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Students' Conceptions About Flat Side Space Materials Viewed From The Cognitive Styles of Students in Junior High School

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ABSTRACT

Purpose of the study: The purpose of this study was to obtain a description of the conception of junior high school students who have field independent (FI) and field dependent (FD) cognitive styles regarding the definition of cubes and blocks and elements of cubes and blocks.

Methodology: This research is a qualitative research using a case study research design. The subjects in this study were students at junior high school which consisted of one class. The interview guideline instrument was in the form of a question guide used by researchers to gather information on students' conceptions of: (1) the definition of cubes and blocks and (2) the elements of cubes and blocks. Qualitative data analysis is carried out interactively and continues continuously until complete, so that the data is saturated. Data analysis techniques in this study used the Miles and Huberman methods.

Main Findings: The results of this study are the conception students of junior high school who have a field dependent (FD) Cognitive Style in stating the definition of cubes and blocks by stating that cubes are geometric shapes that have the same sides and blocks are geometric shapes that have unequal sides, by declaring that a cube is a geometric shape that has 6 square sides while a beam is a geometric shape formed from a combination of squares and rectangles, by stating that a cube is a figure whose sides are the same while a block is a figure that has length , width, and height.

Novelty/Originality of this study: The results of the description of the student's conception can later be used as a reference for the teacher in taking an action during learning and can improve learning outcomes in the future, the future and reduce the existence of misconceptions carried out by students in learning mathematics.

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1. INTRODUCTION

Mathematics is one of the subjects that is taught both at the level of primary education, secondary education, and higher education [1]. Learning mathematics is learning about the concepts, structures contained in the subject matter and looking for relationships between concepts and structures contained in the meaning of mathematics itself. The basic objects studied in mathematics are abstract, often also called mental objects. The

basic objects include (1) facts; (2) concept; (3) operations or relations and (4) principles [2]–[4]. From these 4 basic objects, a mathematical pattern and structure can then be arranged.

Basically an important part that must be mastered by students in learning mathematics is the concept of each material, because by knowing the concept, students can solve problems without memorizing formulas, memorizing definitions or memorizing the characteristics that characterize each student is said to understand the material in learning [5]–[7]. Understanding the correct concept will assist students in solving any problems in the subject matter. Understanding the concept is the ability of students in the form of mastery of a number of subject matter that does not just know or remember a number of concepts learned but is able to reveal them again in a form that is easy to understand, provide data interpretation, and is able to apply concepts that are in accordance with their cognitive structure [8]–[10].

In learning, especially mathematics in junior high school, it is not enough just to be given knowledge to students, but students need to have the skills to make choices and solve various problems using logical conceptual reasoning. One of the causes of failure in learning mathematics is that students do not understand mathematical concepts [11], [12]. Students who master the concept will get a way to solve problems easily. Misconceptions when teachers convey math material to students can result in continuous basic misunderstandings and will be carried over to a higher level of education. Each mathematics learning material is interrelated and to study a topic at the advanced level students must have basic knowledge or prerequisite knowledge, namely reasoning that has been outlined in previous mathematics lessons.

Mathematics is broadly divided into four branches, namely arithmetic, algebra, geometry, and analysis. Geometry is a branch of mathematics that occupies an important position to study, because geometry is used by everyone in everyday life [13]–[15]. The lack of students in understanding geometry, makes students unable to develop themselves. The facts that show the low mastery of geometry in Indonesia, based on the results of the mastery of geometry in the Province of West Nusa Tenggara (NTB) in the 2014 UN PAMER with the subject matter tested in the National Examination (UN) in NTB for the 2014 Academic Year include, (1) the concept operations on exponential numbers, root numbers, social arithmetic, number sequences; (2) understand algebraic forms, concepts of linear equations and inequalities, linear equations, sets, relations, functions, systems of linear equations; (3) understand the concept of congruence, properties and elements of plane shapes, as well as the concept of relationships between angles and/or lines; (4) understand the nature and elements of geometric shapes; (5) understand the concepts in statistics, and apply them in problem solving; (6) understand the concept of the probability of an event and apply it in problem solving. As for the 6 subject matter, the mastery of geometric material in understanding the properties and spatial elements is 68.05%, the result is higher when compared to the national average which is only 62.42%. This indicates that the mastery of the material is good, but this statement contradicts the results of the mastery of the material in North Lombok Regency, which is one of the districts in NTB which has the lowest graduation rate out of ten existing districts and cities.

Cognitive learning theory is a view of learning that focuses on thought processes to increase their understanding, students do not immediately produce instantaneous changes in behavior but require a long process, and along with this Paul and Don around the 20th century said our view of learning move away from behaviorism and view learning as an observable change in certain behaviors [16]–[18]. People who have a field independent cognitive style are more analytical, they can sort stimuli based on the situation, so that their perceptions are only partially affected when there is a change in the situation. People who have a field dependent cognitive style have difficulty differentiating stimuli from the situation they have so that their perceptions are easily influenced by manipulation of the surrounding situation. Cognitive style is divided into two parts, namely, FI and FD and since 1948 has distinguished the type of cognitive style based on tendencies, namely: students with the FD cognitive style are highly influenced or dependent on the environment, obtain better results when working with others, prefer to solve problems. something in a predetermined way, as well as in social situations tends to be better than FD students [19].

From the results of the interviews, the researcher drew a conclusion that the subject's conception of a cube is a flat shape with the same side lengths, while a block is a flat shape that has a different side length. According to the researcher, the subject's conception could have come from preconceptions when studying square and rectangular shapes so that the subject's conceptual understanding of cubes and blocks was flat. Based on the description above, the researcher is interested in conducting research on students' conceptions when viewed from the cognitive style of FD and FI. The purpose of this study was to obtain a description of the conception of junior high school students who have field independent (FI) and field dependent (FD) cognitive styles regarding the definition of cubes and blocks and elements of cubes and blocks, then the results of the description of these students' conceptions can later be used as a reference for teachers in taking an action during learning and can improve learning outcomes in the future, future as well as reducing the existence of misconceptions carried out by students in learning mathematics.

2. RESEARCH METHOD

This research is a qualitative research using a case study research design. The subjects in this study were students of class VIII even semester at SMP Negeri 2 Bayan which consisted of one class. The selection of subjects in this study was by purposive sampling, namely determining the sample with certain considerations [20]–[23]. The selected research subjects consisted of two categories, namely students with field dependent (FD) and field independent (FI) cognitive styles. Collecting data in this study using semi-structured interviews. The interview guideline instrument was in the form of a question guide used by researchers to gather information on students' conceptions of: (1) the definition of cubes and blocks and (2) the elements of cubes and blocks. Qualitative data analysis is carried out interactively and continues continuously until complete, so that the data is saturated. In the Miles and Huberman method, there are activities in analyzing data, namely data reduction, data display, and conclusion drawing/verification [24]–[26].

3. RESULTS AND DISCUSSION

Cognitive style is divided into two parts, namely field independent and field dependent. Since 1948, Witkin has developed a measuring tool to distinguish types of students based on cognitive style. Witkin states that individuals who are analytic are individuals who feel the environment into its components, are less dependent on the environment or less influenced by the environment and these individuals include field independent cognitive styles, while individuals who are global, individuals who focus on the environment as a whole, are dominated or influenced by the environment and individuals like this, including the field dependent cognitive style. People who have a field independent cognitive style are more analytical, they can sort stimuli based on the situation, so that their perceptions are only partially affected when there is a change in the situation. People who have a field dependent cognitive style have difficulty differentiating stimuli from the situation they have so that their perceptions are easily influenced by manipulation of the surrounding situation.

Table 1. Student conception data with field independent cognitive style (FI)

Valid Student Conception Data	Concept Understanding About
	1. Definition of Cubes and Blocks
Subject (AS)	a) The subject (AS) already understands the difference between cubes and blocks but cannot make a good definition conceptually. b) Subject (AS) said that cubes and blocks are a shape/ even though objects conceptually a cube is a geometric shape bounded by six congruent and square-shaped sides and a beam is a geometric shape bounded by six sides or 3 pairs of congruent sides rectangular size.
Subject (EK)	a) The subject (EK) already understands the differences between cubes and blocks and is able to provide conceptual definitions of cubes and blocks in their own words. b) Subject (EK) said that a cube is a flat sided figure that has 6 equal sides, 8 vertices, and 12 edges, while the concept of a beam is a flat sided figure that has 6 different long sides, has 8 vertices, and 12 ribs.
Subject (ZI)	a) Subject (ZI) already understands the differences between cubes and blocks and is able to provide conceptual definitions of cubes and blocks in their own words. b) Based on the results of the first and second interviews, the subject (ZI) always gives different definitions of the concept of cubes and blocks, but the definitions given are conceptually appropriate even though they are incomplete.
Subject (MU)	a) The subject (MU) already understands the differences between cubes and blocks and is able to provide conceptual definitions of cubes and blocks in his own words. b) The concept of a cube according to the subject (MU) is a flat sided shape that has equal sides that have space, while the block concept is a flat sided shape consisting of squares and rectangles that have space
	2. Elements of Cubes and Blocks
Subject (AS)	a) The subject (AS) stated that cubes and blocks have the same elements, while these elements include 12 edges, 6 sides, and 8 vertice b) Subject (AS) understands each of the elements that have been mentioned but has not been able to make a clear definition conceptually c) Subject (AS) said that the definition of each cube and block element is the same d) The subject (AS) gives a different definition to the elements of the sides and vertices, but the definitions given have the same meaning
Subject (EK)	a) Subject (EK) stated that cubes and blocks have the same elements, while these elements include sides, edges, vertices, space diagonals and side diagonals b) The subject (EK) understands each of the elements that have been mentioned and of the 5 elements mentioned, only the definition of a side diagonal element has no clear

	meaning. c) Subject (EK) said that the definition of each cube and block element is the same. d) The subject (EK) gives different definitions to all the elements of cubes and blocks, but the definitions given have the same meaning.
Subject (ZI)	a) Subject (ZI) stated that cubes and blocks have the same elements, while these elements include ribs, vertices and sides. b) The subject (ZI) understands each of the elements that have been mentioned but has not been able to provide a clear definition conceptually. c) Subject (ZI) said that the definition of each cube and block element is the same.
Subject (MU)	a) Subject (MU) stated that cubes and blocks have the same elements, while these elements include sides, edges, vertices, space diagonals and side diagonals. b) Subject (MU) understands the 4 elements of cubes and blocks that have been mentioned and is able to provide clear definitions. c) The subject (MU) has a misconception about the space diagonal. d) Subject (MU) said that the definition of each cube and block element is the same. e) The subject (MU) gives different definitions to all the elements of cubes and blocks, but from the definitions given they have the same meaning.

The results of data analysis in the form of student conceptions of 4 research subjects who have field independent cognitive styles about cubes and blocks are as follows, 1) AS subjects say a cube is a figure that has 6 square sides with a volume (S3) while a block is a figure that has 2 opposite sides of the same length and 4 sides of a rectangle with volume (p x l x h). The elements of cubes and blocks are ribs, vertices, and sides; 2) subject EK said that a cube is a geometric shape consisting of 6 equal sides, 8 vertices, and 12 edges, while a beam is a geometric shape with 6 sides formed from squares and rectangles, has 8 vertices and 12 edges. The elements of cubes and blocks are edges, vertices, sides, side diagonals, and space diagonals; 3) subject ZI said that a cube is a 3-dimensional figure with all sides equal, while a block is a geometric shape with unequal length, width and height. The elements of cubes and blocks are edges, vertices, and sides; 4) the MU subject said that a cube is a flat sided shape where all sides are square-shaped while a block is a flat sided shape made up of squares and rectangles. The elements of cubes and beams are ribs, vertices, sides, side diagonals, and space diagonals. Based on the results of the analysis of data findings from 4 subjects who have field independent cognitive styles stated that, 4 subjects understand the difference between cubes and blocks. Students who are the subject of research 3 of them can provide conceptual definitions. According to experts, the concept of a cube is a spatial figure bounded by six congruent and square-shaped sides (planes), while the beam concept is a geometric shape bounded by six sides (planes) or 3 pairs of congruent rectangular sides. Subject AS and subject ZI said that there were 3 elements of cubes and beams, namely, edges, sides, and vertices, while subjects EK and subjects MU said that there were 5, namely, edges, sides, vertices, side diagonals, and space diagonals. According to the expert, there are 6 elements of cubes and blocks, namely ribs, sides, vertices, side diagonals, space diagonals, and diagonal planes.

Table 2. Student conception data with field dependent cognitive style (FD)

Valid Student Conception Data	Concept Understanding About
	1. Definition of Cubes and Blocks
Subject (FS)	The subject (FS) already understands the difference between cubes and blocks, but FS has not been able to provide clear and conceptual definitions. The concept of a cube according to FS is a geometric shape that has the same sides, while the concept of a beam is construct a space that has unequal sides.
Subject (GN)	The subject (GN) already understands the difference between cubes and blocks but cannot make a good definition conceptually, it can be seen from the definition given, the first interview the subject (GN) said that a cube is a shape that is not solid and has the same sides, then in the second interview, GN said that a cube is a shape that has spaces with the same sides, based on the definition that was disclosed, it is not in accordance with the actual concept of a cube, because the concept of a cube itself is a shape that is bounded by six sides (fields) that are congruent and square shape. Besides not being able to make a definition of a cube, it turns out that the subject (GN) also could not make a definition of a block, this can be seen from the results of the first interview and the results of the second interview.
Subject (MS)	a) The subject (MS) already understands the differences between cubes and blocks and is able to provide conceptual definitions of cubes and blocks in their own words. b) Based on the results of the first and second interviews, the subject (MS) always gives different definitions of the concept of cubes and blocks, but the definitions given are

	conceptually appropriate even though they are incomplete.
Subject (MF)	The subject (MF) already understands the difference between cubes and blocks but cannot make a good definition conceptually, it can be seen from the definition given, in the first interview the subject (MF) said a cube is a geometric shape that has 6 parallel sides and the same length , then in the second interview MF said that a cube is a shape that has the same sides, based on the definition that was disclosed it is not in accordance with the actual concept of a cube, because the concept of a cube itself is a shape that is bounded by six sides (fields) that are congruent and square shape. Besides experiencing being unable to make a definition of a cube, it turns out that the subject (MF) also cannot make a good definition of a beam.
	2. Elements of Cubes and Blocks
Subject (FS)	a) Subject (FS) mentions, cubes and blocks have the same elements, including sides, edges, and vertices. b) The subject (FS) understands each of the elements that have been mentioned based on the display of images of cubes and blocks. c) The subjects (FS) said that the definition of each cube and block element was the same, but in the first interview the FS could not provide a definition of the three elements that had been mentioned.
Subject (GN)	a) Subject (GN) states that cubes and blocks have the same elements, including ribs, sides, and vertices. b) Subject (GN) understands each of the elements that have been mentioned based on the appearance of the cube and block shapes. c) Subject (GN) said that the definition of each cube and block element was the same, in the first interview, GN could only define corner points, while in the second interview, GN gave definitions of the three elements already mentioned.
Subject (MS)	a) The subject (MS) states that cubes and blocks have the same elements, including ribs, sides and vertices. b) The subject (MS) understands each of the elements that have been mentioned but has not been able to provide a clear definition conceptually. c) Subject (MS) said that the definition of each cube and block element is the same. d) The subject (MS) gave a different definition for each element in both the first and second interviews.
Subject (MF)	a) The subject (MF) states that cubes and blocks have the same elements, while these elements include ribs, sides, vertices. b) The subject (MF) understands each of the elements that have been mentioned. c) Subject (MF) said that the definition of each of these elements is the same, but MF has not been able to provide a clear definition conceptually.

The results of data analysis in the form of student conceptions of 4 research subjects who have field dependent cognitive styles about cubes and blocks are as follows, 1) the FS subject says a cube is a geometric shape that has the same sides while a block is a geometric shape that has sides which is not the same. The elements are cubes and blocks, namely ribs, vertices, and sides; 2) subject GN said that a cube is an object that is not solid and has equal sides, while a beam is a shape that is not solid and 3 opposite sides are equal in size. The elements of cubes and blocks are edges, vertices, and sides; 3) the MS subject said that a cube is a geometric shape with 6 square sides, while a block is a geometric shape formed from a combination of squares and rectangles. The elements of cubes and blocks are edges, vertices, and sides; 4) subject MF said a cube is a figure that has the same sides while a block is a figure that has length, width and height. The elements of cubes and beams are ribs, vertices, and sides. Based on the results of the analysis of the data findings in the form of student conceptions, of the 4 subjects who have a field dependent cognitive style, states that, 4 subjects understand the differences between cubes and blocks, and of the 4 students who are research subjects, FS subjects and MS subjects can provide conceptual definitions while subject GN and subject MF cannot make a conceptual definition, because according to the expert, the concept of a cube is a geometric shape bounded by six sides (planes) which are congruent and square in shape, while the concept of a beam is a geometric shape bounded by six sides (planes)) or 3 pairs of congruent sides of a rectangle. In the elements of cubes and blocks, 4 subjects could not make a complete definition, the GN subject in the first interview could only define the corner point elements, the FS subject in the first interview could not provide a definition of the three elements already mentioned, the MS subject gave a different definition. differed in each element both in the first interview and in the second interview, and the MF subject had not been able to make a clear conceptual definition of edges, corners and sides. Students with a field dependent cognitive style say that there are 3 elements of cubes and blocks, namely: sides, edges and vertices. According to the expert, there are 6 elements of cubes and blocks, namely ribs, sides, vertices, side diagonals, space diagonals, and diagonal planes.

Table 3. Comparative analysis of students' conception data on both cognitive styles

Valid student conception data	Understand the concept of
	1. Definition of cube and cuboid
Field Independent	a) All students understand the difference between a cube and a block. b) Students can provide a conceptual definition of cubes and blocks based on their clear understanding.
Field Dependent	a) All students understand the difference between a cube and a block. b) Students can provide definitions of cubes and blocks based on their understanding.
	2. Elements of cubes and blocks
Field Independent	a) Subject (EK) and subject (MU) said the elements of cubes and beams include: ribs, sides, vertices, side diagonals, and space diagonals. b) Subject (AS) and subject (ZI) said the elements of cubes and blocks include: ribs, sides, and vertices. c) All students give different definitions of each element of cubes and blocks.
Field Dependent	a) Students say the elements of cubes and blocks include: ribs, sides, and vertices. b) Students have not been able to make a complete definition of the elements that have been mentioned.

Exposure to students' conception data states that there are differences in the understanding of students who have a field independent cognitive style with students who have a field dependent cognitive style. Furthermore, after an in-depth analysis, it was concluded that students with a field independent cognitive style had a better understanding than students with a field dependent style. These results are consistent with the findings of Guisande et al. (2012), Ardjo (2008), and Ratumanan (2003), that the mathematics learning outcomes of field independent students are better when compared to field dependent students, because basically field independent types in the process of processing information are not too dependent on environmental conditions therefore independent field type in processing learning information can be faster and more accurate, as a result this type will be comfortable with various existing learning conditions, this type also has a tendency to process things that are complex in nature to be easy to understand so that this type is faster in solving problems, meanwhile field dependent cognitive style generally in processing an information obtained is very dependent on environmental conditions. Students with a field dependent cognitive style tend to only accept the information provided and are unable to reorganize it. In addition, students with the field dependent type tend to need more instructions to understand something, so that the subject matter must be clearly structured for students with this type. This style prefers learning about social and human relations compared to subjects about science, as a result students with Field dependent type has a low understanding of learning mathematics.

Based on the ability to communicate their conceptions, there is a difference between students with a field dependent cognitive style and students with a field independent cognitive style. These results are in accordance with the framework proposed by the researcher, where field independent students are more analytic than field dependent students, communicating mathematical understanding requires the ability to express meaning, understand problems and make clear definitions that can be understood by others.

4. CONCLUSION

Based on the results of the analysis and discussion, the following conclusions have been made. The conception of class VIII students of SMP Negeri 2 Bayan who has a field independent cognitive style (FI) in stating the definition of cubes and blocks is by stating that a cube is a figure that has 6 square sides with a volume of side times side times side (S3) while a block is a shape flat side space formed from squares and rectangles, by stating that a cube is a geometric shape consisting of 6 equal sides, 8 vertices, and 12 edges while a beam is a geometric shape consisting of 6 sides shaped like a square and a rectangle, has 8 vertices, and 12 edges, by stating that a cube is a three-dimensional figure with all sides equal, while a beam is a geometric shape with unequal length, width and height. In the elements of cubes and blocks, students say that cubes and blocks have the same elements, namely sides, edges, vertices, side diagonals, and space diagonals. Furthermore, the conception of class VIII students of SMP Negeri 2 Bayan who has a field dependent (FD) Cognitive Style in stating the definition of cubes and blocks is to state that a cube is a geometric shape that has the same sides and a beam is a geometric shape that has different sides. is not the same, by declaring that a cube is a geometric shape that has 6 square sides while a beam is a geometric shape formed from a combination of squares and rectangles, by stating that a cube is a figure that has the same sides while a block is a shape that has length, width, and tall.

In the elements of cubes and blocks, students mention that cubes and blocks have the same elements, namely, sides, edges, and vertices.

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