Pre-service elementary school teachers’ reasoning profile in solving geometry problems based on mathematics ability

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Abstract. A person's reasoning can be seen in the solution of the problem he solved. Geometry is effective for developing the ability to think logically or reasoning students. Solve geometry problems that have an abstract object of study required a process of reasoning or reason. The reasoning of a student with a high mathematical ability may be different from the reasoning of a moderate or low-ability student in solving geometrical problems. The purpose of this study is to obtain information about pre-service elementary school teachers’ reasoning profiles in solving geometry problems based on mathematical ability. The type of research that will be used is descriptive explorative research with qualitative approach. The subject of this research is 3 pre-service elementary school teachers’. Subject selection is based on a written math ability test. The instruments of this study include the main instruments and supporting instruments. The reasoning profile data was obtained through mathematical skills tests and problem-solving test-based interviews. The credibility of the data collected is tested through triangulation. Student reasoning profile of student of pre-service elementary school teacher is able to explain again the thinking process (reasoning or logical argument) clearly.

Keywords: reasoning profile, solving geometry problems, mathematics ability

1. Introduction

Geometry is a branch of mathematics that plays an important role to be studied because geometry is used by everyone in everyday life [1]. In addition, geometry has an important role in studying other branches of mathematics and provides a way to solve problems easily by using drawings, diagrams and coordinate systems [2]. Geometry becomes like a glue concept that can connect various fields in mathematics [3].

Geometry is effective for developing the ability to think logically or reasoning students [4]. [5] writes why geometry should be taught in schools: (1) because the world is built by form and space according to the opinion of [6] that geometry is space mathematics, (2) formal geometry greatly helps students with abstraction problems, (3) help solve other mathematical problems, (4) help visual thinking of students. The geometry material taught to students includes objects and geometric structures, how to analyze characteristics and relationships between objects, build informal thinking into formal thinking and can recognize geometric objects required a process of thinking in this case is reasoning that has an important role in solving geometry problems. Lesh [7] states that problem solving is a way of thinking, analyzing, and reasoning by using experience and knowledge related to the problem. Learning geometry is to study objects whose objects are abstract so that to learn it takes a process of thinking or reasoning.

Various research indicate that there is a complaint about the low level of reasoning achieved by the graduates of PGSD (Pendidikan Guru Sekolah Dasar) because education has not been handled
properly [8], low student's reasoning is shown both in science and non science background when in high school [9]. This indicates that there is a possibility that there is a condition where PGSD students are experiencing difficulties in the context of developing thinking and reasoning skills, which can affect the student's ability to solve problems and eventually become a problem for himself when he becomes a teacher in elementary school [9]. Therefore, research needs to be done to reveal how PGSD students' reasoning in solving geometry problems, when students have the opportunity to think, reason and work to solve geometry problems. Thus, they will develop their confidence and ability to think, strategies for selecting and applying knowledge and justifying their thinking. Thus will have an impact on the ability of students in the process of solving problems when later became teachers in elementary. [10] says that the culture of reasoning will be possible if the students' logical reasoning can run well so that they can grow the habit of reasoning. Reasoning is necessary in studying geometry.

[11] found that the failure to master mathematics well because it caused less students to use reason in solving the problem. Furthermore [12] concludes that there is a relationship between reasoning and mathematical ability, so that differences in mathematical ability are likely to give different reasoning results. The reasoning of a student with a high mathematical ability may be different from the reasoning of a moderate or low-ability student in solving geometrical problems.

Geometry courses can influence the development of PGSD students' reasoning. The reasoning referred to in this research is the reasoning in solving the Geometry problem by using the [13] problem-solving steps. PGSD students' reasoning profile in solving geometry problems based on differences in mathematical ability so that the purpose of mathematics learning can be achieved.

2. Experimental Method

The research type is descriptive explorative research with approach of qualitative approach. The subjects or respondents of this study are students of PGSD. The subjects of the study are 3 students based on the category of mathematics ability test (high, moderate, low).

Methods of gathering data are the provision of tests, interviews, and documentation. The instruments are consists of the main instrument (researcher itself) and supporting instruments include mathematics ability tests and interview guides. The mathematics ability test is constructed by adopting the mathematics problem of SBMPTN (Seleksi Bersama Masuk Perguruan Tinggi). Interview is conducted to confirm between the student ability in solving math problem and their reasoning ability. Documentation method, used to collect data from non-human sources, this source consists of documents and recordings. The credibility of the data collected is tested through triangulation.

3. Result and Discussion

3.1 Reasoning Profile of Pre-Service Elementary School Teachers' Having High Category of Mathematics Ability in Solving Geometry Problems

Understanding Problems

Subject can understand the non-routine geometry problem with logic argument and reasoning activity of analyze. He can identify the unknown and the asked things and explain the condition of the problem through the figure of cube, show the known elements in the figure (12 cm of side length) and what is asked (distance between the side VM and the RSTU diagonal plane).

Devising a Plan

Subject of the research can make plan to solve non-routine geometry problem with logic argument and reasoning activity of analyze and synthesis. He can illustration the figure and conclude that the distance between VM line and RSTU diagonal plane can be represented by VM line, so the length of VM line can be determined by 1) looking at the triangle of RUV as the right triangle of the foot, the VM as the height of the triangle, 2) looking for the length of the UR; 3) looking for the area of the RUV triangle; 4) finding the length of the VM as the distance between the edges of VM and the RSTU diagonal plane.
**Carrying out the Plan**

Subject of the research can implement plan to solve non-routine geometry problem with logic argument and reasoning activity of analyze, synthesize and generalize. Generalization is done by using Pythagoras Theorem. Also, he use the mathematical operation in implementing plan to solve problem which has been made previously, namely, pay attention to triangle RUV with side length of 12 cm, the height is VM, traces the length of the UR (12 $\sqrt{2}$ cm), the area of the triangle RUV (72 cm$^2$), the length of the VM (6$\sqrt{2}$ cm) as the distance requested is the distance between the VM line and the RSTU diagonal plane.

**Looking back**

Subject of the research can look back in solving non-routine geometry problem with logic argument and as well as the behavior of reasoning analysis, synthesis, generalize and justify. Justification is done by checking all the stages that have been done as well as conformity with the use of the formula whether it is related to the concept.

Subject of the research having high category of mathematical ability can confirm clearly what he has been written and he has been explained. So, we can be sure on his data.

3.2 Reasoning Profile of Pre-Service Elementary School Teachers’ Having Moderat Category of Mathematics Ability in Solving Geometry Problems

**Understanding Problems**

Subject can understand the non-routine geometry problem with logic argument and reasoning activity of analyze. She can identify the unknown and the asked things and explain the condition of the problem through the figure of cube, show the known elements in the figure (12 cm of side length) and what is asked (distance between the side VM and the RSTU diagonal plane).

**Devising a Plan**

Subject of the research can make plan to solve non-routine geometry problem with logic argument and reasoning activity of analyze and synthesis. She can illustration the figure and conclude that the distance between VM line and RSTU diagonal plane can be represented by VM line, so the length of VM line can be determined by 1) looking at the triangle of RUV as the right triangle of the foot, the VM as the height of the triangle, 2) looking for the length of the UR; 3) looking for the area of the RUV triangle; 4) finding the length of the VM as the distance between the edges of VM and the RSTU diagonal plane.

**Carrying out the Plan**

Subject of the research can implement plan to solve non-routine geometry problem with logic argument and reasoning activity of analyze, synthesize and generalize. Generalization is done by using Pythagoras Theorem. Also, he use the mathematical operation in implementing plan to solve problem which has been made previously, namely, pay attention to triangle RUV with side length of 12 cm, the height is VM, traces the length of the UR (12 $\sqrt{2}$ cm), the area of the triangle RUV (72 cm$^2$), the length of the VM (6$\sqrt{2}$ cm) as the distance requested is the distance between the VM line and the RSTU diagonal plane.

**Looking back**

Subject of the research can look back in solving non-routine geometry problem with logic argument and as well as the behavior of reasoning analysis, synthesis, generalize and justify. Justification is done by checking all the stages that have been done as well as conformity with the use of the formula whether it is related to the concept.

Subject of the research having moderate category of mathematical ability can confirm clearly what he has been written and he has been explained. She seems be nearly doubt give us information during the interview.
3.3 Reasoning Profile of Pre-Service Elementary School Teachers’ Having Low Category of Mathematics Ability in Solving Geometry Problems

Understanding Problems
Subject can understand the non-routine geometry problem with logic argument and reasoning activity of analyze. He can identify the unknown and the asked things and explain the condition of the problem through the figure of cube. He cannot clearly explain his figure.

Devising a Plan
Subject of the research can make plan to solve non-routine geometry problem with logic argument and reasoning activity of analyze and synthesis. He can illustration the figure and conclude that the distance between VM line and RSTU diagonal plane can be represented by VM line, so the length of VM line can be determined by 1) looking at the triangle of RUV as the right triangle of the foot, the VM as the height of the triangle, 2) looking for the length of the UR; 3) looking for the area of the RUV triangle; 4) finding the length of the VM as the distance between the edges of VM and the RSTU diagonal plane.

Carrying out the Plan
Subject of the research can implement plan to solve non-routine geometry problem with logic argument and reasoning activity of analyze, synthesize and generalize. Generalization is done by using Pythagoras Theorem. Also, he use the mathematical operation in implementing plan to solve problem which has been made previously, namely, pay attention to triangle RUV with side length of 12 cm), the height is VM, traces the length of the UR (12 √2 cm), the area of the triangle RUV (72 cm²), the length of the VM (6√2 cm) as the distance requested is the distance between the VM line and the RSTU diagonal plane.

Looking back
Subject of the research can look back in solving non-routine geometry problem with logic argument and as well as the behavior of reasoning analysis, synthesis, generalize and justify. Justification is done by checking all the stages and he is doubt and not sure what he has been written.

4. Conclusion
Based on the result of this study, it can be concluded that; 1) Student reasoning profile of student of pre-service elementary school teacher having high level of mathematical ability is able to explain again the thinking process (reasoning or logical argument) clearly and firmly; 2) Student reasoning profile of student of pre-service elementary school teacher having moderate level of mathematical ability is able to explain again the thinking process (reasoning or logical argument) clearly but not nearly doubt; 3) Student reasoning profile of student of pre-service elementary school teacher having low level of mathematics ability is able to explain again the thinking process (reasoning or logical argument) clearly but not sure.

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