention to the characteristics of each object in determining its volume. In addition, the subject also pays attention to the form of rank in each unit. Field independent female subjects scanned objects in 3D or 2D, but did not pay attention to the length of the elements. Field independent female subjects pay attention to the spatial (spatial) aspect of an object, such as a dotted line. Field independent female subjects manipulate objects

in the form of rotation. The form of rotation carried out by field independent female subjects is a form of vertical rotation. However, field independent female subjects do not represent objects that have been rotated, because these objects are easy to understand.

Field dependent female subjects identified the known and asked elements. Field dependent female subjects explore objects in 2D, because they use the point of view from the side of the object. Field dependent female subjects identified the existence of blocks and triangles. Field dependent female subjects used object partitioning strategy. Field dependent female subjects scan objects that are adjusted to the original object, both in shape and position. Field dependent female subjects did not pay attention to the spatial aspect of the scanned object. Field dependent female subjects manipulated objects in the form of rotating a triangular object by 1800 clockwise, but it was not represented on the answer sheet, but only imagined and demonstrated with the answer paper. Overall, the difference in visualization ability of field independent subjects is more complex in terms of point of view, object partitioning and object representation presentation compared to field dependent. In addition, field independent subjects are better able to present three-dimensional objects and perform transformations of various objects than field dependent subjects.

Based on the findings above, it is hoped that policy makers in junior high school education can include and develop transformation materials at the junior high school level, because the results of the study show that each subject performs cognitive activities related to transformation such as rotation and translation. Furthermore, it can be used as a reference for basic material transformation at a higher level.

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