Direct identification of Borobudur temple artefacts for learning flat shapes concepts

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Abstract. Understanding concepts is important in learning mathematics, one of them is learning geometry. The concept of geometry is closely related to daily life, so that introducing directly the object of geometry is expected to facilitate the understanding of geometry concepts for students. This research is a descriptive qualitative research. The purpose of this study was to determine student understanding in studying geometry by directly identifying Borobudur temple artefacts. The subjects of this study were 3 students of class VIII SMP. The instrument in this study was the researcher herself as the main instrument guided by a concept understanding test and interview guidelines based on valid and reliable tests. Data were collected through the provision of pre-test and post-test about understanding the concept of a flat figure which includes 7 indicators and accompanied by interviews as supporting data. The results showed that directly identifying the Borobudur temple artefacts can be used as an alternative to studying the concept of flat wake. The weakness of this study is that the three subjects have not been able to answer the problem in indicator 7, which is about developing sufficient requirements or necessary requirements from the concept of a flat figure. This can be a material or material that can be used as future research.

1. Introduction
Mathematics is a compulsory subject taught at every level of school education, from a child in elementary school to high school. Mathematics displayed in schools through the abstract side without context will make students feel that mathematics is not related to their daily lives [1]. Even though there are so many problems or things that are in everyday life related to mathematics. Concrete things that relate to students' daily experiences can be used as an interesting learning resource, one of which is the local culture. Mathematics is always taught in schools as a cultural subject which involves the supposed learning of facts, concepts, and content that is universally accepted [2].

Culture is a complex that includes knowledge, beliefs, art, morals, customs and other abilities and habits possessed by humans as part of society [3]. Indonesia is a country that has a diversity of cultures, it is not impossible if in the culture itself there are mathematical values. Learning mathematics through cultural relevance will help students to know more about reality, culture, society, environmental issues, and themselves by providing mathematical content and approaches that enable them to successfully master mathematics academically [4].

Marsigit [5] argues that the term ethno describes codes, beliefs, physical properties. D'Ambrossio states that mathematics includes views on arithmetic, sorting, inferring and modelling [6]. From these two opinions it can be concluded that ethnomatematics is a science that is used to understand the mathematical values contained in a culture. Ethnomatematics are special ways used by certain cultural
groups or societies in mathematical activities [7]. So, learning mathematics, students need a bridge between mathematics and culture that is ethnomathematics [8]. Besides that, ethnomathematics is more interesting than formal mathematics [9].

The learning process is proven in the results of the PISA (Program for International Student Assessment) analyzed by Stacey [10] which has shown that Indonesian students cannot use mathematical concepts to solve real-life problems. Arisetyawan [11] explains that one of the reasons students cannot use mathematical concepts to solve real-life problems is because teachers at school do not associate cultural activities and daily activities in the learning process. An understanding of the concept of geometry is an important thing to do. One of the abilities students must have in learning geometry is to build knowledge about both geometrical concepts and principles, both flat and spatial, from a formal and informal perspective [12].

Prabowo stated that one of the ethnic groups who applied mathematics in daily life was the Javanese or the term Javanese Mathematics with the understanding of (1) mathematical knowledge that had been reversed by Javanese people and might still continue to be used to this day, and (2) application of mathematical theories to various activities of daily life of Javanese people [13]. One of the existence of Javanese mathematics can be found in the Borobudur temple artefacts. In the Borobudur temple building various geometrical concepts are found, one of which is the type of flat shape, such as square, rectangular, triangle, circle and other reconstruction flat structures.

The main purpose of learning geometry is to enable students to have a good understanding of spatial concepts and procedures encountered in their lives, so that they have the ability to solve spatial problems in their real life situations [14]. Involves the cognitive process of visualization and reasoning is a plot to gain an understanding of geometrical concepts (geometric thinking) [15]. Mathematics teachers are expected to be able to realize mathematics as a science that is inherent in culture (cultural bounded) in learning. The application of ethnomathematics in learning can be made by designing and learning media based on ethnomathematics or other learning innovations. It should be emphasized in learning that learning mathematics through concrete objects will make it easier for students to learn a material concept.

Interviews and tests of understanding the initial concepts conducted by researchers on 3 students of class VIII junior high school, the students interpret the types of flat shapes in accordance with the images in his memory. For example, a rectangle is a rectangle that has length and width, meaning that a rectangle has a pair of parallel sides that are longer (called length) than another pair of parallel sides (called width), a rectangle is a rectangle in which there are a pair of angled parallel sides, and there are many more the other. In other cases there are some students who cannot solve the problem of flat arising in various forms of mathematical representation, some students can only solve problems or problems that are in accordance with the examples given before, but if converted into other forms they cannot solve them.

This research has a difference compared to other studies. This can be seen from how students visited directly to the Borobudur temple to learn the concept of geometry, especially the flat shape. In addition, students were asked to solve problems about flat arising before and after observing geometric shapes in the Borobudur temple. The results of solving the questions before and after observation are then compared for analysis. Learning geometry that utilizes concrete objects will be very helpful for students in learning geometrical concepts, one of which is to get up flat. An alternative that can be applied is through direct observation by visiting the Borobudur temple. This is what drives researchers to raise issues with titles “Direct identification of Borobudur temple artefacts for learning flat shapes concepts”.

2. Method
This study uses descriptive qualitative as a type of research to explain and obtain information in its entirety, breadth and depth [16]. The purpose of this research is to find out whether direct identification of junior high school students about Borobudur temple artefacts can learn the concept of geometry. The subjects of this study were 3 seventh grade junior high school students who directly
observed and studied geometry through identification and direct observation of Borobudur temple artefacts.

The research procedure consisted of the preparation phase, the data collection stage, and the data analysis stage. In the preparation stage, researchers prepared interview guidelines and test instruments consisting of 7 questions. Researchers use random sampling techniques to determine the research subjects. Then the researchers collected data by giving test questions and interviews to students before and after the students made direct observations on the Borobudur temple artefacts. When making observations, students are guided directly by researchers and fill in the observation guidelines that have been prepared by researchers. Furthermore, the data obtained were analyzed. The results of the tests and interviews before the observation and after the observation are compared.

Data collection is done through tests and interviews. Testing the validity and reliability in this study by using triangulation. Test questions are used to obtain data related to student comparisons in solving geometry test questions before and after observing Borobudur temple artefacts. Indicator test questions as follows: restate the concept of a flat figure, classify the types of rectangles according to certain properties, give examples and non-examples of the concept of flat figures, present the concept of flat structures in various forms of mathematical representation, applying concepts or problem solving algorithms, using, utilizing, and choosing certain procedures or operations, and developing the necessary or sufficient conditions of a concept. Interviews are used to obtain supporting data.

3. Results and Discussion
Students visit the Borobudur temple in Magelang, Central Java. Then students identify directly the flat buildings in the Borobudur temple. After that, students are given a test of 7 questions by referring to 7 indicators of concept understanding. Tabel 1, Tabel 2, Tabel 3 are the results of tests conducted by students.

| Type of Indicator | Result |
|-------------------|--------|
| Re-stated a flat concept | The results showed that in redefining each type of flat shapes, student 1 could describe a shape based on the properties it had and be able to recognize the shape of each type of flat shapes well. |
| Classify flat objects according to certain properties | The results showed that in classifying the types of flat shapes according to certain properties, generally true. Student 1 identifies each building according to the properties it has, and the subject has been able to classify each building based on the properties given. |
| Give examples and non-examples of the concept of a flat shapes | The results showed that in determining examples of each type of flat shapes, student 1 tended to recognize the shapes of a flat shapes from the given image, so the subject could determine an example of each type of rectangle |
| Presenting concepts in various forms of mathematical representation. | The results showed that student 1 solved the problem in various forms of mathematical representation there were many errors. The subject cannot associate the properties of a flat shapes with the form of the given problem |
| Apply a problem-solving concept or algorithm | The results showed that in applying the concept or problem-solving algorithm, students 1 in solving problems according to the problem-solving steps were all wrong. Student 1 does not |
Type of Indicator                  | Result
---                               | ---
Use, utilize and select certain procedures or operations | The results showed that in solving problems given by students 1 using, using, and choosing certain operations or procedures, but all were wrong. Student 1 does not understand the problem given
Developing necessary or sufficient conditions for a concept | The results showed that in developing the necessary and sufficient requirements of a concept especially the properties of flat shape, student 1 could not yet understand the relationship between flat shape based on the properties they had. Student 1 did not answer the questions given nor did they comment

Based on the analysis of students 1’s research results in studying the concept of a flat figure with the direct identification of the Borobudur temple artefacts, it is found that some questions relating to certain indicators can be completed by student 1 well, the subject can restate a concept of a flat figure, in classifying the objects of flat shape based on certain properties are generally true, and can provide examples and non-examples of each type of flat figure. For indicators (1) presenting concepts in various forms of mathematical representation, (2) applying the concept of flat shapes based on problem solving algorithms, and (3) using, utilizing, and choosing certain procedures or operations, student 3 still has many errors. Whereas in developing indicators the necessary requirements or sufficient requirements of a concept, student 3 had no comment at all. This means that the subject does not understand the problem given, so the subject is confused in answering the problem.

| Type of Indicator | Result |
|-------------------|--------|
| Re-stated a flat concept | The results showed that in redefining each type of flat figure, student 2 can describe a figure based on the properties it has and be able to recognize the shape of each type of flat shapes well |
| Classify flat objects according to certain properties | The results showed that student 2 identified each shape according to the properties it had. Student 2 can classify each type of flat figure based on the properties given |
| Give examples and non-examples of the concept of a flat shapes | The results showed that student 2 tended to recognize each type of flat shapes from the images provided so that subjects could determine an example of each type of flat shapes. But there are some examples of flat shapes that are not presented in accordance with the picture |
| Presenting concepts in various forms of mathematical representation. | The results showed that student 2 could complete the questions in various forms according to the given, but there were some problems that were solved there were a few errors. In solving the problem, student 2 associates the properties of a flat shape with the given shape |
| Apply a problem-solving concept or algorithm | The results showed that student 2 was able to apply the concept of a flat shapes in solving problems. In solving problems related to the properties of flat shapes according to the problem-solving algorithm, it is generally correct and there are only a few errors |
Analysis of the results of students 2’s research in studying geometry with direct identification of the Borobudur temple artefacts to learn the concept of flat figure obtained that student 2 can restate the concepts of flat shape, can classify the types of flat shape according to certain properties, and can provide examples and non-examples of each type of flat wake. For other indicators of understanding the concept of flat shapes, namely, (1) presenting geometrical concepts in various forms of mathematical representation, (2) applying a problem solving concept or algorithm and (3) using, utilizing, and choosing certain procedures or operations, student 2 has a few errors. Student 2 solves the problem according to the problem-solving procedure, although there are some procedures that are not explained so some calculations are also wrong. Whereas student 2's understanding of the indicators developing the necessary requirements or requirements is quite a flat concept, everything is wrong. The answers given by the subject to the indicator are all wrong. So that the understanding of the concept of a flat figure for student 2 belongs to the very good category.

According to Skemp it can be said that understanding something means assimilating something into the appropriate scheme [17]. Understanding a concept is seen as the ability to link certain schemes that are in accordance with the concept, with or without knowing why the schemes are interrelated. This is what happens to student 2 in solving questions related to indicator 7. Student 2 has not been able to link the concepts of flat builds into their schemes.

Table 3. Result test of Student 3

| Type of Indicator                        | Result                                                                 |
|------------------------------------------|------------------------------------------------------------------------|
| Re-stated a flat concept                 | The results showed that in redefining each type of quadrilateral, student 3 could describe each type of rectangle based on the properties it had and be able to recognize the shape of each type of flat shape well. The subject can re-describe each type of flat shape according to the definition he described. |
| Classify flat objects according to certain properties | The results showed that in classifying the types of flat shapes according to certain traits, student 3 could identify each flat shape according to the properties it possessed. Student 3 can classify each type of flat shape based on the properties given. |
| Give examples and non-examples of the concept of a flat shapes | The results showed that student 3 tended to recognize the types of flat shapes from the images provided, so that subjects could determine examples of each type of flat shape. |
| Presenting concepts in various forms of mathematical representation. | The results showed that student 3 could solve problems in various forms of representation in accordance with the given. The subject relates the properties of flat arising in solving the given problem. |
| Type of Indicator | Result |
|------------------|--------|
| Apply a problem-solving concept or algorithm | The results showed that student 3 was able to apply the concept of a flat shape in solving given problems. Student 3 also understands and solves problems according to the problem-solving steps |
| Use, utilize and select certain procedures or operations | The results showed that student 3 could utilize and choose certain procedures or operations that he could use in solving problems related to the properties of flat arising |
| Developing necessary or sufficient conditions for a concept | The results showed that student 3 could not yet understand the relationship between each type of flat figure based on the properties it possessed |

The results of student 3 research in studying geometry with direct identification of the Borobudur temple artefacts to learn the concept of a flat figure obtained that, in general, have a good understanding of the concept of a flat figure or have improved after learning to do direct identification, even though the indicators for understanding the 7th concept are still imperfect. Student 3 has not been able to understand and develop the necessary or sufficient requirements of a flat figure concept. While the other six indicators can be answered by students 3 well, namely (1) can restate the concepts of flat shape, (2) can classify the types of flat shape according to certain properties, (3) can provide examples and non-examples of each type of flat figure, (4) can solve problems in various forms of mathematical representation, (5) can solve problems according to problem solving algorithms, and (6) can link various flat figure concepts. If we don't have a concept, we will have difficulty formulating trivial problems and can't even solve them [18]. The concept is an important thing that must be considered when studying a material.

4. Conclusion
Understanding the concept of students 1 is in the bad category. With the acquisition of indicators in solving problems related to the properties of a flat shape that is, can restate the definition of each type of flat shape and can understand the definition, in classifying the types of flat shape based on the properties given, generally right, can give examples of each type of flat figure, in solving problems in various forms of mathematical representation, there are many errors, in solving problems related to the properties of flat figure according to the problem solving algorithm, but generally wrong, can use, utilize and choose certain procedures or operations, but there are many errors, no comments.

Understanding the concept of students 2 is in good category. The acquisition of indicators in solving problems related to the properties of a flat figure that is, can restate the definition of each type of flat shape and can understand the definition, can classify the types of flat shape based on the properties given, can give examples of each type of flat figure, can solve problems in various forms of mathematical representation, but there are few errors, in solving problems related to the properties of flat figure according to the problem solving algorithm, generally true, can use, utilize and choose certain procedures or operations, but there are few errors, in developing the necessary requirements and sufficient requirements of a concept, all of them are wrong.

Understanding the concept of students 3 is in good category. The acquisition of indicators in solving problems related to the properties of a flat figure that is, can restate the definition of each type of flat shape and can understand the definition, can classify types of flat shapes based on the properties given correctly, can provide examples of each type of flat figure, can solve problems in various forms of mathematical representation, can solve problems related to the properties of flat shapes in accordance with the problem solving algorithm, can use, utilize and choose certain procedures or operations, in developing the necessary requirements and sufficient conditions of a concept, far from perfect.

The results obtained from the three subjects indicate that there are differences in conceptual understanding between before and after direct identification of the Borobudur temple artefacts. Understanding the concept of a flat shape after directly identifying the Borobudur temple artefacts has increased from before. So it can be concluded that the direct identification of Borobudur temple
artefacts can be used as an alternative to facilitate students in learning the concept of a flat figure.

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References
[1] Danoebroto S W 2016 Studi Kualitatif Tentang Guru Matematika Di SMP Sekitar Candi Borobudur Dalam Melaksanakan Pembelajaran Yang Responsif Budaya Journal Of Mathematics And Education 3
[2] Muhtadi D, Sukirwan, Warsito and Prahmana R C I 2017 Sundanese ethnomathematics: Mathematical activities in estimating, measuring, and making patterns J. On Math. Educ. 8 185
[3] Hawskin 2012 Creating a Coaching Culture (Coaching in Practice) (New York: Bell and Baim Ltd.)
[4] Rosa M and Orey D C 2011 Ethnomathematics: the cultural aspects of mathematics Revista Latinoamericana de Etnomatematica 4 32
[5] Marsigit dkk 2016 Pengembangan Pembelajaran Matematika Berbasis Etnomatematika Proceeding of Etnomatnesia (UST: Yogyakarta)
[6] D’Ambrosio U 1985 Ethnomathematics and its place in the history and pedagogy of mathematics For the learning mathematics 5(1) 44-48
[7] Inda Rachmawati 2012 Eksporasi Etnomatematika Masyarakat Sidoarjo E-Jurnal UNESA 1 1
[8] Abdullah A S 2016 Ethnomathematics in perspective of sundanese culture J. On Math. Educ 8 1
[9] Rosa M, D’Ambrosio U, Clark D, and Lawrence O 2016 Current and Future Perspectives of Ethnomathematics as a Program in International Congress on Mathematical Education Springer
[10] Sundayana R, Herman T, Dahlan J A and Prahmana R C I 2017 Using ASSURE learning design to develop students’ mathematical communication ability World Transactions on Engineering and Technology Education 15 245
[11] Arisetyawan A, Suryadi D, Herman T, Rahmat C and No J D S 2014 Study of Ethnomathematics: A lesson from the Baduy Culture International Journal of Education and Research 2 10
[12] M Samsul 2014 Pembelajaran Geometri berbantuan Cabri 2 Plus (Panduan Praktis Mengembangkan Kemampuan Matematatis) (Bogor: In Media)
[13] Prabowo A 2016 Hasil-Hasil Terbaru Dalam Penelitian Matematika Jawa Proceeding of Seminar Nasional Matematika dan Terapannya (UMP: Purwokerto)
[14] Lappan G, Phillips E D, Fey J T, Friel S N, Grant Y, & Stewart J 2014 Connected mathematics 3 (Boston, MA: Pearson)
[15] Gunhan B C 2014 A case study on the investigation of reasoning skills in geometry South African Journal of Education 34(2) 1-19
[16] Prahmana R C I, Kusumah Y S and Darhim 2017 Didactic trajectory of research in mathematics education using research-based learning J. Phys.: Conf. Ser. 893 012002
[17] Skemp R 1987 The Psychology of Learning Mathematics. Expanded American Edition (New Jersey: Lawrence Elbaum Associates. Publishers)
[18] Santrock, John W 2011 Psikologi Pendidikan. Terjemahan oleh Tri Wibowo B S (Jakarta: Kencana Perdana Media Group)