

# **Student Difficulties in Solving High Order Thinking Skills (HOTS) Problem on Geometry Problems Viewed from the Cognitive Styles**

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## **Abstract**

The results of Indonesian students' mathematics learning scores from UN, PISA, TIMSS and INAP show unsatisfactory results, students are still weak in cognitive skills. Math learning aims to equip students with logical, analytical, systematic, critical, and creative thinking skills, as well as cooperative skills called higher order thinking skill (HOTS). The 2013 curriculum requires students to be familiar with HOTS issues. HOTS has a relationship and influences students' cognitive style. The purpose of the study to determine the difficulties of students in solving the problem of HOTS on geometric problems regarding cognitive style. Research using the qualitative approach, research subject consist of field dependent student (FD) and field independent (FI). Research instruments are HOTS test, interview, and GEFT test. Data analysis was done based on Miles and Huberman's stages: data collection, data reduction, data presentation, and conclusion. The results showed that: 1) FD students tend to experience difficulties in the transformation and coding stages, 2) FI students tend to experience difficulties in the process skill and coding stage.

**Keywords:** Ability, HOTS, Geometry, Cognitive Style

## **Introduction**

Thinking is a mental activity in the face of problems. Thinking is a mental activity that helps formulate or solve problems, make decisions, understand, search for answers and achieve meaning (Johnson, 2011; Liputo in Maulana, 2014). Thinking activities have a positive impact on the development of education (Yee et al, 2011). The cognitive domain sequences are thinking skills according to the intended purpose. Three forms of behaviour as an educational goal of cognitive, affective and psychomotor (Bloom in Sanjaya, 2011; Supardi, 2013).

Mathematics is a subject taught from primary school to college, the purpose of learning mathematics is to equip students with the ability to think critically, creatively and the ability to cooperate (Kemendikbud, 2011). The ability to think critically, creatively and think basic knowledge is HOTS (Crawford & Brown, 2002). Meanwhile, HOTS is a human power in the realm of knowledge and skills, so it is important to be improved and developed, one indication of success in improving human resources in

the field of education is that students have an excellent HOTS. In line with the primary goal of learning in the 21st century is to develop and improve HOTS student (Yen, 2015). The 2013 curriculum mandates students to be familiar with HOTS issues (Kemendikbud, 2016). HOTS have appreciated for believing it can prepare students to face the challenges of work as well as everyday life (Ramos, 2013).

The external challenge to the development of the Curriculum 2013 is the Indonesian competition in education, Indonesia's participation in the International Trends in International Mathematics and Sciences Study (TIMSS) and the International Student for Student Assessment (PISA) since 1999 shows its readiness in facing the progress of the world, although not yet show good achievement. The results of the assessment of Indonesian students' learning from the results of the National Examination (UN), PISA, TIMSS and Indonesia National Assessment Program (INAP) show that students are still weak in HOTS cognitive skills such as reasoning, analysing, and evaluating (Kemendikbud, 2016). The low achievement of Indonesia because the test material in TIMSS and PISA have not contained in the Indonesian curriculum (Kemendikbud, 2013; Direktorat Jenderal Guru dan Tenaga Kependidikan, 2016). PISA 2012 results show the ability of students only able to reach the level of C3 and very few can reach the level of C4 and C5 even no students can reach level C6 in solving the matter space and shape or geometry content (IES, 2015), this shows that students have difficulty in studying geometry.

The problem of geometry in schools is still a challenge for educators to fix the difficulties experienced by students in studying geometry, students still have difficulty in studying geometry. Some studies suggest that students have difficulty in studying geometry, students have difficulty recognizing and understanding symbols, and the language presented and reading difficulties.

HOTS is a knowledge and skill developed during learning in the context of a conceptual application that has not been thought of before, but the concept has been taught (Brookhart, 2010). HOTS according to Brookhart (2010) is the ability to think at a high level in the process of cognitive domain that is analysing, evaluating, and creating.

HOTS has a relationship with students 'thinking patterns in the process of receiving and processing information from a problem, and the process influences students' cognitive style. Development of the cognitive domain of students depends on learning style, the character of students in learning called the cognitive style. Individual differences need to have taken into account in improving the achievement of conceptual understanding and thinking skills. The psychologically differentiated cognitive style is known as field independent and field dependent. Cognitive style owned by students will have a positive effect if provided the right environment and conditions so that students can learn optimally. Teachers should know the cognitive style and can adjust the learning process with the cognitive style of students. Different cognitive styles will have different effects or influences on the understanding of concepts and thinking skills. Student weakness in specific subjects is often associated with low levels of intelligence, regardless of cognitive style factors.

Curriculum 2013 prepares to learn strategies with modelling, teaching media, tools and useful learning resources, and teachers have done various innovations in learning such as the use of innovative learning models, media and learning tools and learning resources to improve students' thinking ability. MTsN 1 Banda Aceh is one of the schools that has fully implemented the Curriculum 2013, so teachers at MTsN 1 Banda Aceh have also performed an innovative learning process. Based on the background of the above problems researchers want to know the difficulties of students in solving the problem of HOTS on geometry problems regarding cognitive style.

## **Research Method**

The type of descriptive qualitative research based on the purpose of research is to determine the difficulties of students in solving the problem of HOTS on geometric problems regarding cognitive style. The study was conducted in the even semester of 2017/2018. Research subjects of students of grade VIII-6 MTsN 1 Banda Aceh with cognitive field dependent (FD) and field independent (FI). The instrument used is Group Embedded Figures Test (GEFT) to determine students' cognitive style, HOTS test consisting of three items with the form of description test with indicator of analysis, synthesis, creating an interview guide sheet in identifying students' difficulties in solving the problem of HOTS on geometric issues in terms of cognitive styles. Data analysis was done based on Miles and Huberman's stages: data collection, data reduction, data presentation, and conclusion.

## **Results and Discussion**

Students' difficulties in solving geometric problems on high order thinking are analysed based on the student's mistakes in solving geometric problems on higher-order thinking. Students' difficulties in solving geometrical problems are analysed based on high order thinking indicators that analyse, evaluate, and create.

Difficulties of students in solving the problem of geometry about HOTS on indicators analyse the views of errors made by field dependent students. The student made a mistake in performing the force operation on the fractional number and substituted a value, failure in the process using the Pythagorean Theorem and did not write down the information contained in the problem. Students have difficulty identifying the type of triangle which resulted in difficulty in finding the area of an equilateral triangle. HOTS test results and interviews stated that students had difficulties in the operation of fractional numbers, substitution of a value, the process using the Pythagorean Theorem. Students have difficulties understanding problems, difficulty using previous information in solving problems, students make mistakes in finding the area of equilateral triangles, and past difficulties lead to difficulties in the final answer. The result of Agustin's research (2012) shows that students make mistakes on rank numbers with the rank of integers. Research Hidayah (2016) that students make mistakes in understanding the problem, students do not write down what is known and asked questions from given.

Difficulties of students in solving the problem of geometry about HOTS on indicators to evaluate the views of mistakes made by field dependent students. Students difficulties in the reading stage, do not understand the material well, other than that the students also difficulties in understanding the problem, determine the method of completion. Students find it difficult to write down the unit of volume size and the difficulty of writing down the information known to the problem, the difficulty in concluding. HOTS test results and student interview difficulties in the reading stage, write down information, determine the unit of information that is known, the difficulty in determining the method of completion, the previous difficulty resulted in the students' difficulty in determining the final answer. Hidayah research results (2016), students make mistakes in writing the unit and do not write the unit on the information provided. Hanifah (2011) research results stated that students made a transformation phase error, students did not write down the method used or could not determine the method used. Students are less conscientious and confident in drawing conclusions, and students do not write answers as desired (Rahayuningsih, 2014; Karimah, 2017).

Difficulties of students in solving the problem of geometry about HOTS on the indicators create views of mistakes made by field dependent students. Students do not write down the information known and asked entirely, the students do not have

sufficient mastery of the material in solving the problem. HOTS test results and interviews, students difficulty in combining information and designing problem-solving methods, using pine volume formula, not mastering pine volume material well, difficulties in understanding the problem, students making mistakes in writing symbols, previous difficulties resulted in difficulties in the final answer. Based on HOTS test results and student interview difficulties on mastery of pyramid volume material, difficulty determining a method of completion and difficulty in solving problems, previous difficulties resulted in student difficulties on the final answer. The results of Pawestri (2013), students do not understand the definition, concepts, and concepts of prerequisite materials, so do not work on matter related material. Hidayat (2013) states that students make a mistake in principle so that in the process of identifying the problem until the final answer the student made a mistake.

Students with cognitive field dependent style in solving geometry problems on HOTS problems on indicators analysing, evaluating, and creating difficulties in fractional number operations and substitution of a value, difficulty understanding problems, using previous information in solving problems, difficulty in final answer, difficulty write down information, difficulties in determining method of completion, difficulty in deciding units of known data, difficulty in making conclusions for not knowing what should be the reference comparison, difficulty in determining the formula used, difficulty in reading phase, and difficulty in mastering the material volume pyramid.

Difficulties of students in solving the problem of geometry about HOTS on indicators to analyse seen from mistakes made field students independent. The student do not write information on the answers in writing, do not specify the triangular side-line information, do not give any particular symbols on the triangle expressing the type of triangle, and do not write the formula and have difficulty in writing the root operation and difficulty in using the Pythagorean Theorem formula. HOTS test results and student interviews have difficulties in writing the operation of the parenthesis rules and the writing of root symbols on fractions, difficulty in performing root operations and subtraction of fractional numbers and difficulty in writing formulas since the previous difficulties resulted in difficulties in the final answer. The results of the study indicate that students have difficulty in counting operations on fractional numbers (Utari, 2013, Imswatama, 2016), and do not write down the methods used correctly or cannot determine the method used (Imswatama, 2016; Hanifah, 2011).

Difficulties of students in solving the problem of geometry about HOTS on evaluating indicators seen from mistakes made field students independent. Students have difficulty in writing complete information, not writing the formula in problem-solving, not assigning units at any length and width and final answer, difficulty withdrawing conclusions, not giving correct decision-making reference. HOTS test results and student interviews have difficulties in decision-making steps, as a result of an error in the previous step makes it difficult to answer the final answer. The results of Hanifah's research (2011) stated that students made mistakes not writing the right method used, and errors in writing the last response or drawing conclusions (Rahayuningsih, 2014; Amalia, 2017).

Difficulties of students in solving the problem of geometry about HOTS on evaluating indicators seen from the mistakes made by students with cognitive style field independent. Students are not able to properly integrate information, not write complete information and write information is not clear. Students cannot solve problems correctly and cannot relate information obtained through problem-solving design. HOTS test results and student interviews have difficulty determining settlement measures or methods of problem-solving. Hanifah (2011) research results stated that students make mistakes in the transformation stage where students do not write down the method used correctly or cannot determine the method used.

Students with independent field cognitive style in solving geometry problems on HOTS problem on indicators analysing, evaluating, and creating difficulties in writing operation of parenthesis rules and writing root symbols on fractional numbers, difficulty in root operations and subtraction on fractions, difficulty in writing formulas, difficulties in determining final answers, difficulty in drawing conclusions, difficulty identifying appropriate methods of completion, difficulties in combining information or problem-solving phases.

### **Conclusions**

Students with field-dependent cognitive style in solving geometry problem on HOTS problem in analysing, evaluating, and creating difficulties at reading stage, understanding comprehension stage, student having difficulty determining unit on known information, transformation stage, student difficulty in deciding settlement method, defining the formula used, the mastery of pyramid volume material, the process skill stage of the student difficulty performing the operation of fractional pairs and substitution of a value, the difficulty of using the previous information in solving the problem, the difficulty in concluding because not knowing what should be the reference comparison.

Students with independent field cognitive style in solving geometry problems on HOTS problem on indicators analysing, evaluating, and creating difficulties in understanding the problem stage, students having difficulties in writing the operation of parenthesis rules, writing root symbols on fractions, root operations and subtraction at portions, the transformation stage, the students have difficulty writing the formula, determining the appropriate method of completion, the process skill stage, the students difficulties in combining the information or the process of solving the problem and the students difficulty in determining the final answer, the difficulty in drawing conclusions.

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