Utilizing case study to understand elementary geometry: A practical approach

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ABSTRACT
In contrast to the branches of mathematics in general that require only analytical skills through formula calculation, geometry requires other skills in the form of visual ability to understand. The student’s analytical skills can be enhanced by theoretical learning methods. However, theoretical learning method will not be optimal in improving the visual ability. Another method is required that can encourage students’ analytical and visual abilities. The learning method that suits these needs is a case study. The case study method in geometry lessons can be applied by creating scenarios that are divided into two stages: the preparation stage and the implementation stage. The preparation stage is related to the formulation of scenarios of case studies that will be conducted by the students in the field, while in the implementation stage the students conduct direct observation in the field based on the case study scenario at the preparation stage and then present the observation result through the presentation, accompanied by suggestion and evaluation from teachers.

Keywords: case study, geometry, method, practical

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1. Introduction

Education in the global era can be interpreted as an education that is dynamic and open to changes and developments of the times. Today, the world is entering the era of the 4th Industrial Revolution, which is marked by the increasingly massive use of information technology. This 4th Industrial Revolution gave birth to a society with new mindset and orientation so that it becomes a challenge for the world of education to create a creative and competitive education system.

Many students have the perception that the subjects of mathematics are difficult to understand. This perception arises for several reasons: (1) mathematics deals with numbers and formulas so that students are easily saturated, (2) wrong assumption that math is distant or not applicable in the practice of everyday life, (3) lack of the creativity of the teacher in creating an interesting learning situation, (4) the teacher is only one-way in teaching mathematics, the absence of active participation from students to be involved (ask, discuss, and propose opinions). This perception if left will make it more difficult for students to master math lessons. Therefore, there needs to be evaluation of learning system from teacher, where one of them is by designing learning method that can foster interest in student learning.

Geometry is a branch of mathematics that requires analytical and visual skills in understanding it. The calculation of length, width, circumference and area of geometry using formulas is an analytical skill. While the ability to know the type, number of edges, and the geometry side is the visual ability.
One way to bridge the students’ analytical and visual abilities in geometry lessons is to make field observations. This activity can be packed attractively through a case study scenario that then directs students to observe in the field. Field observation activities with case studies are an effort to help students understand the lessons more deeply, because of the active involvement of students to explore the knowledge gained. So far, the concept of geometry taught by teachers is still largely informative. If the concept is submitted only informatively it will be easily forgotten because the students only accept then memorize (Yuliastuti, 2016). It takes a concept that is also applicable in understanding geometry. Therefore, there needs to be an effort from the teacher to be able to design learning methods that can facilitate students’ analytical and visual abilities in geometry.

One of the learning method that is able to attract student interest in learning is case study. Learning with problems and case studies is a learning model that provides scenarios and expects students to discuss and study such scenarios (Purwanti & Sudaryanto, 2009). Case study method is a learning method where the subject matter is discussed by making narrative story or case, and practiced through field study and simulation.

Case study is a student centered learning (SCL) method. SCL emphasizes teaching-learning processes that are more initiated by students. In other words, student centered learning is a learning approach where students as the center of the teaching and learning process (Notolegowo, 2015). In his research, (Masek, 2019) explains that the main concern of SCL is to provide students with autonomy and to change the role of educators from teaching to coaching.

The advantages of this case study method can be used to facilitate students in understanding geometry because it is able to encourage students’ understanding both in terms of theory and application. Thus this paper examines two research questions including (1) whether case study methods can be applied in geometry subjects or not? (2) how the implementation mechanism of case studies on geometry lesson?

The discussion of case study methods in previous studies is still limited to the theoretical sphere. In addition, there is little research that discusses its application in one branch of science. This research tries to offer novelty by discussing scenario of case study implementation in geometry lesson comprehensively.

The pedagogical aspect is a very important aspect to achieve educational progress. This aspect relates to the competence of teachers in designing the learning system. Effective learning system is shown by the improvement of the quality of education, where one of the indicators is the improvement of student academic achievement. If there is a decrease in the academic achievement of the students, then there must be evaluation and reformation of the teacher on the pedagogical aspect. Research by Groth (2007) found that there are positive effects of reform-based pedagogical practices. On that basis, the purpose of this study is to assist teachers in improving pedagogical competence, especially in designing a learning system that is able to actualize the potential of students.

2. Methods

This research is a qualitative descriptive study. The analysis is in the form of explanation and discussion of case study scenario in geometry lesson. The case study scenario is explained through two stages: (1) preparation and (2) implementation.
**Preparation**
In the preparation stage the teacher determines the theme, case, narrative story of the case, questions of narrative story, group formation, and preparation time for presentation.

**Implementation**
The implementation stage is a follow up of the preparation stage. At this stage, students go directly to the field for observation, collect data about the geometry type chosen, to answer the list of questions compiled by the teacher. After all the data is obtained and all questions are answered, the students then present the observation result through the presentation activity in the class. Teachers then conduct supervision, provide input and evaluation of the overall implementation stage undertaken by students.

3. **Results and Discussion**

The case study scenario in geometry lessons is divided into two stages, namely the preparation stage and the implementation stage. In the preparation stage, the teacher formulates the case study scenario design. In the implementation stage the students do direct observation and present the results of the analysis. Here's an explanation of both stages:

**Preparation stage**
1. The teacher determines the theme according to the material being studied, such as "Geometry Objects Around Us".
2. The next stage is to determine the case, take the example "Geometry Types".
3. The teacher makes a narrative story about "Geometry Types", as follows:
   "A geometry with features: has 6 faces as large (congruent) and square; has 12 edges of the same length; has 8 vertices; and has a congruent 6 square webs."
4. The teacher makes inquiries from the narrative, for example:
   a) With the characteristics as mentioned above, what kind of geometry is meant?
   b) What objects around us with the characteristics mentioned above (give examples)?
   c) What are the benefits of the objects of the given example?
   d) Take a sample object, then calculate (1) surface area, (2) circumference, and (3) volume!

<table>
<thead>
<tr>
<th>Correct answer (expected):</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The type of geometry in question is a cube.</td>
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<tr>
<td>2. With example objects: pencil box, cardboard box, etc.</td>
</tr>
<tr>
<td>3. Benefits of cube-shaped objects: a place to store goods, etc.</td>
</tr>
<tr>
<td>4. Suppose that the object we will calculate the surface area, circumference, and volume based on the findings in the field is a cardboard box. If after analyzed and observed the side length (symbolized S) of the cardboard box is obtained 30 cm, then calculate:</td>
</tr>
<tr>
<td>➢ The surface area ( (L) = 6 \times S^2 )</td>
</tr>
<tr>
<td>( L = 6 \times (30)^2 )</td>
</tr>
<tr>
<td>( L = 5,400 \text{ cm}^2 )</td>
</tr>
<tr>
<td>➢ The circumference ( (K) = 12 \times S )</td>
</tr>
<tr>
<td>( K = 12 \times 30 )</td>
</tr>
<tr>
<td>( K = 360 \text{ cm} )</td>
</tr>
<tr>
<td>➢ The volume ( (V) = S^3 )</td>
</tr>
<tr>
<td>( V = (30)^3 )</td>
</tr>
<tr>
<td>( V = 27,000 \text{ cm}^3 )</td>
</tr>
</tbody>
</table>

*it is hoped that students will give the same answer. The teacher has understood the answers correctly, so even though the case study method focuses on student activities, teachers are still required to master the subject matter under discussion.*
5. Furthermore, the teacher gives the task to the students to make observations in the environment surrounding the objects that exist to answer questions that have been given, either in the form of groups or individuals.

6. Teachers give students time to prepare presentations, so that students can do the tasks assigned by the teacher well. Teachers instruct students to make direct observations (direct study), rather than searching information through the internet or other information media, which are expected to improve students' understanding through a direct assessment process in the field.

**Implementation stage**

7. Students make direct observations in the field to answer questions from the narrative story given by the teacher. At this stage students are welcome to find as much data as possible. To perform measurements of selected objects, students are allowed to carry measuring tools such as rulers. In addition, to strengthen the research evidence, students are also allowed to bring documentary tools such as cameras, to document images of geometry objects found.

8. Students then present the results of observations that have been done by presenting it in class. The role of the teacher in the process of presentation is to monitor whether the explanation submitted by the students is correct and follow the direction that has been given, so that the purpose of learning can be achieved. Another teacher's role is to provide advice during presentations and discussions, by providing input to the shortcomings that may be encountered during the teaching-learning process using case study methods.

**4. Conclusion and Remarks**

Case study methods can be applied to geometry lessons. Through scenarios of case studies designed on the basis of rules in geometry, students can understand geometry through real case examples by examining and analyzing objects commonly found in everyday life. With examples of cases close to everyday life, it can make easy for students to understand the purpose and objectives of learning.

The case study mechanism in geometry lessons can be divided into two stages: the preparation stage and the implementation stage. At the preparation stage, teachers determine themes, cases, narrative stories about the case, questions from narrative stories, group formation, and preparation time for presentations. The implementation stage consists of field observation activities and results presentation, accompanied by supervision, input and evaluation by the teacher.

The suggestion for further research is to review the learning outcomes of the case study methods on geometry, and compare them with the learning outcomes of other methods, to find out the effectiveness and superiority of case study methods in teaching and learning activities.

**References**


