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Description of Student's Spatial-Visual Intelligence in Solving Geometry Flat Side Problems Based on Geometry Initial Ability Level

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ABSTRACT
This study aims to find out the general description of spatial-visual intelligence on 7th-grade students of Junior High School in solving geometry flat side problems based on geometry initial ability level. This study used Hass Theory, which classifies characteristics of spatial-visual intelligence on imagination, conceptualization, problem-solving, and pattern searching. The type of this study was descriptive with a qualitative approach. This study was conducted in SMP Negeri 2 Pangkajene. The subjects of this study were three students consisting of one student with a high geometry initial ability level, one student with a moderate geometry initial ability level, and one student with a low geometry initial ability level selected by purposive sampling. Data were collected using tests and interviews. The instruments of this study were geometry initial ability test, spatial-visual intelligent test with geometry flat side materials, and interview guidelines. The data analysis technique of this study used the Miles, Huberman, and Saldana Model, which consists of data condensation, data display, and conclusion drawing/verification. The results of this study show that: (1) The most dominant characteristics of students are imagination and pattern searching, while the least dominant characteristic is problem-solving, (2) Students with a high geometry initial ability level can fulfill three of the spatial visual intelligence characteristics, namely, imagination, conceptualization, and pattern searching, (3) Students with a moderate geometry initial ability level can fulfill two of the spatial visual intelligence characteristics, which are imagination and pattern searching, (4) Student with a low geometry initial ability level is not able to fulfill all of the spatial-visual intelligence characteristics.

Keywords: *Spatial-Visual Intelligence, Geometry Initial Ability, Geometry Flat Side, Hass Theory*

1. INTRODUCTION

Intelligence is the ability to solve or create a valuable thing for a particular culture [1]. This opinion shows that when people can solve a problem, they may have high intelligence. Intelligence owned by each individual consists of eight types, even though only a few bits of intelligence are dominant [1]. One of the intelligence is visual-spatial intelligence.

Visual-spatial intelligence is the ability to think three-dimensionally. Someone who has visual-spatial intelligence can manage three-dimensional images, shapes, and space [1]. This management ability is carried out by recognizing shapes, colors, spaces and creating mental or realistic images. Through these activities, someone can generate imagination, graphic representation and re-create the visual world. Recreating the visual world is called visualization. Visualization in mathematics is not only in mathematical analysis but also in other aspects, such as geometry or related to spatial aspects [2].

Geometry is a study in mathematics that studies points, lines, planes, geometry, properties, sizes, and their correlation to each other [3]. Geometry is one of the abstract studies. Thus, in studying geometry, students are

required to have visual-spatial intelligence. This is because visual-spatial intelligence includes the ability or representing the idea visually or spatially. This ability supports intelligence in studying geometry [4].

Visual-spatial intelligence plays an important role in the success of geometry learning [2]. This is because, without visual ability, students will be prone to experience misconceptions. Students often understand formulas separately from the geometry objects. Thus, it can be stated that visual-spatial intelligence is closely related to initial mathematical ability, especially geometry. Continuing with the study conducted by [5], it is noted that there is a positive correlation between visual-spatial intelligence and geometry ability level.

This study focuses on the visual-spatial intelligence of students with high, moderate, and low geometry ability in solving problems according to Hass Theory. Subjects of the study were 7th-grade Junior High School students. This study aims to find out how visual-spatial intelligence of students in solving geometry flat side problems. The geometry flat side in this study includes cubes, blocks, prisms, and pyramids.

2. RESEARCH METHODS

The method used in this study was qualitative. This study aims to determine the general description of students' visual-spatial intelligence in solving geometry flat side problems reviewed based on the initial geometry ability level. Subjects ofe the study were 7th-grade students in SMP Negeri 2 Pangkajene, Pangkep Regency, South Sulawesi. Subjects selected were three students consisting of 1 student with high initial geometry ability (S1a), one student with moderate initial geometry ability (S2a), and one student with low initial geometry ability (S3a).

The data collection techniques in this study used a test to categorize the initial geometry ability and determine the students' initial geometry ability. Interviews to obtain further information regarding the subjects' answers on visual-spatial intelligence and explore the new information that may not be obtained during the test. Data analysis techniques used were data condensation, data presentation, and concluding/verification.

3. RESULT AND DISCUSSION

3.1 Subject with High Initial Geometry Ability (S1a)

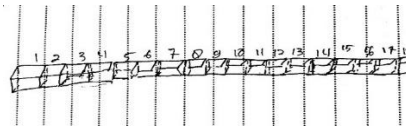


FIGURE 1. The answer of subject S1a on question number 1

In Figure 1, it can be seen that S1a drew a block consisting of 18 unit cubes, where the answer written by the subject is correct. Thus, subject S1a has expressed his idea in the form of a block as instructed to solve the problem given. Therefore, subject S1a can meet the indicator of expressing ideas or thoughts in a picture to solve the problem, representing the characteristics of imagination appropriately.

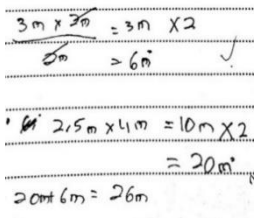
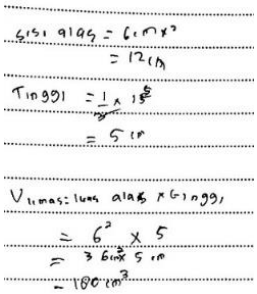


FIGURE 2. The answer of subject S1a on question number 2

In Figure 2, it can be seen that subject S1a wrote some calculation operations. Subject S1a seemed to use concepts he knew to solve the problem, where the subject completed all calculation operations correctly. However, the subject did not write the formula used, so that it was difficult to understand. Apart from that, subject S1a has used concepts he knew to solve the problem given correctly. Therefore, subject S1a can use concepts since he can solve the problem appropriately, representing the conceptual characteristics.

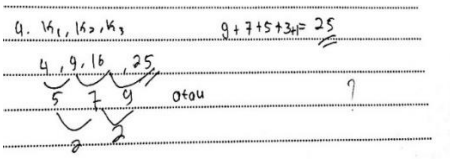


(a)

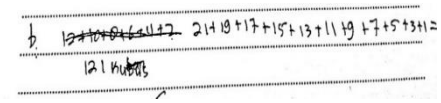
(b)

FIGURE 3. The answer of subject S1a on question number 3

In Figure 3, it can be seen that subject S1a wrote information obtained from question (a). However, subject S1a did not answer the question correctly, where he did not use the formula relevant to the problem given. He also seemed not to understand the meaning of the question well (b). Therefore, subject S1a cannot meet the indicator of completing the problem given correctly, representing problem-solving characteristics.



(a)



(b)

FIGURE 4. The answer of subject S1a on question number 4

In Figure 4, it can be seen that subject S1a has found more than one pattern, and then subject S1a used the pattern to obtain the correct answer (a). The subject used one of the methods he used in part a to find the answer in part b, where the answer written by the subject was also correct (b). Therefore, subject S1a can meet the indicator of finding a pattern to solve the problem appropriately, representing pattern search characteristics.

Based on the description above, a student with high initial geometry ability can meet 3 characteristics of visual-spatial intelligence. This is indicated by a student who can express his ideas in a picture, use concepts he knows, and find more than one pattern to solve the problem given correctly and adequately. This is in line with the opinion, which stated that someone with visual-spatial intelligence has various cognitive skills consisting of the combination of three elements, spatial concept, representational instrument, and reasoning process [6].

3.2 Subject with Moderate Initial Geometry Ability (S2a)

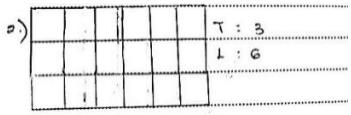


FIGURE 5. The answer of subject S2a on question number 1

In Figure 5, it can be seen that subject S2a expressed her idea in the form of a shape, which looks more like a rectangular than a block, as instructed by the question. During the interview, subject S2a explained that the shape she drew was a block with different lengths, widths, and heights. Subject S2a also mentioned the size of the block she drew, even though it was slightly different from what she wrote in the answer sheet. Nevertheless, S2a has expressed her idea in the form of a picture and explained the picture. Subject S2a can meet the indicator of expressing ideas or thoughts in a picture to solve the problem given, representing the characteristics of imagination.

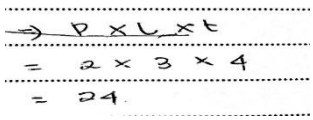


FIGURE 6. The answer of subject S2a on question number 2

In Figure 6, subject S2a used concepts she knew. In this case, she wrote the formula and calculation operation, then obtained the final result. However, the formula written by subject S2a was a formula of block volume that was not relevant to the question given, which was the surface area of a triangular prism. Therefore, subject S2a cannot meet the indicator of using concepts she knew to solve the problem appropriately given, representing the conceptual characteristics.

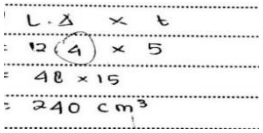
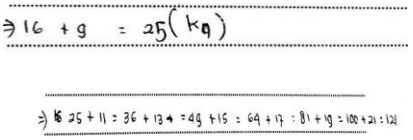


FIGURE 7. The answer of subject S2a on question number 3

In Figure 7, subject S2a did not write information obtained from the question. She only wrote the formula used to solve the problem given, followed by the operation he wrote, then obtained the final result. However, the formula used by subject S2a was not correct, so she did not obtain the right answer. Therefore, subject S2a cannot meet the indicator of completing the problem given correctly, representing problem-solving characteristics.



(a)

(b)

FIGURE 8. The answer of subject S2a on question number 4

In Figure 8, subject S2a wrote the pattern she obtained to solve the problem given and obtained the correct answer for question number 4, part a (a). Subject S2a obtained the right solution for part b (b) using the same pattern and steps. Therefore, subject S2a can meet the indicator of finding a pattern to solve the problem appropriately, representing pattern search characteristics.

Based on the description above, a student with moderate initial geometry ability can meet 2 characteristics of visual-spatial intelligence. This is indicated by a student who can express her ideas in a picture and determine more than one pattern to solve the problem given correctly and adequately. This is in line with the opinion by Hass in [7], which stated that student with visual-spatial intelligence is not only superior in finding the pattern in numbers but also able to find patterns sequentially and connect them with mathematical principles. However, the other two characteristics, conceptualization and problem solving, cannot be met because she cannot solve the problem given by involving the concepts she knew before correctly. This is caused by the lack of student knowledge about flat geometry, mainly the prisms and pyramids shapes.

3.3 Subject with Low Initial Geometry Ability (S3a)

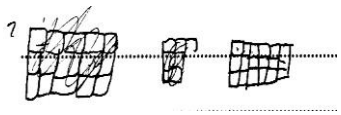
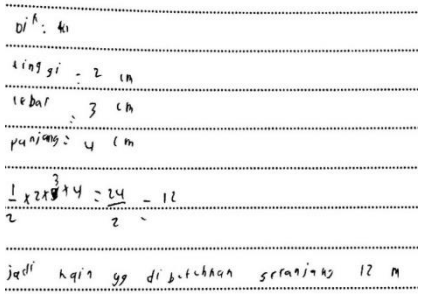


FIGURE 9. The answer of subject S3a on question number 1

In Figure 9, subject S3a expressed her idea in the form of a picture to solve the problem, where she drew 3 shapes, but the 2 of them appear to be crossed out. The shape drawn by subject S3a looks more like a rectangle than a block, as instructed in question number 1. During the interview, subject S3a explained the shape she drew and the size of the shape. Based on the subject's statement, it can be concluded that subject S3a only drew a rectangle, not a block, as instructed in the question. Therefore, subject S3a cannot meet the indicator of expressing ideas or thoughts in the form of a picture to solve the problem correctly, representing the characteristics of imagination.



(a)

(b)

(c)

FIGURE 10. The answer of subject S3a on question number 2

In Figure 10, it can be seen that subject S3a wrote information obtained from question (a). After that, the subject used the information to solve the calculation operation she wrote (b). After obtaining the result, subject S3a concluded the answer obtained (c). However, the explanation written by subject S3a was not correct because she did not use the right formula and did not seem to understand the question well. Therefore, subject S3a cannot meet the indicator of using concepts she knew to solve the problem given, representing the conceptual characteristics.

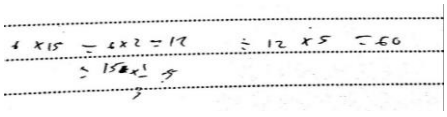
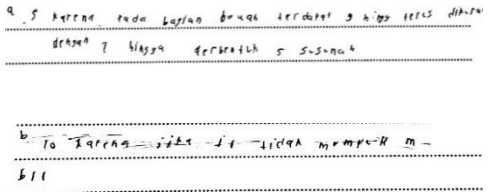


FIGURE 11. The answer of subject S3a on question number 3

In Figure 11, subject S3a did not write the information she knew from the question. Still, she directly wrote several operations so that it is difficult to understand what was written by the subject. The subject's final result was incorrect, so that subject S3a did not complete the problem appropriately given. Therefore, subject S3a cannot meet the indicator of completing the problem given correctly, representing problem-solving characteristics.



(a)

(b)

FIGURE 12. The answer of subject S3a on question number 4

In Figure 12, subject S3a did not appear to write the pattern she found to solve the problem given, where the subject only wrote the answer from k4 part a and the reason why she wrote the answer (a). Likewise, in part b, subject S3a only wrote the solution for k10, which is 11, without reason (b). Therefore, subject S3a cannot meet the indicator of finding a pattern to solve the problem appropriately, representing pattern search characteristics.

Based on the description above, a student with moderate initial geometry ability cannot meet all characteristics of visual-spatial intelligence. This is indicated by a student who cannot express her ideas in a picture, does not use concepts she knows, does not find more than one pattern, and cannot solve the problem given correctly and adequately.

4. CONCLUSION

The subject with high initial geometry ability can fulfill 3 characteristics of visual-spatial intelligence, including imagination, conceptualization, and pattern search. Moreover, the subject with moderate initial geometry ability can fulfill 2 characteristics of visual-spatial intelligence, including imagination and pattern search. Meanwhile, the subject with low initial geometry ability cannot fulfill all characteristics of visual-spatial intelligence. The pattern search and imagination are the most dominant characteristics (the most fulfilled) among other characteristics. Problem-solving characteristic is the most difficult characteristic to be met by all subjects.

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