

Research Article

Learning Obstacle of Students in Geometrical Sequence and Series

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Abstract.

Geometrical sequence and series are mathematic topics that should be mastered by students, but some students encounter obstacles in learning these topics. This research aims to identify the learning obstacle by students in solving geometrical sequence and series problems. The research question was what kind of learning obstacles students face in the topic of geometrical sequence and series. The research is qualitative method with a case study research design. The participants were students of senior high school in Cirebon. Data collection was done by conducting tests and interviews. The test method was to identify the learning obstacles faced by the students and interviews as supporting data. The results show that students meet learning obstacles in solving geometrical sequence and series problems, namely ontogenical obstacle, didactical obstacle, and epistemological obstacles. Ontogenical obstacles were experienced by those students who do not understand the concept of geometrical sequence material, and that the answer written was wrong. The didactical obstacle is experienced by those students who find it easier to do it manually compared to using formulas in solving geometrical sequences and series problems. An epistemological obstacle is experienced by those students who are not able to write down the correct answers because the questions are different from habits.

Keywords: geometrical sequence and series, learning obstacle, senior high school.

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1. INTRODUCTION

Education holds an important role in preparing quality human resources and able to compete in the development of science and technology, so education must be implemented as well as possible to obtain maximum results. Education should be managed, both in quality and quantity. This can be achieved by implementing timely and appropriate education to achieve learning objectives. One of these learnings is mathematics, where mathematics is a subject whose material has abstract characteristics [1]. In mathematics learning in the class, students are often faced with various problems and are required to solve these problems in the way they had learned [2].

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Efforts to achieve goals and create a learning process that allows students to develop their knowledge, teachers need to design a lesson in such a way that the learning process takes place well and the expected learning objectives can be achieved. Learning that takes place in one direction can reduce students' opportunities to build their own knowledge and learning that is less meaningful. Such learning has the potential to cause various difficulties or learning obstacles. As said by the National Council for Mathematics Teachers that in studying mathematics, students must have an understanding and be active in constructing new knowledge based on the experience and knowledge that students already have [3].

One of the materials studied in mathematics is sequences and series. The purpose of this material is to equip students with the concepts of sequences and series patterns used to solve problems. There are still many students who feel confused when faced with questions related to the material of sequences and series. Research conducted by Hariyomurti said that students experienced learning obstacles in the material of arithmetical sequences and series in the form of ontogenical obstacles, didactical obstacles, and epistemological obstacles [4]. In addition, the results of another research conducted by Cesaria stated that in studying mathematics, especially in geometry, students experienced two obstacles, namely ontogenic and epistemological obstacles. Ontogenical obstacle occurs when students do not have sufficient understanding of the material given. While epistemological obstacle occurs when the teaching materials provided are not in accordance with the characteristics of students [5].

In fact, students are still confused in solving problems related to geometric sequences and series material. Students have difficulty understanding the meaning of the questions given so that students find it difficult to write down what is known and asked and determine the steps for solving story problems regarding geometrical sequences and series material. For this reason, the purpose of this research is to identify the learning obstacle by students in solving geometrical sequence and series problems.

2. RESEARCH METHOD

This research is a qualitative research using a case study design. The purpose of this research was to identify the learning obstacle by students in solving geometrical sequence and series problems. Geometrical sequences and series is an essential material because by understanding the material students can solve problems in everyday life such as calculating interest on conventional banks, counting the number of bacterial developments, and so on. The subject were four students of grade 10 of a senior high

school in Cirebon. Data collection is done by using test and interview. The test is used to identify the learning obstacle by students and interview as to support the test results. After the test results related to learning obstacles and interviews are obtained, then the data is analyzed and conclusions are drawn from the data.

3. RESULT AND DISCUSSION

The results in this research were obtained from tests related to learning obstacles in the material of geometrical sequences and series. The following are the test instruments given to students show in Table 1.

TABLE 1: Test istrument.

No	Question
1	A convection company produces clothing every month increasing according to the rules of geometrical sequences. Production in the first month as many as 125 units of clothing and in the fourth month as many as 3375 units of clothing. Determine the number of units of clothing produced in four months!
2	A restaurant has a profit each month increased to double the profit of the previous month. If the profit in the first month is IDR 350,000, then determine in what month the profit of the restaurant reaches IDR 5,600,000!
3	The increase in visitors at a tourist spot during the covid-19 pandemic follows a geometrical sequence. In January visitors reached 56 people and in March visitors reached 224 people. Determine the increase in visitors in May!
4	The results of observations in patients with certain diseases, found bacteria that cause wounds on the patient's legs to widen. To prevent growth and at the same time reduce the number of bacteria until healed, patients are given special drugs that are expected to reduce bacteria by 40% every two hours. If at the beginning of the observation (at 08.00 a.m) there are about 625 bacteria and the first drug is given immediately, determine the estimated number of bacteria after the administration of the drug at 12.00 a.m!

Table 1 shows four questions in the form of contextual questions given to students to find out the learning obstacles experienced by students. Question number 1 is a question related to students' ability to determine the number of the first n-terms if two sequences are known in a geometrical sequence. Question number 2 is a question related to the ability of students to determine the number of sequences if the first sequence and the ratio are known. Question number 3 is a question related to students' ability to determine the nth sequence in a geometrical sequence. Question number 4 is a question related to students' ability to determine the n-th sequence if the first sequence and ratio are known.

Based on the results of tests related to learning obstacles given to research subjects, it was found that there were students who experienced learning obstacles in each number of questions. The obstacles faced by students are finding it difficult to understand the material that has been taught because learning is still applying the online system as it is today, difficulty in understanding the questions given so that they are unable to determine which ones are known and asked in the questions, difficulties in determining the formula that must be used. in solving problems, and students' difficulties in solving such as errors in operating formulas and numbers [4].

Learning is basically an effort to help students to acquire new knowledge. In the learning process, students often have difficulty understanding the concepts being taught. Difficulties that can be experienced by students can be indicated through the mistakes made, which come from various factors. Errors are not only the effect of ignorance, uncertainty, chance, but can also be the effect of prior knowledge which is assumed to be true, but later revealed that the knowledge is false or false. This error is irrational and unexpected but this is an obstacle or difficulty[6]. Learning barriers often occur when students are in the process of cognitive development. Based on the analysis of the answers of students who experience learning obstacles, the following are the learning obstacles experienced by students in question number 1.

TABLE 2: Learning obstacle in question number 1.

No	Answer Question Number 1
a	$U_n = ar^{n-1} \quad U_n = 125 \cdot r^{4-1} \quad 3375 = 125 \cdot r^3 \quad 27 = r^3 \quad r = \sqrt[3]{27}$ $r = \pm 3 \quad S_n = \frac{a(r^n - 1)}{r - 1} \quad S_5 = \frac{125(3^5 - 1)}{3 - 1} \quad S_5 = \frac{125(242)}{2} \quad S_5 = 15.125$
b	<p>Be discovered: $U_2 = 125 \quad U_4 = 3375$ That $U_2 = a + (2 - 1)b \quad 125 = a + 1b \dots (1) \quad U_4 = a + (4 - 1)b \quad 3375 = a + 3b \dots (2)$ Substitute equation (1) into equation (2) with $a = 125 - 1b \quad a + 3b = 3375 \quad 125 - 1b + 3b = 3375 \quad 2b = 3.250 \quad b = 1.625$ Substitute $b = 1.625$ into equation (1) $a + 1b = 125 \quad a + 1(1.625) = 125 \quad a + 1.625 = 125 \quad a = 1.500$ Then $U_n = a + (n - 1)b \quad 1.500 + (n - 1)1.625 \quad 1.500 + 1.625 - 1.625 \quad 1.500$</p>

Table 2 (a) shows that the student made mistakes. The student didn't write correctly what was asked in the question. After conducting interview, the student stated that he was not careful in reading the questions so that the answers written was wrong. Table 2 (b) shows that the student didn't write the formula correctly so that the answers written was also wrong. The student stated that he felt confused when distinguishing formulas for geometrical sequences and formulas for arithmetic sequences.

Table 3 (a) shows that the student solved the problem manually. The results made by the student is correct, but the conclusions written is slightly wrong, he should be in the 4th month. After conducting interview, the student stated that it was easier to solve problems manually compared to using formulas and at the time of writing students'

TABLE 3: Learning obstacle in question number 2.

No	Answer Question Number 2
a	First month: $350.000 \times 2 = 700.000$ Second month: $700.000 \times 2 = 1.400.000$ Third month: $1.400.000 \times 2 = 2.800.000$ Fourth month: $2.800.000 \times 2 = 5.600.000$ So in the 6-th month the restaurant made a profit.
b	Be discovered: First month: 350.000 Second month and so on the profit is doubled = 750.000 Asked: Determine in what month the profit of the restaurant reaches IDR 5,600,000 Answer: First month: 350.000 Second month: $350.000 + 750.000 = 1.100.000$ Third month: $1.100.000 + 750.000 = 2.600.000$ Fourth month: $2.600.000 + 750.000 = 3.350.000$ Fifth month: $3.350.000 + 750.000 = 4.100.000$ Sixth month: $4.100.000 + 750.000 = 4.850.000$ Seventh month: $4.850.000 + 750.000 = 5.600.000$

conclusions was wrong. In line with research conducted by Hariyomurti [4] that students feel that the questions given are easier to do manually and students are also worried about making mistakes when using formulas.

Table 3 (b) shows that the student solved the problem manually as in Table 3 (a). However, the student made many mistakes in solving the problem. After further exploration, the student stated that the answers were written with origin and some of them looked at their friends' answers. The student also admitted that he did not understand the basic concepts of geometrical sequences and series. According to Unaenah, this happens because there are differences in the demands of thinking on teaching materials so that students experience ontogenical obstacles [7]. The learning obstacles experienced by students in question number 3 can be seen in Table 4 below.

TABLE 4: Learning obstacle in question number 3.

No	Answer Question Number 3
3	Be discovered: $a = 56$ $U_3 = 224$ Asked: $U_5?$ Answer: $a = 56$ Determining the ratio (r) $U_3 = 224$ $a.r^2 = 224$ $56.r^2 = 224$ $r^2 = \frac{224}{56}$ $r^2 = 4$ $r^2 = 2^2$ $r^2 = 2$ So, $U_5 = a.r^2(n - 1)$ $U_5 = 56 \cdot 2^2(5 - 1)$ $U_5 = 56 \cdot 2^2(4)$ $U_5 = 56 \cdot 16$ $U_5 = 895$

Table 4 shows that the student didn't write the formula for the nth sequence in the geometrical sequence correctly. The student wrote the power of the ratio into ordinary multiplication and also make mistakes when multiplying the final result in the answer. After conducting interview, the student wrote the formula wrong and felt confused when using the formula. In addition, the student also stated that the teacher delivered the material too quickly so that the student who did not understand the use of the nth sequence formula in geometric sequences had difficulty when working on problems. The learning obstacles experienced by students in question number 4 can be seen in Table 5 below.

Table 5 (a) shows that the student is able to understand the meaning of the questions. However, the answer written by the student is wrong. After conducting interviews with

TABLE 5: Learning obstacle in question number 4.

No	Answer Question Number 4
a	08.00 a.m until 12.00 a.m = past 4 hours $n = \frac{4 \text{ hours}}{2 \text{ hours}} n = 2$ Every 2 hours reduced by 40% First 2 hours $625 \times 40\% = 250$ Second 2 hours $(625 - 250) \times 40\% = 150$ Estimated number of bacteria: $625 - (250 + 150) 625 - 400 = 225$
b	Be discovered: Initial number of bacteria is 625 bacteria Reduction = 40% in 2 hours Start at 08.00 a.m Asked: Determine the approximate number of bacteria after administering the drug at 12.00 a.m? Answer: Determine how many times the bacteria are reduced From 08.00 a.m – 12.00 a.m, 4 hours have elapsed, then: $n = \frac{4 \text{ hours}}{2 \text{ hours}} n = 2$ So bacteria is reduced for two times.

these students, the student felt confused when solving questions because the questions given had never been met before. Table 5 (b) shows that the student hasn't been able to understand the meaning of the questions so that the answers written are wrong. After conducting interview, the student was confused about what to ask in the questions, causing other errors in solving the questions.

The types of learning barriers according to Brosseau are ontogenical obstacle, didactical obstacle, and epistemological obstacle. Ontogenical obstacles are learning barriers that occur because of the limitations of students in self-development or related to students' mental readiness to learn. Didactical obstacles are obstacles that arise from the method or approach used by a teacher. Epistemological obstacles are obstacles that occur because of the limited knowledge that students have in certain contexts. The following is the classification of learning obstacles based on the findings that occur to students for the four questions given according to Brosseau's definition [6].

Table 6 above shows that there are three types of learning obstacles experienced by students. First, ontogenical obstacles occur in 1(a), 1(b), 3, and 4(b). It can be seen that student errors are related to students' mental unpreparedness in learning so that they make mistakes that are key to learning. The student is wrong in writing what is asked in the problem, doesn't write the formula correctly so that the answer written is also wrong, does not understand the concept of the material for geometrical sequences, does not write the formula for the nth sequence in the geometrical sequence correctly, and has not been able to understand the meaning of the question so that the correct answer is given written wrong.

This means that ontogenical obstacle occur when students do not have sufficient understanding of the material given [5]. Second, didactical obstacle occurs in 2(a). It can be seen that the obstacles that arise occur due to errors in the method or approach used by the teacher. The student found it easier to work manually compared to using formulas in solving geometrical sequences and series problems, and the teacher is too

TABLE 6: Learning obstacle classification.

No	Learning Obstacle	Learning Obstacle Classification
1	The student made a mistake in writing what was asked in the question.	Ontogenical obstacle
	The student didn't write the formula correctly so that the answers written are also wrong.	Ontogenical obstacle
2	It is easier for the student to work manually than using formulas.	Didactical obstacle
	The student made mistakes in solving problems because he didn't understand the concept of geometrical sequence material	Ontogenical obstacle
3	The student didn't write the formula for the nth sequence in the geometric sequence correctly.	Ontogenical obstacle
4	The student is able to understand the meaning of the question. However, the answer written by the student is wrong because the question is different from habit.	Epistemological obstacle
	The student hasn't been able to understand the meaning of the question so that the answer written is wrong.	Ontogenical obstacle

fast when explaining material to students. Third, the epistemological obstacle occurs in 4(a). The student is able to understand the meaning of the question. However, the answer written by the student is wrong because the question is different from habit. The obstacles that arise occur because of the limited knowledge that students have in certain contexts, meaning that students cannot solve problems that have never been encountered [8]. Epistemological obstacle occur when the teaching materials provided are not in accordance with the student's characteristics [5].

4. CONCLUSION

Based on the results of the discussion above, it is found that there are learning obstacles experienced by students in the material of geometrical sequences and series, namely ontogenical obstacles, didactical obstacles, and epistemological obstacles. Ontogenical obstacles experienced by students include students incorrectly writing what is asked in the problem, not writing the formula correctly so that the written answer is also wrong, not understanding the concept of geometrical sequence material, not writing the nth sequence formula on the geometrical sequence correctly, and not being able understand the meaning of the question so that the answer written is wrong. Didactical obstacle experienced by students is that students find it easier to do it manually compared to using formulas in solving geometrical sequences and series problems,

and the teacher is too fast when explaining the material to students. Epistemological obstacle experienced by students is that students are able to understand the meaning of the question. However, the answer written by the student is wrong because the question is different from habit. Online learning makes students find it difficult to participate in learning activities so that students experience learning obstacle. The learning obstacle test was conducted online so that the researcher did not see directly how the students responded in working on the problem. Interviews were also conducted online. The suggestion for further research is that the test is carried out directly through video conferences (if learning is still done online) so that researchers can see student responses directly.

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