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Understanding Students' Concept on Space Geometry Subject Viewed from Cognitive Style of the 8th Grade Students at State Middle School 1 of Bima in the Academic Year of 2016/2017

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Abstract— **This research aims to: (1) describe the concept understanding of the 8th grade students at State Middle School 1 of Bima on geometry subject that has independent field cognitive style, (2) Describe the concept understanding of the 8th grade students at State Middle School 1 of Bima on geometry subject that has dependent field cognitive style. Researchers used a qualitative descriptive approach with a case study research design. The population in this study were all 8th grade students at State Middle School 1 of Bima. The determination of the sample in this study used a purposive sampling technique. The process of data analysis in this study began with transcribing the interview data, examining the data available from the research subjects and compiling them in units which were further categorized based on criteria. The results of this study indicate: (1) Understanding the Students' Concept of Field Dependent Type (FD), students with FD cognitive style in general are only able to meet the indicators of understanding the proposed problems. As for the indicators, classifying objects according to certain properties, restating a concept, using and choosing a particular procedure or operator, and conveying the results have not been met in the first, second, third and fourth question. (2) Understanding the Students' Concept of Field Independent Type (FI), all students with FI cognitive style have been able to meet all the indicators. This is shown by the students who are able to understand the questions well, so they are able to analyze the statements of the questions.**

Keywords: concept understanding, cognitive style, space geometry

I. INTRODUCTION

Mathematics is a science that has certain characteristics. One of mathematics characteristic is having abstract study objects. In mathematics, the basic object studied is abstract. The basic objects include facts, concepts, operations, and principles. From these basic objects, a mathematical pattern and structure can be arranged [1]. Therefore, learning mathematics should be sequentially and systematically done in stages, and it is based on past learning experiences. Mathematics is given to equip students with the ability to think logically, analytically, systematically, critically, and creatively. Therefore, mathematics is considered as a very important science and taught in almost all levels of education, ranging from middle schools, high schools to universities. The important role of mathematics is recognized by Cockcroft in Shadiq states that "It would be very difficult – perhaps impossible – to live a normal life in very many parts of the world in the twentieth century without making use of mathematics of some kind" [2].

Education in Indonesia aims to develop the students' potency to have intelligence, noble character and skills needed as members of society and citizens. One way to achieve these educational goals is the reform in mathematics learning. The reform in learning mathematics have been carried out but the reality is still encountered by students' difficulties in understanding mathematical material. The ability to understand mathematical concepts is very closely related to other mathematical abilities.

The National Council of Teachers of Mathematics 2000 states that mathematical understanding is a very important aspect in the principles of mathematics learning. In the process of learning mathematics must be accompanied by understanding. This is the main goal of learning mathematics. Learning without understanding is something that has happened and been a problem since the 1930s, so learning with understanding continues to be emphasized in the curriculum [3]. A student considered to be able to understand a mathematical concept is, among others, when he builds

relationships between new knowledge and prior knowledge. According to Anderson, the students having the ability to understand are those who are able to construct the meaning of the messages that arise in teaching such as oral communication, writing, and graphics [4].

Minister of Education and Culture Regulations Number 54 of 2013 states that one of the goals of mathematics education in secondary education is that the students understand mathematical concepts, be able to explain the correlation of concepts and apply concepts or algorithms flexibly, accurately, efficiently, and precisely in problem solving [5]. In the implementation of curriculum 2013, geometry subject at State Middle School 1 of Bima was also not fully mastered by students. In one class that contains an average of 35 students, there are still around 20 students who have not yet finished during the geometry test. So the percentage of geometry test completeness is around 42%.

Based on an interview from one of the teachers of State Middle School 1 of Bima, the decline in student achievement was allegedly due to several factors. Several factors may be indicated as the cause of the decline in the students' achievement in geometry subject, including: 1.) The students do not understand the concept of dimensional space correctly, 2.) The students have difficulty in imagining questions about geometry, 3.) Some students only rely on memorization without understanding concepts so that they make mistakes in solving problems, 4.) The prerequisite materials include straight lines, angles, plane area, trigonometry, and the requirements for the implementation of the Pythagoras theorem have not yet mastered by some students.

Based on indications, one of the causes of the students' failure in learning geometry is that the students do not understand mathematical concepts or students' misunderstanding on mathematical concepts. Each student has a different way in conveying and constructing their knowledge. These differences show different cognitive factors among students, so they affect students in conveying and constructing a problem. When solving a mathematical problem, the students have different speech and thinking styles. Each person has his own speech in action, which is expressed through consistent perceptual and intellectual activity. Several factors may influence the students in solving mathematical problems, one of which relates to individual characteristics in thinking, feeling, remembering, solving problems and making decisions, namely the cognitive style of students. Cognitive style is different for each student depending on the form of student responses in processing and organizing the information he gets.

Witkin, Moore, Goodenough and Cox in Mallala state that, in the learning activities of each individual can be divided into two groups, namely global and analytic [6]. Global individuals are individuals accepting something more globally and having difficulty to separate themselves from their surroundings or more influenced by the environment. Those individuals are called as Field Dependent (FD) cognitive style (FD). Meanwhile, analytic individuals are individuals who tend to express something apart from the background of the image, and are able to distinguish objects from the surrounding context.

Cognitive style possessed by students needs to be studied more deeply, so that later appropriate learning materials, goals and methods can take into account differences in students' cognitive styles. Cognitive style relates closely to the way and the attitude of students in learning that can affect their learning achievement. Kogan in Slavin reveals that one of the individual differences in cognitive style is field dependent and field independent [7].

The research done by Riding and Smith, generally relates to cognitive style. It reveals that "The accommodation of cognitive style in the training design process has the potential to improve the effiviency and effectiveness of indifidual learning, and drv may also help in the identification of learning difficulties" [8]. This research results that if learning can determine the type of student cognitive style, it is possible to improve the efficiency and the effectiveness of learning, and may also help to identify students' learning difficulties.

Students having a field independent cognitive style generally tend to be able to proceed the information they receive more easily because students having these learning characteristics can be more independent in learning and have a great sense of knowledge in a particular field and the problem they like. Meanwhile, students having a field dependent cognitive style generally tend to accept existing information. They need help from others in understanding learning information. They prefer to learn something that is certain and dislike independent assignments. Perceptual and intellectual aspects reveal that each individual has different characteristics from other individuals. In accordance with a review of these aspects, it was stated that individual differences can be expressed by cognitive types known as cognitive style. Cognitive style is the way a person processes, stores or uses information to respond a task or various types of environment. The cognitive style in this study is the cognitive style of Field Dependent-Field Independent.

The purposes of this study are to describe the concept understanding of eighth grade students of State Middle School 1 of Bima in geometry subject that has field independent cognitive style, and to describe the concept understanding of eighth grade students of State Middle School 1 of Bima City in geometry subject that has field dependent cognitive style.

II. RESEARCH METHODOLOGY

Based on the research problems, the type of this research in this study was qualitative research using a case study research design. It is a research focused on one phenomenon chosen and understood deeply, by ignoring other phenomena [9]. The phenomenon was in the form of students' conceptions about solid figures geometry and their elements.

The population in this study was all of the 8th grades students of State Middle School 1 of Bima. The selection of subjects in this study used purposive sampling that was the determination of samples with certain considerations [10]. Determination of the subjects in this study was based on the Group Embedded Figures Test (GEFT) and mathematics teachers' recommendations. There were two variables in this study, namely the independent variable, namely field dependent cognitive learning style and field independent

cognitive learning style. Data were collected by using the method of test, questionnaire, interview and documentation.

The stages covered include preparation, implementation of data collection and analysis, and reports preparation. The steps taken by researchers were Preparation Phase, and the activities carried out at this stage were: 1) Assessing theories about understanding concepts, understanding mathematical concepts, and cognitive styles, 2) Studying theories of Space Geometry Subject used by the students in mathematics learning at Middle School, 3) Researchers prepared themselves as the main instrument, and they also prepared appropriate supporting instruments in expressing students' understanding of mathematical concepts, 4) Conducting pre-research to get a picture of student concepts understanding in the form of definitions, elements of the space geometry, 5) Having a valid instrument, a validation instrument was performed on the validator by referring to the validation sheet, 6) Based on inputs and suggestions from the validator, the draft instrument of assistance was later corrected. These valid assistive instruments were then used for data collection tools.

At the stage of data collection and analysis, activities carried out were selection of research subjects, interviews on research subjects and interview data on each subject. The data were then analyzed by using the theoretical basis stated by scientists or experts. After obtaining the research results and the data analysis, it was then continued by writing a research report.

The data validity in this study was done by time triangulation. Time triangulation means to compare and to recheck the trust level of information obtained through different times. Activities in data analysis were data reduction, data display, and conclusion drawing / verification. The data analysis process in this study began by transcribing the data of interview, analyzing the data available from the research subjects and compiling them in units which were further categorized based on criteria.

III. RESEARCH RESULTS AND DISCUSSION

After testing the grouping of students' cognitive style, it uses the first assistive instrument, the GEFT test, and the results are:

TABLE I.   TYPE OF COGNITIVE STYLE OF THE 8TH GRADE STUDENTS AT STATE MIDDLE SCHOOL 1 OF BIMA

Cognitive Style	Total Students	Percentage
Field Dependent (FD)	20	66,67 %
Field Independent (FI)	10	33,33 %
Total	30	100%

Based on the Table, it shows that of the 30 students, there are 20 students having field dependent cognitive style and 10 students having field independent cognitive style. This type of cognitive style grouping is used as a basis for analyzing students' concepts understanding.

After grouping the students based on the type of cognitive style, then a written test in the form of four question descriptions was done to find out the level of understanding of students' concepts of Space Geometry subject. Furthermore, 6 students were selected as interviewees from the results of students' answers in solving the Geometry questions consisting of 3 students of FD cognitive style types and 3 students of FI cognitive style types. The list of the students as interviewees is shown in the Table below:

TABLE II.   THE LIST OF THE STUDENTS AS INTERVIEWEES

Group	Code of Students' Name	Students' Code
Field Dependent (FD)	RH	FD1
	NL	FD2
	FO	FD3
Field Independent (FI)	AMK	FI1
	TP	FI2
	MF	FI3

The results of this study were taken from the test of the Space Geometry questions of the 8th grade students at State Middle School 1 of Bima, consisting of 30 students. This study was reviewed based on the students' cognitive styles of FD and FD, taken by six students in which each of the three students from each type of cognitive style group.

In this study, an analysis of students' understanding of concepts was carried out in answering the question essay of space geometry in terms of the cognitive style of students who had previously been tested by using the GEFT test. From the results of the study, it reveals the concept of understanding indicators that consist of restating concepts, classifying objects according to certain properties, using and choosing certain procedures or operations, and summarizing the results.

Subjects classified as FD consist of subject FD1, FD2, and FD3. Based on the results of the research description, it can be explained that the subject FD1, FD2, and FD3 have not met the four indicators of understanding the concept. This is shown from the four indicators; there are several indicators that have not been met by the subject of FD1, FD2, and FD3.

At the first question, Subject FD1, FD2, and FD3 have fulfilled the indicators of understanding the subject matter proposed indicated by the subject FD1, FD2, and FD3 is able to analyze what is desired by the question and what variables are known from the given problem. Subjects FD1, FD2, and FD3 also do not meet the indicators of classifying objects according to certain properties as indicated by the inability of subjects FD1, FD2, and FD3 to distinguish diagonal of space and side. For indicators to restate a concept, using and choosing a particular procedure or operation, subjects FD1, FD2, and FD3 do not meet these indicators. This is shown by the low subject using the right steps in solving the problem given even though the subject FD1, FD2, and FD3 use the cube volume formula. For indicators delivering results only FD3 meets the indicators. This is seen from the three subjects FD1, FD2, and FD3, only the subject FD3 writes the conclusion that correspond to the problem.

At the second question, the subjects FD1, FD2, and FD3 have been able to meet the indicator of understanding the

subject matter proposed, classifying objects according to certain properties. This can be seen from the ability of the three subjects to understand what is desired by the problem and what variables are given to help work on the problem. For indicators restating a concept, using and choosing a particular procedure or operator, only subjects FD1 and FD2 fulfill the indicator while FD3 does not. It is shown that only subjects FD1 and FD2 are able to choose the right formula in solving problems. As for the indicators conveying the results of the three subjects namely FD1, FD2, and FD3 do not meet the indicators.

At the third question, subjects FD1, FD2, and FD3 have met the indicators of understanding the subject matter proposed, classifying objects according to certain characteristics, and restating a concept, using and choosing a particular procedure or operator. This is shown by the ability of subjects FD1, FD2, and FD3 in understanding the core problems raised by the question, known supporting variables, all three subjects are also able to analyze the steps and choose the right formula to answer or to solve the given problem. But in this third problem, subjects FD1, FD2, and FD3 have not met the indicator of delivering the results shown by not writing the conclusions of the work.

At the fourth question, subjects FD1, FD2, and FD3 are able to meet the indicators in understanding the subject matter proposed and classifying objects according to certain traits. For indicators to restate a concept, using and choosing a particular procedure or operator only subjects FD2 and FD3 fulfill while FD1 does not. This is shown by the subject FD2 and FD3 which are able to choose and to use the right formula, so that it gets the right answer, while FD1 is wrong in choosing and using the formula so the answer is wrong. For indicators to conclude results, all three subjects of FD1, FD2, and FD3 do not meet the indicators, indicated by the absence of conclusions that match the problem.

Puspitadari and Nining explain the causes of mistakes made by students at the nonstructural level are students' low ability to interpret data, students' poor memory, students' rushing attitudes in doing the test, students' weakness in translating questions into mathematical models [11]. Subjects with students classified as FI consist of subjects FI1, FI2, and FI3. Based on the results of the research description, it can be explained that the subjects of FI1, FI2, and FI3 have fulfilled all four indicators of concept understanding.

At the first question, the subjects FI1, FI2, and FI3 have met the indicators of understanding the subject matter proposed, indicated by the subjects FI1, FI2, and FI3 is able to understand and to analyze what is desired about the problem and what variables are given to solve the problem. Subjects FI1, FI2, and FI3 have also fulfilled the indicator of classifying objects according to certain properties shown by subjects FI1, FI2, and FI3 is able to analyze the initial steps that must be taken to find the length of the ribs (sides) of the cube. Subjects FI1, FI2, and FI3 have also fulfilled the indicator of restating the concept, using and selecting certain procedures or operations indicated by the three subjects being able to analyze the steps and to choose the right formula in solving the problem. In addition, the subjects FI1, FI2, and FI3 have met the indicators conveying the results shown from how the

subjects FI1, FI2, and FI3 are able to conclude in accordance with what has been done.

At the second question, the subjects FI1, FI2, and FI3 actually have met the four indicators. In the first indicator, which is an indicator of subject matter understanding, the subjects FI1, FI2, and FI3 are able to analyze well, also the indicator of classifying objects according to certain characters and the indicator of summarizing the results. However, the indicator of restating the concept, using and choosing a particular procedure or operation subject FI3 is better than the FI1 and FI2 subjects as indicated by the FI3 subject analysis which is better in choosing a formula. It is in line with the supporting variables of the given question.

At the third and the fourth question, the subjects FI1, FI2, and FI3 have met the four indicators. But in broad outline, the FI3 subject has better capabilities compared to the FI1 and FI2 subjects. This is shown by the FI subject in more detail in finishing the question, while the FI3 subject always draws up images of solid figures to make it easier to finish the question.

Hamzah. B. Uno [12] mentions the differences between the two types of cognitive styles in learning. In the field dependent type (FD), it is generally more interested in the framework of social situations, understanding the face/love of others, interested in verbal messages with social content, considering greater external social conditions as feeling, warm, sociable, friendly and responsive. On the other hand, field independent (FI) type shows that there is pressure from outside and responds to situations coldly with distance, and insensitive.

From the description above, it can be seen that there are so many obstacles experienced by the students that may hinder understanding of concepts. These constraints include errors in learning mathematics such as lack of accuracy in the process, calculation errors due to lack of mastery of a calculating operation, the use of a wrong process, an error in concluding the final result, an error in translating the problem, haste in working on the question. This is consistent with research conducted by Jingga, grouping mistakes including 1) strategy mistakes; 2) calculation error; 3) misconceptions; 4) skill hierarchy errors; 5) mistakes in drawing conclusions [13].

IV. CONCLUSION

Based on the research results and the discussion, the following conclusions can be drawn; (1) Understanding the Students' Concept of Field Dependent Types (FD), Students with FD cognitive style are generally only able to meet the indicators understanding the subject matter proposed. Meanwhile, the indicators of classifying objects according to certain properties, restating a concept, using and choosing a particular procedure or operator, and conveying the results have not been met in the first, second, third and fourth question, (2) Understanding the Students' Concept of Field Independent Type (FI), all students with FI cognitive style have been able to meet all the indicators. This is indicated by students being able to understand the questions well, so they are able to analyze the statements that are known from the questions.

Students are also able to classify procedures in determining the initial steps. In addition, students with FI cognitive style have been able to meet the indicators of restating a concept, using and choosing a particular procedure or operator and also conveying the conclusions. This can be seen from the students' ability that are able to choose and to determine the main steps in completing the questions and also students of the FI cognitive style are able to infer work results that are in accordance with the questions. The obstacles factors of students' general understanding of concepts are as follows; (a) students do not understand Space Geometry subject well, (b) Students only memorize it without knowing the concepts of the subject so that it is easy to forget the formula, (c) students are in a hurry in answering the question, and (d) students are not careful in the stages of completing the question.

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