Space Geometry Learning in Primary Schools Based on Ethnomathematics as the Implementation Independent Learning Curriculum

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ABSTRACT
Understanding the concept of space geometry is highly important but challenging for elementary school students. An appropriate learning model is necessary to understand space geometry. One learning model that can bring students into a concrete world is ethnomathematics-based learning. This study aims to investigate students' understanding of space geometry concepts through an ethnomathematics-based learning model. This study constitutes research and development (R&D), which aims to design an ethnomathematics-based learning model to help students understand the space geometry concept as an attempt to implement an independent learning curriculum at elementary schools. The samples were 60 elementary school students chosen randomly. Data were collected through a test of the space geometry concept. The results showed that the majority of students have a good understanding of space geometry through ethnomathematics-based learning. The students' understanding was categorized as high (62.8%), medium (33.2%) and low (4%).

Keywords: *Space geometry learning, Ethnomathematics, Independent learning curriculum*

1. INTRODUCTION

Mathematics is one of the subjects learned from elementary to university level. Mathematics is a field of study that supports the development of science and technology and plays a role in supporting social and cultural sciences. This is because mathematics has an important role based on concepts and processes in mathematics that are logical, systematically arranged, rational, and exact, which is closely related to the thinking process and decision-making [1].

Geometry concepts relate to basic ideas that are always related to points, lines, planes, surfaces and space. Geometric concepts are abstract, but these concepts can be realized in semi-concrete or concrete ways. Geometric shapes are divided into two: flat shapes and space shapes. Geometry is a mathematical study that studies built space by focusing on measurements, statements related to shape, the relative position of a geometric drawing, the field of space, and so on. In geometry, we will be able to construct various types of flat and multi-sided shapes. Polygons can then be used to arrange spatial shapes such as triangles, circles, squares, rectangles, parallelograms, rhombuses, spheres, cones, prisms and others. Studying geometry provides many basic skills and helps to build logical thinking, analytical reasoning and problem-solving abilities.

Geometry allows us to understand space in real life, which helps students understand concepts better. Understanding geometric concepts needs to be taught to children because understanding geometric concepts is needed in everyday life. Through geometric concepts, children can develop problem-solving abilities. Besides that, geometric abilities are a branch of mathematical abilities that are useful in life.

The success of learning activities in elementary schools depends on the learning support components developed. The independent curriculum is present in the context of restoring learning by emphasizing essential content so that students can deepen concepts and strengthen literacy and numeracy competencies through learning [2]. The independent curriculum gives students, teachers and schools the freedom to innovate, learn independently and be creative in determining learning that is appropriate to the level of development, characteristics, potential and needs of students [3].

Quality mathematics learning requires teacher skills to choose appropriate learning contexts and tools [4]. In addition to teaching students techniques and tools for solving math problems, they need to learn more than just basic math algorithms. All students need to expand their understanding of how mathematics relates to other disciplines, including culture [5]. One strategy that can be applied is culture-based learning, or what is called ethnomathematics.

Ethnomathematics is a combination of culture and mathematics, which must be connected to realities that

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are relevant to people's lives so that mathematics is not just a subject but also a human activity that is closely related to local culture [5]. Ethnomathematics is very appropriate to be applied to mathematics learning in Indonesia. By implementing and linking mathematics with culture, students are not only intelligent in the mathematical aspect but also know and preserve culture, both national culture and local culture, which is the heritage of the Indonesian nation. Apart from that, learning mathematics will also be more meaningful in improving the concept of mathematics as a form of independent learning in elementary school.

Based on the explanation above, this research aims to investigate students' understanding of space geometry concepts through an ethnomathematics-based learning model as an attempt to implement independent learning at elementary schools.

2. RESEARCH METHODS

This research constitutes research and development (R&D) [6], [7] and is part of a bigger research. This research aims to investigate students' understanding of space geometry concepts through an ethnomathematics-based learning model. This study used the Four-D model from Thiangarajan, consisting of define, design, development, dan disseminate [8].

This research was carried out at an elementary school in Banda Aceh, Aceh Province. The samples in this study were 60 elementary school students chosen randomly. Data was collected through a test of understanding geometric concepts consisting of five questions. From the test, students were asked about the characteristics of space geometry, including cube, cuboid, prism, cylinder, and pyramid, using the context of ethnomathematics. Then, data were analyzed using qualitative descriptive analysis techniques, which are processed inductively using an interactive analysis model consisting of data reduction, data presentation, decision-making, and data verification.

3. RESULTS AND DISCUSSION

Students' understanding of the space geometry concepts through ethnomathematics contexts will be described in the following sections.

3.1 Cube

A cube shape is a three-dimensional shape bounded by six equal sides, 12 equal edges and eight vertices. The cube has a square shape and has another word, namely a regular hexagon. Examples of cubes include cardboard boxes of the same size and dice. Characteristics of a cube are as follows: (1) has six faces; has 12 edges; (2) has eight vertexes; (3) the edges of the cube are the same length; the faces of the cube are square; (4) the diagonals of the space have the same dimensions; and (5) the diagonals of each cube are rectangular. The formula for finding the volume of the cube is $s \times s \times s$, and the surface area of a cube can be written as $6 \times (s \times s)$, where s is the edge of the cube.

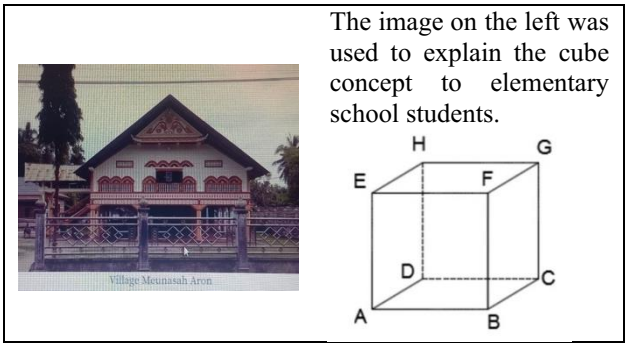

Figure 1*Meunasah* Building

The result showed that students' understanding of cube concepts is considered good, with an average score of 75. Students were able to define a cube and its characteristics. Some students could not mention all the characteristics of a cube. For instance, they incorrectly stated the number of edges and faces.

3.2 Cuboid

A cuboid is a geometric shape that has rectangular and square sides. Characteristics of the cuboid are: (1) the number of faces on the cuboid is 6, 4 faces are rectangular, and two faces are square and parallel; (2) has 12 edges, where eight pairs of edges have the same length, (3) the total number of vertex is 8; (4) has 12 face diagonals and four space diagonals; and (5) has six diagonal faces. The volume of the cuboid is $p \times l \times t$, where p is the length of the cuboid, l = the width of the cuboid, and t is the height of the cuboid.

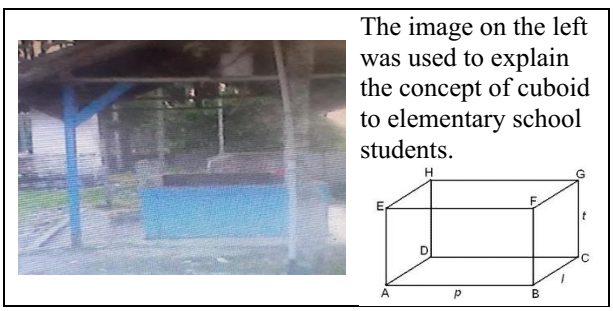

Figure 2. Water Tank (Water Storage)

The result showed that students' understanding of cube concepts gained an average score of 72. Students were able to understand the concept of a cuboid, which is a three-dimensional object that has square and rectangular faces. Students also understood the characteristics of a cuboid, namely: cuboid has six faces, consisting of 4 rectangular faces and 2 square faces, and they are parallel. However, some students did not yet understand that a cuboid has 12 face diagonals and four space diagonals. Some students were able to indicate six diagonal faces.

3.3 Prism

A prism is a three-dimensional space that has a top base and a bottom base. Characteristics of a prism comprise: (1) it has three types of faces, namely a bottom

base, a top base, and lateral faces; and (2) it has lateral faces in the shape of a flat plane (in this case, triangle, for the triangular prism, see Figure 3). The volume of a triangular prism is (1/2 x base x height) x prism height.

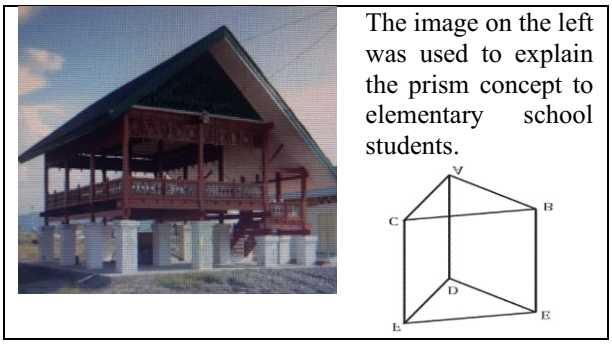

Figure 3. Study Hall

The result showed that students' understanding of the concept of prism and its characteristics received an average score of 74. They understood that a prism has three types of faces: top base, bottom base, and literal faces. They noticed that the lateral faces of a prism are rectangular or square. In the triangular prism, they understood that the number of vertex is three times the number of vertex on the bottom base. While the number of edges is three times the number of edges on the bottom base. Yet, some students still incorrectly explained the literal faces of a prism and the number of edges on a prism.

3.4 Cylinder

A tube shape is a shape from three-dimensional space and has a lid and a base. The shape itself is a circle that is the same size as the one enclosed in a rectangle.

Characteristics of a cylinder are: (1) has two edges, has three faces, has a bottom base, curved surface, and a top base; (2) the height of the cylinder is the distance between the bottom base and the top base of the cylinder; and (3) the bases are circular and the same size. The volume of a cylinder is $\pi \times r^2 \times t$.

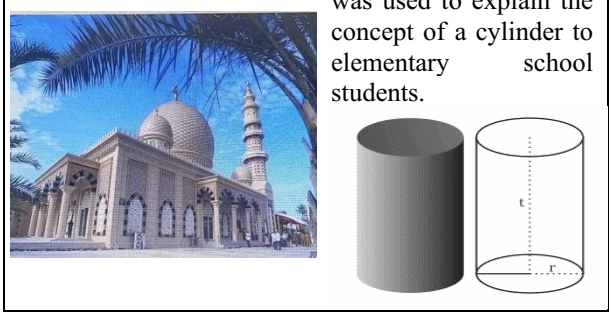

Figure 4. Mosque Building

The result showed that students understood the concept of the cylinder with an average score of 76. They recognized that a cylinder is a three-dimensional object where a bottom base and a top base are circles of the same size. A cylinder has a literal face that forms a rectangle. Nonetheless, some students still had limited knowledge of the characteristics of a cylinder, namely, a cylinder has two edges and three faces (top, bottom, and lateral faces).

3.5 Pyramid

The pyramid shape has three shapes, namely the triangular pyramid, the rectangular pyramid, and the pentagonal pyramid. However, in this study, only two pyramids are discussed: the triangular pyramid and the rectangular pyramid. The distinguishing characteristic of the two is the base. Characteristics of a triangular pyramid include: (1) it has four faces where one side is a triangular base, and three faces are triangular lateral faces; (2) the number of edges is 6; (3) the number of the vertex is 4, of which three are at the base, and one is at the top of the pyramid cone or called apex. On the other hand, characteristics of a rectangular pyramid are: (1) it has four faces where one face is a rectangular base and four faces are lateral faces; (2) the number of edges is 8; and (3) the number of the vertex is 5, of which four are at the base, and one is at the pyramid apex. The pyramid volume is ⅓ × Base Area × Height.

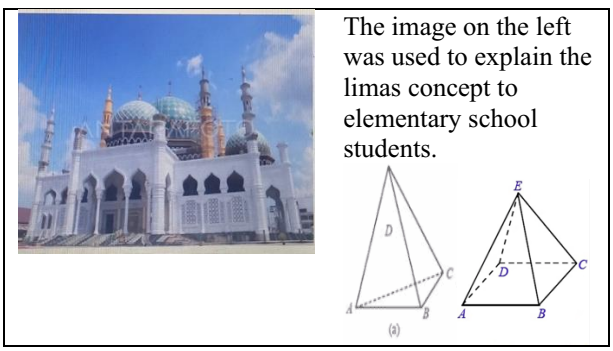

Figure 5. Mosque Building

The result showed that students' understanding of the pyramid concept obtained an average score of 70. Students understood the characteristics of a triangular pyramid, including that it has four faces, one of which is a bottom face, and the others are lateral faces, which all faces form triangles. They also recognized the characteristics of a rectangular pyramid, including it has five faces consisting of one bottom face in a rectangle shape and four lateral faces in a triangle shape. They could identify the number of edges and vertex on the pyramids. However, some students had not yet understood the concept of the height of a pyramid.

Overall, based on the test on the space geometry concepts, it was found that students' understanding was categorized as high (62.8%), medium (33.2%) and low (4%), as depicted in Figure 6.

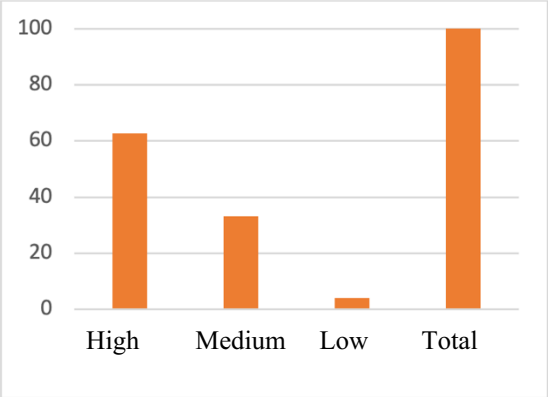

Figure 6. Students' Understanding the Concept of Space Geometry Using Ethnomathematics Contexts at Elementary School

Regarding ethnomathematics-based learning, a researcher [9] suggests that the presence of ethnomathematics in mathematics learning provides a new nuance that learning mathematics is not only confined to the classroom but to the outside world by visiting or interacting with local culture can be used as a mathematics learning media. Meanwhile, seen from the perspective of the learning approach, ethnomathematics is in line with the mathematics learning approach, which is suitable if applied in the independent learning curriculum.

Several previous research [10] found that there are characteristics that stand out the most when discussing ethnomathematics in mathematics learning, namely linking mathematics and cultural products in a learning process when discussing a mathematical concept. The mathematical concepts studied are sought to find appropriate cultural concepts, as well as the existing cultural products being modelled in appropriate language or mathematical form. Furthermore, Fajriyah [11] stated that the role of ethnomathematics is to support students to be able to construct mathematical concepts based on students' knowledge of their sociocultural environment. As learned in this study, students construct their understanding of the characteristics of three-dimensional objects through cultural contexts related to them. Apart from that, ethnomathematics provides a learning environment that creates good motivation and interest learning environment so that students actively participate in mathematics learning, which is expected to influence their mathematical understanding.

4. CONCLUSION

The results of the research show that students' understanding of the concept of space geometry through an ethnomathematics-based learning model obtained the following results: 62.8% for a high category, 33.2% for a medium category, and 4% for a low category. The result of this study suggests that elementary school teachers apply ethnomathematics-based mathematics learning in the mathematics classroom to help students develop their understanding of geometric concepts. It is hoped that the results of this research can contribute to improving mathematics learning in schools.

AUTHORS' CONTRIBUTION

Author 1 contributes to conceptualization, data analysis, and writing. Author 2 contributes to data analysis and editing. Author 3 contributes to data collection.

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