Analysis of difficulties in mathematics learning on students with guardian personality type in problem-solving HOTS geometry test

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Abstract. Learning in the current 2013 curriculum is based on contextual issues based on questions that can encourage students to think broadly. HOTS is a real-life based assessment of everyday life, but in practice, the students are having trouble completing the HOTS issue. Learning difficulty is also influenced by personality type Based on the fact that the real difference one can see from a person is behavior. Kersey classifies the personality into 4 types, namely Idealist, Rational, Artisan, and Guardian. The researcher focuses on the type of guardian personality that is the type of personality that does not like the picture. This study aims to describe the difficulty of learning mathematics in students with a type of guardian personality in the completion of Geometry materials especially in solving HOTS. This research type is descriptive qualitative research. Instruments used in this study were the researchers themselves, personality class test sheets, learning difficulty test sheets in the form of HOTS Geometry test, and interview guides. The results showed that students with guardian personality it was found that a total of 3.37% difficulties of number fact skill, 4.49% difficulties of arithmetics skill, 37.08% difficulties of information skill, 31.46% difficulties of language skill, 23.60% difficulties of visual-spatial skill.

1. Introduction

One of the teaching strategies that promote HOTS is problem-solving. Problem solving is an active that involves various actions in the mind of thought including accessing and using knowledge and experience [17]. Students need to equip themselves with various knowledge and high skills in problem-solving, which involves higher order thinking. Assessment of the 2013 Curriculum adapts international standard assessment models, hopefully helps students in increasing their level of thinking ability, because high-level thinking of learners can be encouraged to think broadly and deeply about the subject matter [9]. The Bloom Revision Taxonomy is used to measure high-level thinking skills (HOTS), Anderson & Krathwohl classified the dimensions of the cognitive process is used to measure high-level thinking skills by category of analyze, evaluate and create [3]. Assessment of the 2013 Curriculum adapts international standard assessment models, hopefully helps students in increasing their level of thinking ability, because high-level thinking of learners can be encouraged to think broadly and deeply about the subject matter [9].
high-level thinking ability, it is shown that based on the Trends in International Mathematics and Science Study (TIMSS) survey in 2011 the achievement of Indonesian mathematics students ranked 38th out of 42 countries with an average score of 386. By the Organization for Economic Co-operation and Development (OECD) in 2015 using the Program for International Student Assessment (PISA) test that Indonesia's mathematical achievement ranks 69 out of 76 countries that follow PISA [11]. Thus, it appears that there is still a low level of mathematics achievement in the ability to think high levels of Indonesian high school students in the International level. The instilment of high-level thinking ability should have been begun by schools in Indonesia in order to meet the demands of the 21st century. This is in line with the characteristics of the 21st century community's skills according to the partnership of 21st century skills that identifies students in the 21st century should be able to develop the competitive skills required in the 21st century that are focused on the development of HOTS [6].

The results of National Examination Junior High School data in 2015/2016 in Kediri obtained from the BSNP PAMER program show that the absorptive capacity of the students in mathematics was low, ALHUDA Junior High School was one of the schools that had low absorption, Geometry polyhedron was below 50%, Geometry material had the lowest absorption power, so it is concluded that students had learning difficulties in Geometry materials. This was supported by the results of research conducted by Ozeram stated that the results from the study revealed that seventh year secondary school students have a number of misconceptions and lack of knowledge related to Geometry subject [20]. The difficulty of this learning is the lack of understanding of Geometry concepts that ultimately inhibit the further learning process. Kennedy & Tipps argued that learning Geometry was capable of developing problem-solving abilities and being the supporters of many other topics in mathematics [15]. As in Jones stated that "The study of Geometry contributes to helping students develop the skills of visualization, critical thinking, intuition, perspective, problem-solving, conjecturing, deductive reasoning, logical argument and proof" [13]. With regard to this, it seem that students are experiencing difficulty in mathematical learning in solving mathematical issues that are in the form of HOTS questions that are questioned with high-level thinking, especially in Geometry material.

The difficulty of learning mathematical students is not only caused by ineffective learning but may also be caused by differences in personality types possessed by each individual. Dacey & Travers stated that psychosocial factor could influence the difficulties faced by students. In addition, differences in student personality become one of the causes of varied difficulties faced by students [7]. One of these personality types was done by Keirsey. Keirsey classified the personality into 4 types, namely Idealist, Rational, Artisan and Guardian [14]. The classification by Keirsey was based on the fact that the real difference one can see from a person is behavior (behave). Referring to research conducted by Dewiyani stated that the guardian personality type did not like the image, but rather the preferred word and type of test was the objective of the test [8]. Based on the opinion of Dewiyani it is possible to prevent students' understanding of the geometric material. Based on this researcher analyzed the difficulty of learning mathematics at a student with guardian personality in problem-solving HOTS Geometry. Many mathematics skills were involved in problem-solving. However, large numbers of students have not acquired the basic skills they need in mathematics [2]. Ineffectiveness in the learning process will adversely affect the difficulty of acquiring mathematical skills. Understanding the difficulties students experience in mathematics skills will help students in the learning process. Lack of student math skills in the problem-solving process will have an impact on students' difficulties.

The researcher will analyze students' with guardian personality type of difficulties on the HOTS Geometry test to know the extent of students' understanding and what difficulties are often encountered in the material. This study refers to the results of previous studies which conducted by Tarzimah, which also discussed the issue of students’ learning difficulties. This study looked difficulties in mathematics learning of into five types of mathematics skills i.e. number fact skill, arithmetic skill, information skill, language
skill, visual-spatial skill [23]. Abdullah et al [1] studied Analysis of Students’ Errors in Solving Higher Order Thinking Skills (HOTS) Problems for The Topic of Fraction and also Jonhson et al [12] studied Learning Disabilities.

2. Research Methods
The research design used was the qualitative method with descriptive approach. In this research, it formed a description of difficulty learning student mathematics with guardian personality at solving HOTS Geometry issue. This method was carried out by analyzing oral tests and interviews with students. Subjects in this study were students with guardian personality based on high achievement, medium and low achievement in AL-Huda Kediri Junior High School. Selection of subject in this research used purposive sample technique. The analysis was conducted on the student with a guardian personality with high ability, medium ability, and low ability. The classification was based on previous semester grades and consultations with teachers while the guardian personality was taken from the Kersey personality test.

The data in this study was based on the results of the written exam on HOTS Geometry and interviews were processed in such a way that it could be concluded that the learning difficulties of students with the guardian personality of each student's ability. The research procedures undertaken in this study referred to the procedure of the study according to Bogdan modified by Moleong. The research stages included: (1) pre-field stage; (2) fieldwork; and (3) data analysis stage [18]. The data credibility test was completed by using techniques triangulation that finding the suitability of data that was sourced from the results sheet of problem-solving tasks and interviews.

3. Results and Discussion
The data collection was conducted by giving personality type test to Junior High School at AL-Huda Kediri which amounted to 40 students. Personality type tests were done as a determination in the categorization of student personality types. The following student personality test results are shown in Table 1. The result of personality type test is 13 students with guardian personality type.

| Personality Type  | Frequency | Percentage |
|-------------------|-----------|------------|
| Artisan           | 9         | 22.5 %     |
| Guardian          | 13        | 32.5 %     |
| Idealist          | 7         | 17.5 %     |
| Rationalist       | 11        | 27.5 %     |
| Total             | 40        | 100 %      |

The following results group difficulties in problem solving based on students’ mathematical skills with guardian personality type on HOTS solution completion.

| Hots Question | Types of difficulties mathematics skill | Total |
|---------------|----------------------------------------|-------|
|               | Number fact skill | Arithmetic skill | Information skill | Language skill | Visual-spatial skill |       |
| 1             | 0                       | 0                     | 13 (14.60 %)     | 9 (10.11 %)    | 6 (6.75 %)           | 28 (31.46 %) |
| 2             | 3 (3.37 %)              | 4 (4.49 %)            | 12 (13.48 %)     | 10 (11.24 %)   | 8 (8.99 %)           | 37 (41.57 %)  |
| 3             | 0                       | 0                     | 8 (8.99 %)       | 9 (10.11 %)    | 7 (7.87 %)           | 24 (26.97 %)  |
| Total         | 3 (3.37 %)              | 4 (4.49 %)            | 33 (37.08 %)     | 28 (31.46 %)   | 21 (23.60 %)         | 89 (100 %)    |
Table 2 shows the number of difficulties according to mathematics skill from the sample of the study in solving HOTS mathematics problem-solving for the topic of Geometry. The highest number of difficulties by the students was in HOTS question 2, which was 41.57% in various types of difficulties compared to other items HOTS question. Meanwhile, the lowest number of difficulties by students was in HOTS question 3, which was 26.97% in various types of difficulties. In addition, information skill was the highest type of difficulties in mathematics skill by students, which was 37.08%.

In this study, the selection of this subject interview was conducted with the consideration of mathematics teachers at AL-HUDA Kediri Junior High School. The consideration of the subject selection was based on the student's ability in mathematics. The subjects determined by the researcher were students with high, medium and low ability. Selected student as subject of researcher were students S1 with low ability, S2 with moderate ability, and S3 with high ability.

3.1 Analysis of problem-solving HOTS Question 1
Cognitive Levels: Analysis and Evaluation
A carpenter has 32 meters of timber and wants to make a border around a garden bed. He is considering the following designs for the garden bed. Circle either "Yes" or "No" for each design to indicate whether the garden bed can be made with 32 meters of timber.

![Garden Design Option](image)

**Figure 1. Garden Design Option**

Garden bed using this design, can the garden bed be made with 32 meters of timber? Explain!
Design A Yes / No
Design B Yes / No
Design C Yes / No
Design D Yes / No

The question of HOTS 1 on the cognitive levels evaluation and analysis of Subject S1 encountered difficulties in solving. Below is the answer to Subject S1 with low ability with guardian personality types answer to the completion of the HOTS question 1.

| Design   | Answer |
|----------|--------|
| Design A | No, because timber has different size |
| Design B | No, because it will be less for design B |
| Design C | No, because this design curvy shape and it is hard to become fence |
| Design D | Yes, because design D has the same size and circumference of 32 m |

**Figure 2. The answer of subject S1 with high ability on HOTS question 1**

Figure 2 it seems that subject S1 on the solution of the HOTS 1 test based on aspects category cognitive level of analysis and evaluation. It appears that students do not answer correctly on design A and design C, while for design B and design D students answer correctly but the arguments given are not correct, so it appears that students S1 has difficulties in the work of HOTS 1.

The following are interviews with the subject of S1 research:
R : "What information is in the question?"
S1 : "timber with length of 32 meters"
R : "Ok, then what is the question, and How is to find?"
S1 : "Perfect match design for 32 meters timber, by calculating the park design circumference".

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R : "Are you sure of your choice?"
S1 : "Design 1, 2 and 3 I am not sure about it, but I'm sure Design 4 is right."
R : "Ok, give an explanation!"
S1 : "Design 4 is a rectangular and a formula to find the circumference of rectangular is \( = 2 \times (p + l) \)
\[ = 2 \times (10 + 6) = 32 \text{ m}. \]
R : "Ok, right, then how to design 1, 2 and 3?"
S1 : "I do not know why I just imagined it from the picture it looks like 32 m wood is not enough for
the three designs."

Based on interviews and answers analysis on the solution of the HOTS questions 1 on aspects of
analysis and evaluation questions with the type of guardian personality is started by analyzing the
questions appropriately but at the evaluation stage, the student could not complete the answer
correctly. Subject S1 experienced difficulties mathematics skills i.e. information skill that are
difficulties in problem-solving planning, students could not see what was known and what was being
asked the question but at the time of interview the student knew what was asked and what was
known, but did not write down into the answer, enabling students to experience difficulties, this was
due to the laziness factor and would take a long time to solve, and students merely memorized the
formula alone without understanding the concepts, as the student's answer correctly on D design,
where the student memorized the formula in looking around from the rectangle, while for the other
design the student was difficult in the determination of the circumference, this means the students just
memorize the formula without knowing the concept of looking around, language skill that are
difficulties in understanding question, and visual spatial skill that are subject S1 can not afford in
manipulate geometrical shapes. According to Polya, understanding problem is the first phase of
problem-solving process [21]. During the phase of understanding problem, first of all, student must
know the story from the information given and the objective of the problem.

| Design A (Yes)            | Design B (No)         |
|---------------------------|-----------------------|
| Design C (Yes)            | Design D (Yes)        |
| Design A (Yes) = 10 + 5 + 5 + 6 + 2 + 1 + 2 + 1 = 32 | Design B (No) = -     |
| Design C (Yes) = 8 + 2 + 2 + 6 + 2 + 2 + 4 + 4 + 1 + 1 = 32 | Design D (Yes) = 10 + 10 + 6 + 6 = 32 |

**Figure 3.** The Answer of Subject S2 with Moderate Ability on HOTS Question 1

Figure 3 shows subject S2 answers all question correctly but the arguments given in each answer
are less precise. This means that in the category of analysis has difficulties in the information skills of
the student’s difficulties in problem-solving planning. It appears that subject S2 is less precise in
writing information about questions and arguments written on each answer option. In Figure 4 subject
S3 looks at all the answers correctly but does not provide an argument in every answer. This means
that on the category of cognitive and analysis has difficulties in the information skills of students has
difficulties in planning problem-solving, it appears that the absence of information about the
questions written on the answer and not given the right reasons on each answer option.

### 3.2 Analysis of problem-solving HOTS Question 2

Cognitive Level: Evaluation

Look at Figure 5 below!
Mrs. Ana has a cupboard under the stairs. She will measure the size of the cupboard, and measured height and width for each stair in a row of 9 cm and 12 cm. Identify the size cupboard for Mrs. Ana!

**Figure 5. Cupboard**

The question of HOTS 2 on the cognitive levels evaluation to Subject S2 encountered difficulties in solving. Below is the answer of Subject S2 with moderate ability with guardian personality types answer to the completion of the HOTS question

\[
\begin{align*}
\sqrt{12 + 9} &= 144 + 81 \\
\sqrt{225} &= 15 \\
15 \times 10 &= 150 = \text{area of the cupboard} \\
\sqrt{150 - 90} &= 22500 - 8100 \\
\sqrt{14400} &= 120
\end{align*}
\]

**Figure 6. The Answer of Subject S2 with Moderate Ability on HOTS Question 2**

Figure 6 it seems that the solution given by subject S2 of the HOTS question 2 based on aspects cognitive category evaluation it seems that subject S2 has difficulties in problem-solving planning, so it was not written what was known and asked the answer of the student became unstructured and allowed many errors in solving.

The following are interviews with the subject of S2:

R : "Build what's in the cupboard?"
S2 : "Area of a rectangle and a triangle."
R : "Then how to find a cupboard?"
S2 : "Triangle area plus rectangular area"
R : "ok, how to find wide of a triangle?"
S2 : "The base height is divided by 2, looking for hypotenuse and then searched the area.
R : "try to look at your answer, where is the answer saying that"
S2 : "this it is" (answers)
R : "You answered no information about it, should be given what statement is known and what is being asked?"
S2 : "it was too long."
R : "now look at your answer looking for hypotenuse, please explain!"
S2 : "square root for 12 squares plus 9 squares"
R : "why in your answer there is no squares?"
S2 : "I am forget it, because I'm doing it fast"

Based on interviews and answers analysis on the completion of the HOTS questions on aspects of S2 with moderate ability on the type of guardian personality evaluation questions to start by analyzing the questions appropriately but at the evaluation, stage students could not complete the answer correctly. S2 knew what was being asked and knew this meant that S2 was able to analyze the matter, but S2 was lazy in writing a long answer. This is the cause of the student's answer to be unstructured so there were many mistakes, in the answer it meant the student was in trouble with information skills. The subject S2 also has difficulties in arithmetics skill, it seem that the answer is not accurate in the planning procedure of the calculation experienced by subject S2. Furthermore, the
difficulties in recognizing and understanding number fact skill, students wrote: \( \sqrt{13 - 12} = 169 - 144 = \sqrt{25} = 5 \), meaning student made incorrect calculations, although the end result was in line with the correct answers. Incompetency in conceptual knowledge of fraction caused error in procedural skill of fraction. According to Narayanan, students were lacking in arithmetic and procedure knowledge as a result from weak conceptual understanding [19].

In Figure 7 it seem that subject S1 responded incorrectly, also did not finish the work until the end. This is because the subject S1 has difficulties in understanding the category of HOTS question 2. It seem in accuracy and logarithm in computational and mathematical working procedure subject S1 responded incorrectly, not writing the information received on the question, and subject S1 also difficulty in manipulate geometrical shape. This means that subject S1 has difficulties on arithmetic skill, information skill, language skill, visual-spatial skill. As a result student has failed to carry out problem-solving correctly. Refers to Tambychik, students faced with difficulties in problem-solving due to their lacking in the ability to visualize mathematics problem and concept [23], the affect of mathematics difficulties is cumulative because the development of mathematics skills is based on the previous skills [5]. While subject S3 answered with less precise that is at the final step, subject S3 is not having difficulties in the process, but the lack of accuracy in the final step.

3.3 Analysis of problem-solving HOTS Question 3
Cognitive Level: Analysis
Bobi cuts a cake with rectangular surfaces into four parts as shown in Figure 8, according to Bobi's cookie is cut as wide. Susi does not agree with Bobi's opinion. Among the statements of Bobi and Susi, which statements are true? Explain!

The question of HOTS 3 on the cognitive levels analysis of Subject S3 encountered difficulties in solving. Below is the answer to Subject S3 with high ability of guardian personality types answer to the completion of the HOTS question

![Figure 8. Bobi's Cake](image)

![Figure 9. The Answer of Subject S3 with High Ability on HOTS Question 3](image)
Figure 9 it seems that the solution given by subject S3 of the HOTS question 3 based on aspects
category cognitive level analysis seems that subject S3 has difficulties in visual-spatial skill, subject
S3 has difficulties in manipulate geometrical shape.
The following are interviews with S3 research subjects:
R : "what's the matter?"
S3 : "cake"
R : "Only cake? Try to look at the base of the flat-shaped cake? "
S3 : "rectangle."
R : "Ok, then what's the question?"
S3 : "Cake is cut as wide or not"
R : "then, how to cut the cake?"
S3 : "Cut with hypotenuse"
R : "Yes, the cake is cut tilted according to each diagonal, this is what is known in the matter. What's
your answer?"
S3 : "the same piece of cake"
R : "why so ?"
S3 : "because if viewed from its shape is equally big and both types of triangle are equal if divided
into two then the same size"
R : "take note of the illustration of the answer you are drawing, then see the pieces of the triangle
you cut into two then you compare the pieces of the triangle. Is it true?"
S3 : "Yes it's true"
R : "Well, now take a look at the question on the question!" Is it about sending a cut of the triangle?
S3 : "no miss, my answer is wrong"
R : "You've tried to answer well, but it's just not right in understanding the meaning of the matter,
S3 : "Yes, I will be more careful again in understanding the question"

Based on interviews and answers on HOTS solving questions on aspects analysis of subject S3
with high ability of guardian personality types started by analyzing questions incorrectly. The subject
S3 was difficulties in the visual-spatial skill that is difficulty in understanding the forms of Geometry.
According to Lerner's being a visual abnormality child who is often unable to distinguish Geometry
form [16]. Furthermore, S3 was difficulties in language skill, the conclusion of S3 that is the triangles
could be divided into two equals. Whereas in the matter there is no command of the triangle divided
into two. Factors that cause students to experience difficulties are lack of understanding in reading
and understanding of the problem. Meanwhile, the answer subject S1 is correct, but the argument
given is not correct so the answer wrong becaused between the answer and the question are not
consisten. This means that subject S1 has difficulties in mathematics skills such as information skill
and language skill. The subject S1 has difficulties in manipulate geometrical shape particular in
visual-spatial skill. According to Garderen, deficiency in visual-spatial skill might cause difficulty in
differentiating and relating information meaningfully [10]. In another situation, the answer of subject
S2 is wrong, it seems that S2 has difficulties in understanding the problem so that the answer is not
correct, it means subject S2 has difficulties in manipulate geometrical shape especially in subject S2
was difficulties in visual-spatial skill.

Based on the results of the analysis, this study found some difficulties for students. These show
evidence of earlier studies that show that students have much difficulty in understanding of Geometry.
Geometry it self is a crucial component of mathematics education [4]. The results of this research also
strengthen previous research conducted by Utami stating that the mistakes of students in settlement of
problems of Geometry as they are hasty and not conscientious in conducting process calculation [24]. Further, this research also shows difficulties of students who have the guardian personality type for answering HOTS with dominant material of Geometry. The most difficult parts of this are language skills, information skills, and visual spatial skill with various causes. One of the causes is students only have limited understanding of any information given. So that, students are hardly solving questions of the HOTS. These findings strengthen findings Tambychik & Meerah's study which resulting that the weaknesses of many student are at number fact skill, visual-spatial skills, and information skill [22].

4. Conclusion
This study concludes that students with guardian personality type have difficulties in mathematics problem-solving HOTS Geometry due to incompetency in acquiring many mathematics skills. It was found that a total of 89 type of difficulties based mathematics skill have been identified in the problem solving process involving HOTS, also found a total of 3.37% difficulties of number fact skill, 4.49% difficulties of arithmetics skill, 37.08 % difficulties of information skill, 31.46% difficulties of language skill, 23.60% difficulties of visual-spatial skill. Information skill was found to be the most critical mathematics skill.

The HOTS problem with cognitive level analysis and evaluation category, students with high and moderate abilities are experiencing difficulties in information skill, while students with low ability in information skill, language skill, and visual-spatial skill. The HOTS problem with cognitive level evaluation category, students with high ability did not have difficulties, students with moderate abilities difficulty in information skill, number fact skill, and arithmetics skill, while students with low ability in information skill, language skill, visual-spatial skill, and arithmetics skill. The HOTS problem-solving with cognitive analysis category of students with high ability were difficulties in language skill and visual-spatial skill, moderate ability in visual-spatial skill, while students with low ability were difficulties in information skill, language skill and visual-spatial skill. Therefore, teachers should be able to recognize the difficulties faced by students in solving problems related to HOTS. Furthermore, the researcher suggest to look for each other type of personality type, the research to a compare between each type of personality type David Kersey and also be able develop problems related to the problem of HOTS, especially on the Geometry material.

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