EduMa: Mathematics Education Learning And Teaching
December 2023, Vol 12 No 2 Page 139 – 152
https://syekhnurjati.ac.id/jurnal/index.php/eduma/eduma/article/view/13289
p-ISSN: 2086-3918, e-ISSN: 2502-5209

EduMa
MATHEMATICS EDUCATION LEARNING AND TEACHING

Praxeological Analysis of Mathematics Textbooks for Class XI High School Students on Arithmetic and Geometric Sequences

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a r t i c l e i n f o

How to cite this article:

Siagian, Q. A., Aswin, & Herman, T. (2023). Praxeological Analysis of Mathematics Textbooks for Class XI High School Students on Arithmetic and Geometric Sequences. *Eduma : Mathematics Education Learning and Teaching,* 12(2), 139 - 152. doi: http://dx.doi.org/10.24235/eduma.v12i2.13289

Article history:

Received: 03 24, 2023

Accepted: 06 25, 2023

Published: 12, 2023

a b s t r a c t

This study aims to analyze one of the mathematics textbooks published by the Ministry of Education and Culture. Then, the researcher will provide recommendations regarding the presentation of easy-to-understand material based on analysis of techniques, technology, and theory on each problem given by students' mathematics textbooks. This type of research is qualitative with a didactic anthropological theory approach, especially in praxeology. Data collection techniques in the library by reading, recording and processing these sources as research material. Researchers choose books based on the criteria needed to obtain relevant data. These criteria include (1) there is a problem in presenting mathematical material, (2) there is an author's name, and (3) publications from the Ministry of Education and Culture. The researcher found problems in the 2017 revised edition of class XI students' mathematics textbooks finding formulas and examples of arithmetic and geometric sequences. The study results showed several problems presenting the material for arithmetic and geometric sequences, which would raise student learning barriers. The identified Learning barriers are ontogenic, epistemological, and didactical obstacles. With these obstacles, the researcher provides alternative designs which are expected to minimize the occurrence of student learning barriers. So that the design alternatives provided can reduce obstacles for students in thinking and understanding the material of arithmetic and geometric sequences.

K e y w o r d s :
Textbooks; Learning Barriers; Praxeology

INTRODUCTION

The beginning of the emergence of didactic anthropological theory was found in the theory of didactic transposition, now a sub-theory of ATD discovered by Yves Chevallard. According to Chevallard, the Anthropological Theory of Didactic (ATD) focuses on human activities using an epistemological model of mathematical knowledge (Putra, 2017). In the study of didactic mathematics, several methods and frameworks have been developed through learning, one of which is praxeology.

Praxeology is an essential component of ATD. Praxio consists of two components: praxis (practical block) and logos (theoretical block) (Bosch & Gascón, 2006). Concretely, the praxeological organization consists of four components: the type of questions, techniques, technology, and theory. In line with Wijayanti & Winslow (2017), in general learning practices, we will never forget the types of questions or problems (types of questions can be explicitly interpreted or generally). To do this, we need techniques and technology to underpin those techniques and theories to justify them. In addition, praxeology is used to analyze the teacher's learning process and the textbooks used.

The analysis of these books aims to obtain an overview of the material given to students as one of the studies on didactic obstacles. Pedagogical incompetence and the teacher's lack of knowledge about the material can be the leading causes of students' difficulties in understanding the concept (Ekawati et al., 2015). In addition, when textbooks do not facilitate proper flow and instruction, teachers and students are fixated on books, and the learning carried out can trigger learning barriers.

In addition to the role of the teacher in the classroom, textbooks also play an essential role in helping students understand teaching material. So, paying attention to how it is presented in terms of language, context, and material suitability is imperative. If these three things are not paid attention to, the textbook will cause difficulties for students in understanding the material, which will cause learning obstacles. Learning obstacles also play an essential role because they force students to modify and adapt several aspects of their thinking to solve a given problem (Bishop et al., 2014).

Barriers to student learning can occur at any time during the teaching and learning process, so learning preparations that are adapted to students' characteristics are needed to minimize these obstacles' occurrence (Cesaria & Herman, 2019). One of the steps to overcome student learning difficulties is planning, implementing, and evaluating the learning process, including preparing teaching materials that allow students to construct concepts and understand (Adolphus, 2011). Appropriate learning designs oriented toward student learning barriers by paying attention to students' mindsets are expected to overcome learning barriers to achieve the goals of learning mathematics (Sumiaty & Dedy, 2019). One aspect of the learning design of teaching materials the government provides is the textbook and student handbook.

The ability of high school students to understand the concept of arithmetic and geometric sequences found in the research by Pirmanto et al. (2020) is still relatively low. Likewise, in Karim & Novtiar (2021) X SMK students, in solving problems of arithmetic and geometric sequences, experience obstacles in the learning process. Packages and student handbooks can be one of the reasons students are less able to understand the concept of arithmetic and geometric sequences material fully. Students who cannot understand concepts will find it difficult to answer various questions related to material for arithmetic and geometric sequences (Hartati, 2021). The teacher can become another facilitator in explaining the material concepts of arithmetic sequences and series. However, suppose the textbook is unable to explain the concept maturely. In that case, it will be difficult for the teacher to raise problems as a starter regarding the concept of arithmetic sequences and series.

Another study uses a praxeological model to analyze mathematics students' textbooks on set material (Rizqi et al., 2021). In addition, it was also found that research by Rahayu et al. (2022) in elementary school mathematics textbooks for fraction material required several improvements to the presentation of the material recommended for presenting prerequisite ability tests, forms of fractions and concrete formation to describe the forms of fractions. However, no research has been found that analyzes student textbooks on arithmetic and geometric sequences.

There are many kinds of textbooks used by various schools, such as those published by the private sector and the government. After reviewing several mathematics student textbooks, it turned out that there was not a little teaching material in the textbooks that triggered learning barriers for students. Too many textbooks in circulation trigger teachers and schools to choose books to be used selectively. Books published by the government are books that various schools in Indonesia widely use. This study aimed to analyze one of the mathematics textbooks published by the Ministry of Education and Culture. Then the researcher will provide recommendations regarding the presentation of material for arithmetic and geometric sequences that are easy to understand based on technical, technological and theoretical analysis of each problem provided by students' mathematics textbooks. Therefore, it is hoped that these recommendations can minimize the existence of learning obstacles that occur in students.

LITERATURE REVIEW/ THEORETICAL FRAMEWORKS

Didactic Anthropological Theory can be the basis for analyzing students' mathematical knowledge through an epistemological model known as praxeology (Wijayanti & Winslow, 2017). Praxeology is the practical study of human behaviour, not an abstract understanding of human behaviour but its practical application (Sch & Schultheis, 2020; Stone, 2022). A type of task (T) is a specific task/problem to be solved by students, which can be conveyed through textbooks or other means. In solving these problems, a technique (τ) is needed, corresponding to one with T. Entering the knowledge block, technology (θ) is an argument or explanation of the technique students use in solving problems. Furthermore, there is theory (Θ) as a generally accepted concept in mathematics to justify the various technologies used. In carrying out an analytical activity, the praxeological model provides a reference to the epistemological model as a simple form of activity regarding the description of each praxeological component. Learning obstacles are students' difficulties when using their knowledge in learning. Learning obstacles are divided into three parts, namely:

a. Ontogenic obstacle

Ontogenic obstacle, which is one of the learning obstacles for students that occurs due to a process of jumping in students' thinking, causing a discrepancy between learning or, in other words, the didactic design that is carried out is not following the level of student thinking (Fitriani et al., 2020). This is in line with what has been expressed by (Rismawati et al., 2018), which state that "If the level received by students is too low, students will not experience the natural learning process, conversely if the level received by students is too high, students will experience difficulties. I do not even like math because it is hard."

b. Obstacle epistemology

The epistemology of the obstacle is a learning barrier due to students' limited knowledge or context. When students only receive conceptual understanding from one direction, namely from the teacher, they will have difficulty understanding that context (Rismawati et al., 2018). This is similarly explained in (Hercovics, 1989), which states that a student is said to experience epistemological barriers if he cannot use his knowledge to solve a problem in a new context. Other epistemological learning barriers are learning barriers related to difficulties in applying concepts, visualizing objects, determining the use of principles, and barriers related to mathematical proof (Noto et al., 2019).

c. Didactical obstacles

The didactical obstacle is one of the learning barriers caused by the teaching and teaching materials used by the teacher during learning. In line with the study's results (Fitriani et al., 2020) stated that the teacher in teaching only explained the material in the textbook and then gave examples of questions and gave exercises, which resulted in limited students' ability to deal with new problems.

METHODS

This type of research is qualitative research with a didactic anthropological theory approach, especially in praxeology (Chevallard, 2006). Praxeology consists of two components, namely, the knowledge block and the functional block. The practical or knowledge block consists of 2 parts: the types of tasks and techniques, where the types of assignments in question are the types of particular problems given to students. Based on this specific task, students need techniques to complete the tasks given. Meanwhile, the logo or knowledge block comes from Greek, which refers to human thoughts and reasoning about the cosmos. The knowledge block also consists of technology and theory. Technology justifies the techniques students use to solve a problem, and theory relates to the arithmetic or concepts used.

The researcher analyzed the praxeology of arithmetic and geometric sequences from students' mathematics textbooks. The components that the researchers analyzed were problems, techniques, technology, and theory. Chevallard (2006) argues that when humans are faced with problems, doubts arise so that a technology (θ) is needed to explain and justify techniques and a theory (Θ) to explain and unify several technologies; both belong to the theoretical block. So, praxeology consists of 4-tuples (T, τ, θ, Θ) where all the components are closely related, and this is a valuable tool for analyzing the method or way of presentation that books used to convey the information they want to convey regarding the material of arithmetic and geometric sequences.

The subjects of this study were students' mathematics textbooks in finding formulas and examples of arithmetic and geometric sequences. The book analyzed was the student textbook "Mathematics" for class XI SMA/MA/SMK/MAK, the 2017 revision edition by the Ministry of Education and Culture. Researchers choose books based on the criteria needed to obtain relevant data. These criteria include (1) there is a problem in presenting mathematical material, (2) there is an author's name and (3) publications from the Ministry of Education and Culture. Researchers collected data by collecting data in the library by reading, recording, and processing these sources as research material (Melfianora, 2019).

RESULT AND DISCUSSION

Textbooks published by the Ministry of Education and Culture have previously been analyzed by Rizqi et al. (2021), who gave research results that the textbooks studied only presented several forms of technology without further explanation. Textbooks published by the Ministry of Education and Culture do not contain the first set of theories on the conditional ability test. The five technologies suggested by the researchers are not all contained in mathematics textbooks. Based on a praxeological analysis of the 2017 revised edition of the XI class mathematics textbook on arithmetic and geometric sequences, problems, techniques, technologies, and theories are presented in Table 1 below.

Table 1
Praxeology Task Design

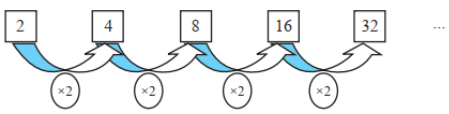
Task Design I			
Problems	Technique	Technology	Theory
Finding the Formula for the nth Term of an Arithmetic Sequence **Definisi 5.1** Barisan aritmetika adalah barisan bilangan yang beda setiap dua suku yang berurutan adalah sama. Beda, dinotasikan "b" memenuhi pola berikut. $b = u_2 - u_1 = u_3 - u_2 = u_4 - u_3 = \ldots = u_n - u_{n-1}$ n: bilangan asli sebagai nomor suku, u_n adalah suku ke-n. Berdasarkan definisi di atas diperoleh bentuk umum barisan aritmetika sebagai berikut. $u_1, u_2, u_3, u_4, u_5, \ldots, u_n$ Setiap dua suku yang berurutan pada barisan aritmetika memiliki beda yang sama, maka diperoleh $u_1 = a$ $u_2 = u_1 + 1.\, b$ $u_3 = u_2 + b = u_1 + 2.b$ $u_4 = u_3 + b = u_1 + 3.b$ $u_5 = u_4 + b = u_1 + 4.b$ … $u_n = u_1 + (n-1)b$	• Giving a symbol to each tribe and each tribe is different. • Substituting the value of n.	Seeing the pattern of every two successive tribes.	$u_n = u_1 + (n-1)b$

<table>
<tr><td colspan="4" align="center">Task Design II</td></tr>
<tr>
<td>Masalah 5.4

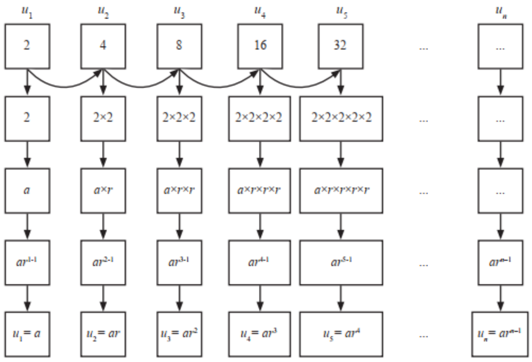
Lani, seorang perajin batik di Gunung Kidul. Ia dapat menyelesaikan 6 helai kain batik berukuran 2,4 m × 1,5 m selama 1 bulan. Permintaan kain batik terus bertambah sehingga Lani harus menyediakan 9 helai kain batik pada bulan kedua, dan 12 helai pada bulan ketiga. Dia menduga, jumlah kain batik untuk bulan berikutnya akan 3 lebih banyak dari bulan sebelumnya. Dengan pola kerja tersebut, pada bulan berapakah Lani menyelesaikan 63 helai kain batik?

Alternatif Penyelesaian
Dari masalah di atas, dapat dituliskan jumlah kain batik sejak bulan pertama seperti di bawah ini.
Bulan I : $u_1 = a = 6$
Bulan II : $u_2 = 6 + 1.3 = 9$
Bulan III : $u_3 = 6 + 2.3 = 12$
Bulan IV : $u_4 = 6 + 3.3 = 15$
Demikian seterusnya bertambah 3 helai kain batik untuk bulan-bulan berikutnya sehingga bulan ke-n : $u_n = 6 + (n - 1).3$ (n merupakan bilangan asli).
Sesuai dengan pola di atas, 63 helai kain batik selesai dikerjakan pada bulan ke-n.
Untuk menentukan n, dapat diperoleh dari,
$63 = 6 + (n-1).3$
$63 = 3 + 3n$
$n = 20$.
Jadi, pada bulan ke-20, Lani mampu menyelesaikan 63 helai kain batik.</td>
<td>• Gives a symbol to each tribe.
• Finding the u_n formula from looking at the pattern in each term where u_1 is always added to the different multiple (b).
• Substituting the u_n value into the formula we get.</td>
<td>Look for the value of n by using the formula obtained.</td>
<td>The general solution of the nth formula of the problem.
$u_n = 6 + (n-1)3$
$u_n = 3 + 3n$</td>
</tr>
<tr><td colspan="4" align="center">Task Design III</td></tr>
<tr>
<td>Finding the Formula for the n^{th} Term of a Geometry Sequence

5.3 Menemukan Konsep Barisan Geometri

Contoh 5.6
Perhatikan barisan bilangan 2, 4, 8, 16, …


Nilai perbandingan $\frac{u_2}{u_1} = \frac{u_3}{u_2} = \ldots = \frac{u_n}{u_{n-1}} = 2$. Jika nilai perbandingan dua suku berurutan dimisalkan r dan nilai suku pertama adalah a, maka susunan bilangan tersebut dapat dinyatakan dengan 2, 2 × 2, 2 × 2 × 2, …</td>
<td>• Go through an example to find the formula for the n^{th} term of a geometric sequence.
• Using the comparison of each term and exemplifying it with the symbol r.</td>
<td>Look at the pattern from the examples given to determine the formula for the n^{th} term of a geometric sequence.</td>
<td>The formula for the n^{th} term of a geometric sequence:
$u_n = ar^{n-1}$</td>
</tr>
</table>

Perhatikan gambar berikut ini!  dari pola di atas dapat disimpulkan bahwa $u_n = ar^{n-1}$			

The results of the analysis of learning obstacle characteristics according to Brousseau (2002) on the material of arithmetic and geometric sequences:

1. Task Design I

In task design I, a problem was found; theoretically, the expected formulation of the nth term of the arithmetic sequence followed the conclusion. $u_n = u_1 + (n-1)b$. However, finding the formula (technique) does not properly use previously presented information. The definition explains the difference between two adjacent or different tribes (b). However, the different information is only used implicitly in discovering the formula. This will cause obstacles for students in finding patterns in each tribe. This obstacle is classified as an epistemological obstacle.

In the technique, students must know the difference between each tribe by looking at the pattern. This will create obstacles for students to understand, which is classified as an ontogenic obstacle. In addition, this book uses an approach that assumes that students already understand how to find formulations in each tribe that involve differences (b). Thus, causing obstacles to students in understanding the textbook. Obstacles that will occur are classified as didactical obstacles. The same thing was found in the research by Rahayu et al. (2022) on the presentation of the textbooks analyzed; it still does not make it easier for students to sort fractions. So there is a need for recommendations for improving the presentation of material in the sorting fractions section.

2. Design Task II

In task design II, a problem was found, namely, theoretically, the expected formulation of the n^{th} term of the arithmetic sequence following the conclusion, namely $u_n = 3 + 3n$. However, finding a formula (technique) will raise questions related to the pattern of each tribe, which will certainly result in obstacles for students. Obstacles are caused by methods or approaches presented in textbooks, called didactical obstacles.

The justification characteristics of the techniques used do not reflect the consideration that students have various knowledge, learning experiences, ways of thinking, and other academic potential. Students' ability to understand problem-solving in problem 5.4 is different, considering that students' basic abilities in arithmetic sequence material differ. Even though the problems can produce several methods of solving (open-ended), such as the conventional method and the Gauss method, this problem is an epistemological obstacle due to limiting students' context.

3. Design Task III

In this design task III, a problem was found, namely, theoretically, the expected formulation of the n^{th} term of the geometric sequence following the conclusion, namely $u_n = ar^{n-1}$. However, it will trigger the emergence of weaknesses that might be found when finding the formula. Students find this formula from an example; this does not train students in abstract thinking even though at the high school level, according to Piaget, students must be trained to think towards the abstract. The lack of training in abstract thinking processes given to students will lead to ontogenic obstacles, namely the limitations of students in developing their abilities.

In this problem, students will experience difficulties in generalizing techniques from statements a to ar^{1-1} because not all students have the essential ability to understand the generalization techniques used in textbooks. Students' lack of knowledge in understanding the formula raises an epistemological obstacle. In addition, the generalization methods or techniques used in textbooks have not been adequately applied to the statement process a to ar^{1-1}. The use of the generalization method will trigger obstacles in understanding the process of finding the statement a to ar^{1-1}, this obstacle is classified as a didactical obstacle.

Learning barriers that occur in students must be considered so that students can understand the material well. Based on the problems above, the researcher provides an alternative task design presented in Table 2 below.

Table 2
Alternative Praxeology Design Task

<table>
<tr>
<td rowspan="2">Alternatif Task Design I</td>
<td>Problems</td>
<td>Finding the Formula for the n^{th} Term of an Arithmetic Sequence

Definisi 5.1
Barisan aritmetika adalah barisan bilangan yang beda setiap dua suku yang berurutan adalah sama.
Beda, dinotasikan "b" memenuhi pola berikut.
$b = u_2 - u_1 = u_3 - u_2 = u_4 - u_3 = \ldots = u_n - u_{n-1}$
n: bilangan asli sebagai nomor suku, u_n adalah suku ke-n.

Berdasarkan definisi di atas diperoleh bentuk umum barisan aritmetika sebagai berikut.
$\boldsymbol{u_1, u_2, u_3, u_4, u_5, \ldots, u_n}$
Setiap dua suku yang berurutan pada barisan aritmetika memiliki beda yang sama, maka diperoleh
$u_1 = a$
$u_2 = u_1 + 1.\ b$
$u_3 = u_2 + b = u_1 + 2.b$
$u_4 = u_3 + b = u_1 + 3.b$
$u_5 = u_4 + b = u_1 + 4.b$
...
$\boldsymbol{u_n = u_1 + (n-1)b}$</td>
</tr>
<tr>
<td>Technique</td>
<td>• Providing a symbol for each tribe and different for the two successive tribes.
• Add equations (Gauss method) to get the formula for the n^{th} term.</td>
</tr>
</table>

	Technology	Students correctly use the information from definition 5.1 and use their learning experiences when adding equations. So that students easily remember the discovery of the formula for the nth term of an arithmetic sequence.
	Theory	Using the Gauss method, the following: $u_n = u_1 + (n-1)b$ $u_n = a + (n-1)b$
Alternatif *Task Design* II	Problems	**Masalah 5.4** Lani, seorang perajin batik di Gunung Kidul. Ia dapat menyelesaikan 6 helai kain batik berukuran 2,4 m × 1,5 m selama 1 bulan. Permintaan kain batik terus bertambah sehingga Lani harus menyediakan 9 helai kain batik pada bulan kedua, dan 12 helai pada bulan ketiga. Dia menduga, jumlah kain batik untuk bulan berikutnya akan 3 lebih banyak dari bulan sebelumnya. Dengan pola kerja tersebut, pada bulan berapakah Lani menyelesaikan 63 helai kain batik?
	Technique	• Gives a symbol to each tribe. • Count in various ways according to student abilities, such as: 1) Conventional way Students use their basic abilities, namely adding up each tribe with the difference. Known from the question: - First month = 6 - The next month 3 more than the previous month. So, we can form an arithmetic sequence. 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54, 57, 60, 63, … So when Lani finished 63 pieces of batik cloth during the 20th month. 2) Gauss Way Students find the formula for the nth term by first subtracting each of the two consecutive terms. Then, add them up using the Gauss method. So that the formula for the nth term is obtained. After obtaining the formula for the nth term, students then substitute theu_n. Known from the question: - First month: $u_1 = a = 6$ - Second month: $u_2 = 9$ - Third month: $u_3 = 12$ So, the nth month = $u_n = 63$

		The following month 3 more than the previous month. So that $u_2 - u_1 \quad = 3$ $u_3 - u_2 \quad = 3$ $u_4 - u_3 \quad = 3$ $\vdots \quad \vdots \quad \vdots$ $\underline{u_n - u_{n-1} = 3 \qquad\qquad +}$ $u_n - u_1 \quad = (n-1)3$ $u_n = u_1 + (n-1)3$ $u_n = 6 + (n-1)3$ $u_n = 3 + 3n$ Then value substitution $u_n = 63$ $63 = 3 + 3n$ $3n = 60$ $n = 20$ So, when Lani finished 63 pieces of batik cloth during the 20th month.
	Technology	Students have various learning experiences and abilities, so it is possible to provide different answers, such as using conventional and Gauss methods.
	Theory	The general solution of the nth formula of the problem. $u_n = 6 + (n-1)3$ $u_n = 3 + 3n$
Alternatif *Task Design* III	Problems	Finding the Formula for the nth Term of a Geometry Sequence Using the concept that the ratio (r) of two successive terms is the same can be written as follows. Experiment I $\frac{u_2}{u_1} = r$ $\frac{u_3}{u_2} = r \qquad\qquad \text{x}$ $\frac{u_2}{u_1} . \frac{u_3}{u_2} = r . r$

		$\frac{u_3}{u_1} = r^2$ $u_3 = u_1.r^2$ $u_3 = a.r^2$ Experiment II $\frac{u_2}{u_1} = r$ $\frac{u_3}{u_2} = r$ $\frac{u_4}{u_3} = r$ x ――――――――――― $\frac{u_2}{u_1}.\frac{u_3}{u_2}.\frac{u_4}{u_3} = r.r.r$ $\frac{u_4}{u_1} = r^3$ $u_4 = u_1.r^3$ $u_4 = a.r^3$ Experiment III $\frac{u_2}{u_1} = r$ $\frac{u_3}{u_2} = r$ $\frac{u_4}{u_3} = r$ $\vdots \quad \vdots$ $\frac{u_n}{u_{n-1}} = r$ x ――――――――――― $\frac{u_2}{u_1}.\frac{u_3}{u_2}.\frac{u_4}{u_3}.\ldots.\frac{u_n}{u_{n-1}} = r.r.r.\ldots.r$ $\frac{u_n}{u_1} = r^{n-1}$ $u_n = u_1.r^{n-1}$ $u_n = a.r^{n-1}$
	Technique	• Give a symbol to each term and the ratio of every two successive tribes.

	• Multiply equations (Gauss method) to get the formula for the n^{th} term.
	Technology	Students use the concept of the ratio (r) of two successive terms to become information that will be used in multiplying equations. So that students easily remember the discovery of the formula for the n^{th} term of a geometric sequence.
	Theory	The formula for the n^{th} term of a geometric sequence: $$u_n = u_{1.}r^{n-1}$$ $$u_n = ar^{n-1}$$

Based on the description in Table 2, the explanation regarding each alternative task design is as follows:

1. Task Design I

The researcher describes an alternative task design I based on definition 5.1, which is only known, namely the difference (b) of each term which will not cause obstacles for students in finding the formula for the n^{th} term of an arithmetic sequence, namely $u_n = a + (n-1)b$. Presenting several experiments is to see the number of differences (b) when adding up the equations. Making it easier for students to understand textbooks without the help of a teacher or tutor.

In addition, using the Gauss technique provides meaning in finding the formula for the n^{th} term of an arithmetic sequence. Thus, students are not only guided by textbooks or memorizing formulas. Following Djaali's statement, students only memorize formulas to solve math problems (Sardiyanto et al., 2017).

2. Design Task II

In the alternative task design II, the researcher is based on students' various learning experiences and abilities, so it is possible to provide different answers, such as using conventional and Gauss methods. The researcher provides alternative solutions using the Gauss method based on student's previous learning experiences in finding the n^{th} term of arithmetic sequences and salt abilities. Using the Gauss method can improve students' mathematical thinking processes. Apart from the Gauss method, conventional methods can also be used to find answers to problem 5.4 because the problems given are not too complex. This researcher suggests the use of conventional methods used to verify answers.

3. Design Task III

In the alternative task design III, the researcher based on the student's initial knowledge regarding the ratio (r) of two successive terms, which then became information that would be used in multiplying equations using the Gauss method because students had already used the Gauss method in arithmetic sequences. So that students find it easier to find the formula for the n^{th} term of a geometric sequence using the Gauss method. The researcher's purpose is to use the Gauss method of experiments in finding the formula, namely, to build students' thinking patterns when the available tribe reaches the n^{th} term. With this, you will find the formula for the n^{th} term of a geometric sequence.

CONCLUSION

Based on the analysis results, it was found that there were several problems in presenting the material for arithmetic and geometric sequences, which would raise student learning obstacles. Identified learning barriers are ontogenic obstacles, epistemological obstacles, and didactical obstacles. In task designs I and III, the causes of ontogenic, epistemological, and didactical obstacles were identified, while in task design III, the causes of epistemological and didactical obstacles were identified. With these obstacles, the researcher provides an alternative design that is expected to minimize the occurrence of student learning barriers. With these obstacles, the researcher provides an alternative design that is expected to minimize the occurrence of student learning barriers, both in task design I, II, and III material for arithmetic and geometry sequences in student textbooks with the title "Mathematics" for SMA/MA/SMK/MAK class XI 2017 revised edition by the Ministry of Education and Culture.

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