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THINKING PROCESS IN SOLVE GEOMETRY PROBLEM OF STUDENT WITH LOW SPATIAL INTELLIGENT

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ABSTRACT

This study aims to describe the process of thinking student of mathematics education with low spatial intelligence in solving geometry problem based on the step-by-step problem solving by Polya. This research is a qualitative descriptive study. The subject of this study is a second semester students of Mathematics Education Study Program of IKIP PGRI MADIUN with a low level of spatial intelligence. Data collection techniques were used that method written test and interview. The data analysis was conducted based on data written test and interview. Furthermore, to obtain valid data triangulation method of writing data from and interviews. This research resulted in the description of the thought processes of students with a low level of spatial intelligence in solving geometry problem. In understanding the problem using the thought process of assimilation, in a problem-solving plan to use the thinking process of assimilation that is less than perfect. In implementing the plan of solving students with low spatial intelligence to use the thinking process of assimilation. While in checking the breakdown of students with low spatial intelligence does not make the process of assimilation and accommodation.

Key Word: thinking process, geometry problem, spatial intelligent

INTRODUCTION

In line with the demands of the curriculum 2013, the learning process should be able to encourage and inspire students to think critically, analytical and precise in identifying, understanding, solve problem, and apply the learning materials. Based learning problem-solving importance is given to the next student teachers who will teach problem solving to learners.

Problem-based learning can be applied in various branches of science in mathematics. One of them is the branch of geometry. Besides being in a special position in the curriculum, geometry contains many concepts that are related to one another. In psychology, geometric abstraction is a presentation of visual and spatial experience, e.g. field, pattern, measurement and mapping. Meanwhile, from the standpoint of mathematics, geometry provides approaches to solving the problem, for example, pictures, diagrams, coordinate system, vectors, and transformation.

Process of thinking occurs when a person solve the problem, i.e. find the answer to a given problem. Hudojo Herman (2005) states that the person will practice problem-solving process data or information. Processing of the data or information is called thinking. In the process of thinking occurs between the processing of incoming information by scheme (cognitive structures) that exist in the human brain. Experience or new information received will be adapted through a process of assimilation or accommodation. Assimilation is the cognitive process that occurs when a person integrates perceptions, concepts, or new experiences into an existing scheme in mind. If a new experience is not in accordance with the scheme there will be accommodation. Accommodation can happen in two ways, namely: (1) establish a new scheme that can be matched with the right stimulation or (2) modify the existing scheme so that it matches with the stimulus (Suparno, 2001).

Knowing the thinking process of students in solving a problem is very important for the lecturers. By knowing the thought process of students, faculty can track the location and type of errors made by students in the problem solving process. Mistakes made by students can be a source of information to learn and know the extent of student understanding. Besides faculty can

design appropriate learning the thinking process of students.

In the process of solving the problem required a high level of thinking. Steps to solve the problem one proposed by Polya. Polya (1973) in Ruseffendi (1988) developed a four-step problem-solving is understanding the problems, develop problem-solving plan, implement the plan solution, and recheck the breakdown. Learning through problem solving, students gain experience possible to use the knowledge and skills that have been held to apply to solving problems that are not routine.

One of the things that affect the thinking process of students in solving the problem is the geometry of spatial intelligence. Spatial intelligence is intelligence that includes the ability to think in pictures, as well as the ability to absorb, transform and recreate different aspects of the visual-spatial world. Visual-spatial intelligence relating to the ability to capture the color, direction and space accurately. Someone who has the ability to recognize the identity of spatial objects when they are there from a different angle, and is able to estimate the distance and the existence of himself with an object. Therefore, spatial ability is very important in the learning process as well as to recognize the surrounding environment, for example the ability of spatial relations are a very important part in the study of geometry.

In the process of thinking to solve problems Geometry, students should be able to visualize or illustrate pictures of geometry in his dreams. Surely this is closely related to spatial intelligence possessed by each individual. A student with low spatial ability is made possible less successful in the visualisation process when compared to students with high or moderate spatial ability. To determine the association between a low level of spatial intelligence with the thinking process (assimilation and accommodation) students in solving this geometry, the researchers intend to want to know more thought processes in solving geometry problems of students with a low level of spatial intelligence.

METHODS

This research is a qualitative descriptive study that produces descriptive data in the form of words written or spoken of people and behaviors that can be observed. Data and sources of data in this study is a written test data obtained from the results of the work in the research subjects working on solving geometry and interview data.

Subjects in this study were students IKIP PGRI MADIUN that meet the following criteria, namely: (1) have studied geometry, (2) is able to communicate well, and (3) meet the criteria of a low level of spatial intelligence. To determine the subjects in this study, researchers conducted tests of spatial intelligence to the second semester students of mathematics education courses. Furthermore, the results of these tests taken one subject that has a low level of spatial intelligence. Criteria for assessment of the level of intelligence of students can be seen in Table 1 below.

Table 1. Criteria for Evaluation of Spatial Intelligence

Score	Spatial Intelligence Level
50 – 64	Low

(Wannef Jambak, 2007)

Instruments used in this research include: researchers as the main instrument, the auxiliary instrument in this study in the form of a written test which includes items Geometry problem solving, and the second auxiliary instrument in the form of interview guidelines.

To know the thought process of students is based on a high degree of spatial intelligence in solving mathematical problems, then it can do the steps as follows.

1. Students are given the task to solve geometry problems.
2. The authors suggested questions only if necessary to clarify what he was thinking of students.
3. Researchers conducted interviews pertaining to answer problem-solving that has been done by the research subject.

Credibility or confidence level data in this study used triangulation. Triangulation is a technique of checking the validity of the data with other data utilizing outside research data that serves as a comparison. Moleong (2012) says there are four kinds of triangulation is a triangulation of sources, methods, investigators and theories. In this study used data triangulation technique is the triangulation method. Triangulation method is done by comparing and checking behind an information obtained through interviews and tests.

The process of data analysis in this study, both the data written and interview data using the model of Miles and Huberman (1992) in Aries Yuwono (2010) performed with the following steps.

1. Analysis of the data written

a. Analysis is written based on the truth about the breakdown of the student.
b. From the responses of the students carried out the classification and identification of the data that is to write a collection of data organized and categorized making it possible to draw conclusions from these data.
c. Draw conclusions and to verify this conclusion.

2. Analysis of data from interviews
   a. Data reduction, i.e. activities which refers to the process of selecting, focusing, simplifying, abstraction and transformation of raw data that emerged from the notes written in the field.
   b. From the responses of the students was conducted classification and identification data.
   c. Draw conclusions and verify the data that has been collected.

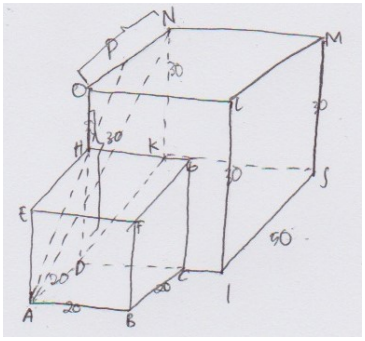
Results of the data analysis of the written and interview data than or triangulation to obtain valid data. Valid data is used to determine the thought processes of students in solving geometry problems by step Polya.

RESULT AND EXPLANATION

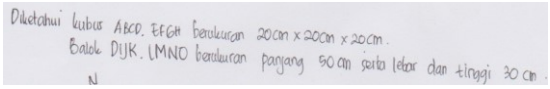
Before determining the subject of research, first observation of spatial intelligence level of students. Researchers use the instruments of spatial intelligence tests to determine the level of spatial intelligence of students. Researchers determine one student with low spatial intelligence level as a research subject. After working on the subject of the instrument sheet geometry problem solving, researchers conducted interviews with the study subjects. Data were analyzed to obtain a description of the thinking process of students in solving geometry problems. The following analysis of the data subjects with low spatial intelligence is referred to as the subject of TY.

1. Data Written TY and analysis
   a. Understanding the problem

      TY subject can understand the given problem by sketching wake combined cubes and blocks corresponding to a given problem come with the size of each side.



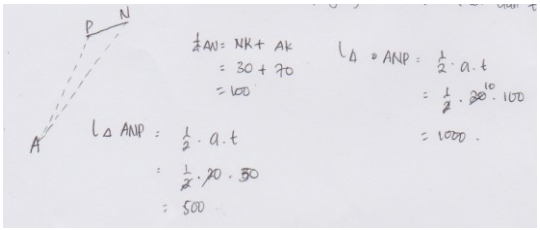
In addition the subject of TY writes things that are known and things that were asked of problems. Here are the results of the work TY.



In addition the subject of TY can associate the things that are known by the knowledge that has been previously owned so as to create a plan of solving the problem to obtain a broad triangle APN, it indicates that the subject TY been able to determine that it is known already quite used to answer in question.

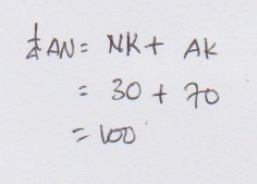
b. Make a plan

In creating a problem-solving plan, subject TY first sketched on a plane triangle ANP. Next determine the length of AN, the AN = NK + AK. This is not in accordance with the final step is to write down the area of the triangle ANP with the formula for the area of the triangle, which is 1 / 2.at. following the work of the subject TY:

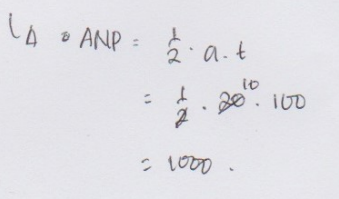


c. Carry out a plan

Under the plan solution has been prepared, the first step is to calculate the length of the subject TY AN which is the height triangle ANP. TY summing the subject line segment NK and AK to get the length of AN. TY subject is not able to associate the things that are known in the matter with a formula that has been previously owned Pythagoras to calculate the length of AN. This is indicated by the results of the written work following TY subject.



Subject TY determine the area of a triangle ANP using the formula as shown in the results of the written work following TY subject.



d. Looking back at the completed solution

Subject TY did not write any other way to solve the problem, so just check the processes of counting was done.

Based on the results of the subject TY writing can be seen a few mistakes made, ie when determining the length of PH resulting in long-PA wrong. In addition, the subject of the PM is unable to make the link with the right to determine the height of the triangle ANP, so that the subject cannot do TY solving the problem properly.

2. Data Interviews of TY and analysis

Before the interview, the subject is given a test TY solving the same problem to understand and think about the answer, then the subject of TY interviewed about the procedure and the results of solving a given problem. The excerpt of the interview is as follows:

a. Understanding the problem

TY subject can understand that given the problems can mention what is asked and what is known of the problem. Here are excerpts of interviews with the subject of TY.

$P_{6.4}$: "Kira-kira dari soal yang anda kerjakan tadi apa yang diketahui?"
$S_{6.4}$: "Diketahui panjang rusuk kubus 20cm. Panjang balok 50cm dan lebar serta tingginya 30cm." (sambil menunjuk lembar soal)
$P_{6.5}$: "Panjang, lebar, dan tinggi baloknya mana?"
$S_{6.5}$: "Ini Bu." (sambil menunjuk lembar soal)
$P_{6.6}$: "Sudah itu saja yang diketahui?"
$S_{6.6}$: "Iya."
$P_{6.7}$: "Dari yang diketahui itu, kemudian yang ditanyakan apa?."
$S_{6.7}$: "Luas segitiga ANP."

Subject TY not sure if what is known about enough to solve the problem/asked in a matter. This is evident from the following interview excerpts.

$P_{6.8}$: "Kira-kira setelah yang diketahui itu tadi sudah bisa menjawab yang ditanyakan pada soal belum?"
$S_{6.8}$: "Belum."

b. Make a plan

Subject TY made plans to determine the formula for solving the area of the triangle APN $= \frac{1}{2} \times PN \times (KN + AD + DK)$. Subject TY determine the height of the triangle APN = (KN + AD + DK) as shown in the following interview excerpts.

$S_{6.9}$: "Mencari tingginya segitiga dulu karena rumus luas segitiga itu: $\frac{1}{2} \times alas \times tinggi = \frac{1}{2} \times PN \times (KN + AD + DK) = \frac{1}{2} \times 20 \times 100 = 1000cm^2$."
$P_{6.10}$: "Berarti untuk tingginya ditambahkan dari KN + AD + DK?"
$S_{6.10}$: "Iya Ibu."
$P_{6.11}$: "Kenapa kok anda tambahkan?"
$S_{6.11}$: "Biar tahu hasilnya Bu."
$P_{6.12}$: "Berarti memang seperti itu ya ditambahkan?"
$S_{6.12}$: "Iya Ibu."

Subject TY specifies the length of PN to deduct ON-high as in the following interview excerpts.

$P_{6.13}$: "PN = 20cm ya, apakah itu ada dari yang diketahui?"
$S_{6.13}$: "Tidak ada."
$P_{6.14}$: "Terus dapatnya 20 dari mana?."
$S_{6.14}$: "Dari ini Bu. ON = 50cm kemudian dikurangi tingginya 30cm, jadi 50 – 30 = 20cm".(sambil menunjuk lembar soal)
$P_{6.15}$: "Kenapa kok ON – tinggi?."
$S_{6.15}$: "Biar tahu aja Bu."

c. Carry out a plan

Subject TY then answer the problem by using Pythagoras formula based on the length and height of the triangular pedestal APN that has been planned in the planning step. Subject TY also said that the high obtained in previous writing test is different, it should be 100. Here are excerpts of interviews with the subject TY at the time of carrying out the plan.

$P_{6.16}$: "Setelah itu anda mencari luas segitiga ANP, anda menggunakan cara apa ya?"
$S_{6.16}$: "$\frac{1}{2} \times alas \times tinggi = \frac{1}{2} \times PN \times (KN + AD + DK) = \frac{1}{2} \times 20 \times 100 = 1000cm^2$." Sebenarnya tingginya ini salah karena memakai jawaban yang kemarin."

d. Look back at the completed solution

Subject TY rechecking the results of solving the problem. Subject TY find that different from

the previous high. This can be seen in the following interview excerpts of subject TY.

$P_{6.17}$: "Bedanya apa yang ini dengan yang sekarang?"
$S_{6.17}$: "Tingginya yang berbeda."
$P_{6.18}$: "Kalau yang kemarin tingginya berapa?"
$S_{6.18}$: "Tingginya 50 Bu, kalau sekarang tingginya 100." (sambil mengerjakan dilembar jawaban)
$P_{6.19}$: "Berarti anda lebih yakin yang mana?"
$S_{6.19}$: "Yang sekarang Bu."
$P_{6.20}$: "Berarti jawabannya 1000. Yakin ya?"
$S_{6.20}$: "Iya yakin."

TY subjects have no other way to solve the given problem. This is evident from the following interview excerpts.

$P_{6.21}$: "Apakah ada cara lain untuk menentukan jawaban?"
$S_{6.21}$: "Tidak Ibu."
$P_{6.22}$: "Yakin cuma ini aja tidak ada yang lain?."
$S_{6.22}$: "Sebenarnya ada Ibu dioret-oretan yaitu $= \frac{1}{2} \times alas \times tinggi = \frac{1}{2} \times PN \times AP = \frac{1}{2} \times 20 \times 50$. 50 itu didapat dari 20 itu untuk lebar kubus dan 30 untuk tinggi balok."
$P_{6.23}$: "Kok bisa seperti itu?, berarti $20 + 30 = 50$ untuk tingginya"
$S_{6.23}$: "Iya Ibu."
$P_{6.24}$: "Berarti AP = 50cm ya?"
$S_{6.24}$: "Iya."
$P_{6.25}$: "Sisi AP itu yang mana?. Benar itu panjangnya 50cm."
$S_{6.25}$: "Yang ini Bu benar 50." (sambil menunjuk lembar soal)
$P_{6.26}$: "Terus kenapa anda memakai yang itu (jawaban dioret-oretan) tidak memakai yang ini (pada lembar jawaban)?" (sambil menunjuk lembar jawaban dan buram)
$S_{6.26}$: "Kurang yakin."
$P_{6.27}$: "Berarti anda yakin yang ini dan tidak ada yang lain selain ini?."
$S_{6.27}$: "Tidak ada."

3. Triangulation Method

Having obtained the results of the analysis of written answers and interview data analysis, the comparison is then performed to determine whether or not valid data. Having obtained the data from the subject TY valid, then the valid data is compared with the thinking process indicators proposed by the researchers in Table 2. for it can be deduced.

Table 2. Triangulation Data Methods Written and Interview Subject TY

Steps	Written Results	Interview Results
Understanding the problem	- Subject TY know easily and correctly the things that are known and things that were asked on the issue. - Subject TY may determine that it is known has been able to answer the case in question so that the subject is able to plan properly solving.	- Subject TY know easily and correctly the things that are known and things that were asked on the issue. - Subject TY may determine that it is known has been able to answer the case in question so that the subject is able to plan properly solving.
Make a plan	- Subject TY make a connection between the things that are known to determine the length of AN, which is the height triangle ANP. - Subject TY be able to determine the length AN derived from NK + AK though less precise in determining the length of AN. - Subject TY capable of linking formula area of a triangle that has been known previously to define the subject area of the triangle ANP - Subject TY cannot create a problem-solving plan properly.	- Subject TY make a connection between the things that are known to determine the length of AN, which is the height triangle ANP. - Subject TY be able to determine the length of AN obtained from KN + AD + DK though less precise in determining the length of AN. - Subject TY capable of linking formula area of a triangle that has been known previously to define the subject area of the triangle ANP. - Subject TY cannot create a problem-solving plan properly.
Carry out a plan	- Subject TY can calculate the length AN of the base side of the triangle which is APN, though with less correct answers because of wrong concept. - Subject TY unable to determine the area of a triangle ANP correctly.	- Subject TY can calculate the length AN of the base side of the triangle which is APN, though with less correct answers as wrong concepts. - Subject TY cannot determine the area of a triangle ANP correctly.
Look back at the completed solution	- Subject TY is not sure of the breakdown products have been obtained. - Subject TY do not write any other way that can be done to solve the problem	- Subject TY is not sure of the breakdown products have been obtained. - Subject TY has no other way of solving the problem.
Subject TY data are valid as follows: 1. Understanding the problem a. Subject TY can easily and correctly know the things that are known and things that were asked on the issue. b. Subject TY may determine that it is known has been able to answer so that the subject matter in question is able to plan properly solving. 2. Make a plan a. Subject TY can create a connection between the things that are known to determine the length of AN, which is the		

height triangle ANP. b. Subject TY can determine the length AN obtained from KN + AD + DK though less precise in determining the length of AN. c. Subject TY capable of linking the formula area of a triangle that has been known previously to define the subject area of the triangle ANP. d. Subject TY cannot make a plan to correct the problem solving 3. Carry out a plan a. Subject TY can calculate the length AN of the base side of the triangle which is APN, though with less correct answers as wrong concepts. b. Subject TY cannot determine the area of a triangle ANP correctly. 4. Look back at the completed solution a. Subject TY not sure of the breakdown products have been obtained. b. Subject TY have no other way of solving the problem.
Conclusions: In understanding the problem, subject TY use the thinking process of assimilation, in a make a plan Subject TY use the thinking process of not perfect assimilation. Subject TY cannot answer the question correctly, so that the subject TY doing the thinking process of assimilation but deficient in implementing the plan. While the solution is not to re-examine the results of using the thinking processes of assimilation and accommodation.

CONCLUSION

The process of thinking students who have a low level of spatial intelligence in solving geometry problems, in understanding the problem doing the thinking process of assimilation. In making plans thinking problem solving process of assimilation is less than perfect. In implementing the plan of solving problems doing the thinking process of assimilation. In re-examine the breakdown did not do the thinking process of assimilation and accommodation.

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