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ANALYSIS OF THE STUDENTS' MATHEMATICAL CONCEPTUAL UNDERSTANDING ABILITY ON SEQUENCES AND SERIES MATERIAL IN SENIOR HIGH SCHOOL

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ABSTRACT
Mathematical concept understanding is one of the important competencies in learning mathematics, especially in the material of sequences and series. Based on observations, grade X high school students have difficulty in distinguishing arithmetic and geometric sequences and applying formulas correctly. This study aims to evaluate the ability of grade X students in understanding mathematical concepts of sequences and series material. This study uses a descriptive qualitative research type. Data were collected through a test instrument consisting of 5 essay questions and a non-test instrument consisting of interviews. Students of X.11 SMAN 1 Telagasari consisting of 34 students were selected for the study. Then, reducing the students to 3 people, each representing a category of conceptual understanding ability: 1 student with high ability, 1 student with moderate ability, and 1 student with low ability. Data analysis involves three steps: reducing data, displaying data, and drawing conclusions. The results of the study showed that students with high understanding were able to meet all indicators of conceptual understanding, while students with moderate understanding only mastered several indicators, and students with low understanding had difficulty in understanding the concept almost completely. These findings indicate the need to implement more interactive and exploration-based learning strategies to help students understand concepts in depth so that students' conceptual understanding can improve.
Keywords : conceptual understanding.; mathematics; sequences and series

ABSTRAK
Pemahaman konsep matematis merupakan salah satu kompetensi penting dalam pembelajaran matematika, khususnya pada materi barisan dan deret. Berdasarkan observasi siswa kelas X SMA mengalami kesulitan dalam membedakan barisan aritmetika dan geometri serta menerapkan rumus dengan benar. Penelitian ini bertujuan untuk mengevaluasi kemampuan siswa kelas X dalam memahami konsep matematis materi barisan dan deret. Penelitian ini menggunakan jenis penelitian kualitatif deskriptif. Data dikumpulkan melalui instrumen tes yang terdiri dari 5 soal uraian dan instrumen non-tes yang terdiri dari wawancara. Siswa X.11 SMAN 1 Telagasari yang terdiri dari 34 siswa dipilih untuk penelitian. Kemudian, mereduksi siswa tersebut menjadi 3 orang yang masing-masing mewakili kategori kemampuan pemahaman konsep: 1 siswa dengan kemampuan tinggi, 1 siswa dengan kemampuan sedang, dan 1 siswa dengan kemampuan rendah. Analisis data melibatkan tiga langkah: mengurangi data, menampilkan data, dan menarik kesimpulan. Hasil penelitian menunjukkan bahwa siswa dengan pemahaman tinggi mampu memenuhi semua indikator pemahaman konsep, sementara siswa dengan pemahaman sedang hanya menguasai beberapa indikator, dan siswa dengan pemahaman rendah mengalami kesulitan dalam memahami konsep hampir secara menyeluruh. Temuan ini menunjukan perlunya penerapan strategi pembelajaran yang lebih interaktif dan berbasis eksplorasi untuk membantu siswa memahami konsep secara mendalam sehingga pemahaman konsep siswa dapat meningkat.
Kata kunci*: barisan dan deret; matematika; pemahaman konsep.*

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Introduction

One of the basic skills that is important for students to have is the ability to understand mathematical concepts, by understanding mathematical concepts, students are able to construct the meaning and purpose of the learning objectives (Nurfajriyanti & Pradipta, 2021) . The ability to understand mathematical concepts is very important and is the key for students to be able to learn mathematics well (Rukoyah in Hasanudin & Maryati, 2023) . In line with Sari et al (2022) which states that understanding concepts is very important because when students understand the concepts of prerequisite material, they will find it easier to understand the concepts of subsequent material.

The National Council of Teachers of Mathematics (NCTM) states that the ability to understand concepts is the basic goal of learning mathematics because when students understand mathematical concepts, they will easily solve problems in learning mathematics (Radiusman, 2020) . In line with objective education mathematics the so understanding draft (Hasanudin & Maryati, 2023) . Mathematics is part important on lesson mathematics . Conceptual understanding is the ability of students to understand concepts and apply them in different situations and conceptual understanding allows students to develop their concepts when solving mathematical problems (Yulianah et al., 2020) . Conceptual understanding is a level of ability that expects students to be able to understand concepts, situations, and known facts and be able to explain them with sentences that are composed by themselves according to the knowledge they have, without changing the meaning or significance. (Aisyah & Firmansyah, 2021) .

Understanding a concept is a basic component of the implementation of the mathematics learning process. If students are able to interpret many concepts, they will be better at solving problems, because when solving a problem, provisions are needed based on the concepts they already have (Alzanatul Umam & Zulkarnaen, 2022) . Understanding concepts is a very important aspect in learning, because by understanding concepts, students can develop their abilities in each subject matter. (Suendarti & Liberna, 2021) . Understanding draft is mastery a number of material learning , where student No just know And knowing , but capable disclose return draft in more form easy understood as well as capable apply it (Anathiya et al., 2021)

A concept is something that is depicted in the mind, a thought, an idea, or an understanding (Mareta & Zulkarnaen, 2024) . Draft is an abstract idea that allows somebody For can grouping object or incident And to explain whether object or incident That is example or No example from the idea (Fajar et al., 2019) . The ability to understand mathematical concepts is the ability to absorb and interpret mathematical concepts, relate them to other concepts, restate them in mathematical form, and create problem-solving algorithms appropriately, accurately, and efficiently using one's own language (Sengkey et al., 2023) . How ever, many students still do not understand the concept well, as can be seen from the results of the questions and how to work on the questions (Khairunnisa et al., 2022) . Based on the results of the study Giawa et al (2022) stated that the ability

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to master the concepts of class XI students of SMAN 1 Ulususua is still relatively low in the material on exponents and roots, students are unable to find the flow of solving problems and are unable to understand and use concepts appropriately. The results of other studies according to Rahmawati & Roesdiana (2022) There are still class XII MIPA students who do not master the mathematical concepts in the material on derivatives of algebraic functions.

Students are said to have good conceptual understanding skills if they are able to achieve conceptual understanding indicators (Fitri et al., 2023). According to Darmawanti (2020) indicator understanding draft mathematical namely restating concepts that have been learned, classifying objects based on mathematical concepts, applying concepts algorithmically, presenting concepts in various representations, and linking various mathematical concepts internally or externally. One of the materials that requires a good understanding of concepts is sequences and series (Wau et al., 2022). This material studies the number patterns and relationships between terms in a sequence, both arithmetic and geometric. Understanding the concepts in Sequences and Series is important because these concepts are often used in various other branches of mathematics, such as calculus and algebra, and have applications in everyday life, such as in financial calculations and population growth. One of the things that is widely used in everyday life is arithmetic sequences and series (Ulfa & Kartini, 2021) . The substance of geometric sequences and series, arithmetic sequences and series, and applications of sequences such as growth, decay, and compound interest, are found in this material (Pirmanto et al., 2020) .

Based on initial observations, many grade X high school students have difficulty in understanding the material on Sequences and Series. Some students cannot distinguish between arithmetic and geometric sequences, have difficulty determining the formula for the nth term, and do not understand the concept of the sum of a series. These difficulties indicate that students' understanding of mathematical concepts in this material still needs further research. Besides that, research conducted by Khairullah & Heriyana (2023) on class XI students of SMK Karya Nasional Kuningan found that many students still had difficulty solving questions on the topic of sequences and series because students were not yet able to interpret questions or use a term so that students could not choose the formula according to what the question instructed.

Several previous studies have examined students' mathematical conceptual understanding in various materials, such as algebra and geometry. However, studies that specifically discuss students' mathematical conceptual understanding in sequence and series materials are still limited. In addition, many studies still focus on the final learning outcomes without delving deeper into the factors that influence students' understanding, such as the learning strategies used or their level of learning independence. The novelty of this study lies in the in-depth analysis of students' conceptual understanding abilities in sequence and series materials and the factors that influence them, so that it can be the basis for developing more effective learning strategies at the high school level.

Based on these problems, research is needed to analyze students' mathematical concept understanding abilities in sequence and series material. This study aims to determine the extent of students' conceptual understanding,

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identify the difficulties they face, and find factors that influence their understanding. The results of this study are expected to provide an overview of the level of students' conceptual understanding and become the basis for developing more effective learning strategies. Thus, students can more easily understand the material of sequences and series and be able to apply it in various situations.

Research methods

This research was conducted at SMA Negeri 1 Telagasari. Descriptive qualitative method was used in this research. Qualitative method was used to obtain data that in-depth, data that contains meaning. Using purposive sampling technique, 34 students from class X.11 were selected and reduced to 3 students representing each category of conceptual understanding ability: 1 student with high ability, 1 student with medium ability, and 1 student with low ability. This study used test and non-test instruments to collect data. The test instrument used was 5 descriptive questions on the material of Sequences and Series. The non-test instrument consisted of interviews to obtain additional information about students' answers to the questions. Instruments research used in study This adapted from thesis Pauji (2020) which has tested validity And its reliability . The maximum score is included in the high, medium, and low ability categories based on Arikunto in Purwaningsih & Marlina (2022) which presents on Table 1 :

Table 1. Categorization of mathematical ability

No	Category	Value Range
1	Tall	$x \geq Mean + SD$
2	Currently	$Mean - SD < x < Mean + SD$
3	Low	$x \leq Mean - SD$

Miles Huberman explains that data analysis techniques consist of three components: reducing data, displaying data, and drawing conclusions. This study was analyzed with five indicators according to sustainable namely restating concepts that have been learned, classifying objects based on mathematical concepts, applying concepts algorithmically, presenting concepts in various representations, and linking various mathematical concepts internally or externally.

Results and Discussion

The research data was obtained through descriptive questions on the material of arithmetic sequences and series, totaling 5 questions from 34 students who had taken the descriptive test. The standard deviation and average of the total score were obtained. on Table 2 as follows:

Table 2. Mean and standard deviation

N	Mean	SD
34	57.5	21.86

Table 2 shows the average obtained by all students is 57.5 and the standard deviation obtained is 21.86. Then, grouping students' abilities into 3 categories presented on Table 3 as following :

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Table 3. Categories of mathematical concept understanding ability

N	TKM	Value Range	Student
6	Tall	$x \geq 79.36$	S11, S18, S24, S25, S26, S32
21	Currently	$35{,}64 < x < 81{,}07$	S1, S3, S4, S5, S6, S8, S9, S10, S12, S13, S14, S15, S16, S19, S20, S27, S28, S29, S30, S31
7	Low	$x \leq 35{,}64$	S2, S7, S17, S21, S22, S23, S33

Information:
TKM : Student Ability Level
N : Number of Students
SD : Standard Deviation
Mean : Average

Table 3 shows the results of the category of high-ability students, namely 6 people, medium-ability students, namely 21 people and low-ability students, namely 7 people. Then 3 research subjects were taken representing each category of students X.11, namely S26 (high-ability), S13 (medium-ability) and S22 (low-ability) for analysis which are presented on Figure 1 as follows:

S26 (high capability)

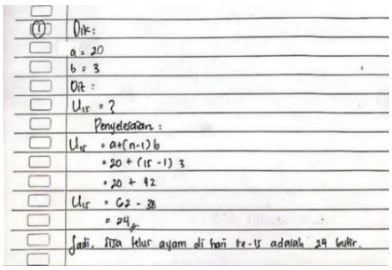

Figure 1. S26's answer to question 1

In Figure 1, there are S26's answer results with an indicator of restating a concept that has been studied, based on the answer results, S26 wrote down what was known correctly. In addition, S26 has also used the correct formula in finding the number of eggs on the 15th day. S26 has been able to solve the given problem by writing down the correct final answer, which is 24 eggs. So, it can be concluded that S26 has been able to restate a concept that has been studied. This was confirmed through interviews conducted by researchers with S26. Based on results interview obtained that the S26 is capable answer all question in accordance with written answer. For analysis which are presented on Figure 2 as follows:

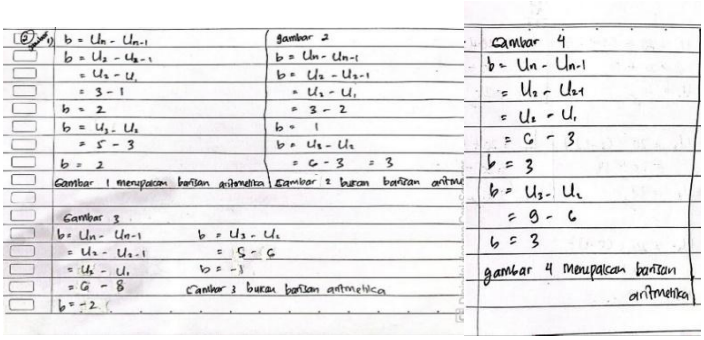

Figure 2. S26's answer to question 2

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In Figure 2, there are the results of S26's answers with the indicator of grouping objects based on mathematical concepts, based on the results of S26's answers, he was able to determine the images that are included in the arithmetic sequence. S26 was able to determine that images 1 and 4 are arithmetic sequences and images 2 and 3 are not included in the arithmetic sequence. So, it can be concluded that S26 has been able to classify objects based on mathematical concepts. This was confirmed through interviews conducted by the researcher with S26. Based on results interview obtained that the S26 is capable answer Figure 1 and Figure 4 included in line arithmetic .

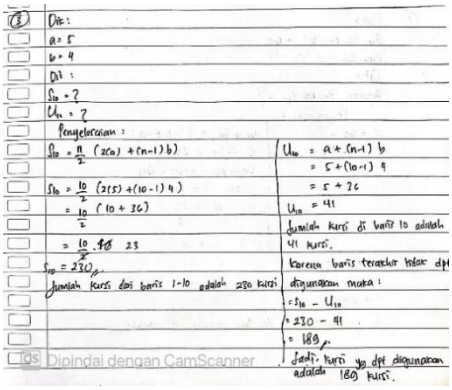

Figure 3. S26's answer to question 3

In Figure 3, there are the results of S26's answers with the indicator of applying concepts algorithmically, based on the results of S26's answers, he was able to understand what was asked in the question, namely by finding the total number of seats minus the seats in the 10th row. So, it can be concluded that S26 is able to apply concepts algorithmically. This was confirmed through the researcher's interview with S26. Based on results interview obtained that the S26 is capable answer And to describe all step workmanship question until won 189 seats so that can sure S26 is very understand question This Figure 4.

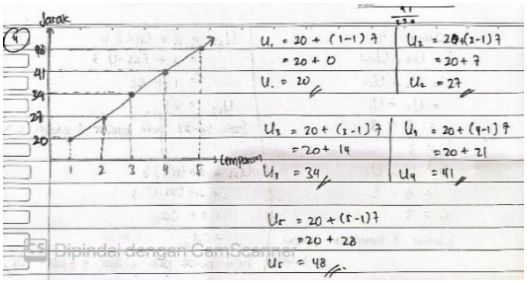

Figure 4. S26's answer to question 3

In Figure 4, there are the results of S26's answers with indicators of presenting concepts in various representations, based on the results of S26's answers, he has been able to determine arithmetic sequences correctly. S26 is able to determine the 1st to 5th terms correctly. So, it can be concluded that S26 has been able to present concepts in various representations. This was confirmed through the interviews conducted. Based on results interview obtained that the S26 is capable answer steps draw chart with Correct start from First, the first, second, third, fourth, and fifth terms are known, using the nth term formula. Then a

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graph is made where the x-axis is the throw and the y-axis is the distance in Figure 5.

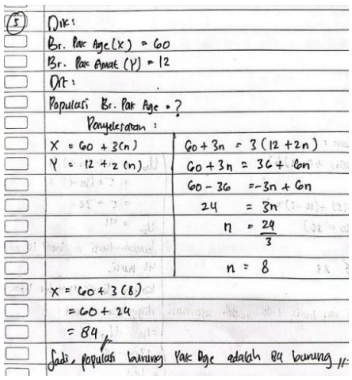

Figure 5. S26's answer to question 5

In Figure 5, there are the results of S26's answers with indicators of linking various mathematical concepts internally or externally, based on the results of S26's answers, he was able to write down what was known correctly and understand what was asked in the question. So, it can be concluded that S26 was able to link various mathematical concepts internally or externally. This was confirmed by the interview conducted with S26 . Based on results interview obtained that the S26 is capable answer step correct solution because it is considered This question is almost similar to the arithmetic sequence question.

Based on the results of data analysis on each indicator, students with high abilities are able to master all indicators. This is in accordance with the research of Khairani et al (2021) which states that students with high abilities in distinguishing examples and excluding examples of concepts that have been taught are included in the very good category, in the indicator of rewriting concepts that have been taught, students with high abilities are also included in the good category for analysis which are presented on Figure 6 as follows:

S13 (moderate ability)

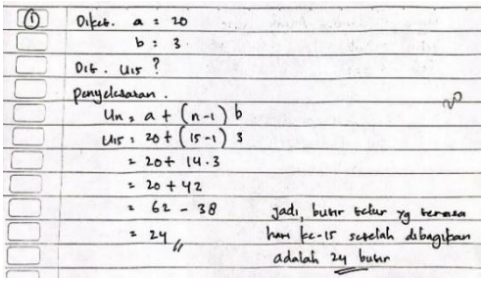

Figure 6. S13's answer to question 1

In Figure 6, there are the results of S13's answers with the indicator of restating a concept that has been studied, based on the results of S13's answers, he has been able to solve the existing problems. writing the correct final answer results, namely 24 items. So, it can be concluded that S13 has been able to restate a concept that has been studied. This was confirmed through interviews conducted

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by researchers with S13. Based on results interview obtained that the S13 is capable To answer the question, first write down nth term formula and the numbers and the result is 24 . For analysis which are presented on Figure 7:

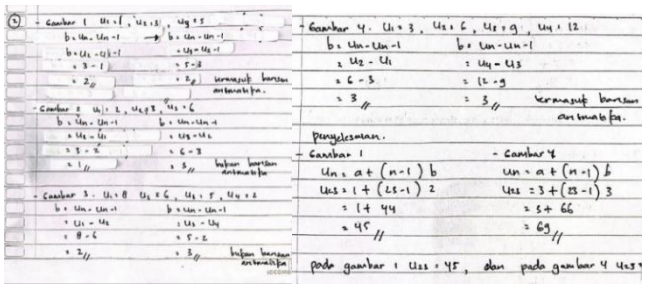

Figure 7. S13's answer to question 2

In Figure 7, there are the results of S13's answers with the indicator of grouping objects based on mathematical concepts, based on the results of S13's answers, he was able to determine the images that were included in the arithmetic sequence. So, it can be concluded that S13 has been able to classify objects based on mathematical concepts. This was confirmed through an interview conducted with S13. Based on results interview obtained that the S13 is capable answer Figure 1 and figure 4 as line arithmetic .

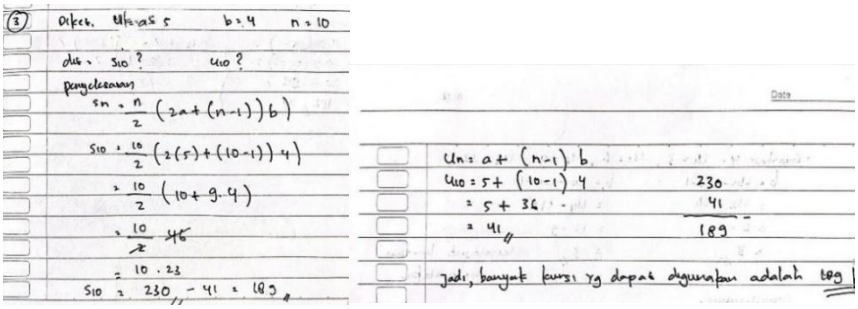

Figure 8. S13's answer to question 3

In Figure 8, there are the results of S13's answers with the indicator of applying concepts algorithmically, based on the results of S13's answers, he has been able to solve the given problem by writing the correct final answer, which is 189 chairs. So, it can be concluded that S13 has been able to apply concepts algorithmically. This was confirmed through interviews conducted by researchers with S13. Based on results interview obtained that the S13 is capable answer And determine S_{10}that is, we get 230 and U_{10}then we get 41 reduced because the tenth row could not be used so that 189 seats were obtained . For analysis which are presented on Figure 9 as follows:

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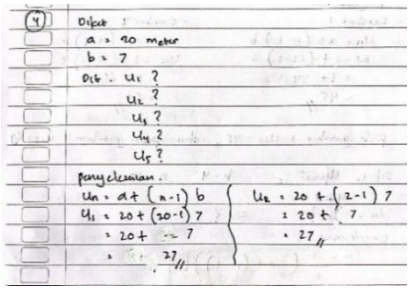

Figure 9. S13's answer to question 4

In Figure 9, there are the results of S13's answers with the indicator of presenting concepts in various representations, based on the results of S13's answers, he was only able to determine the arithmetic sequence in the 2nd row and S13 did not describe the requested graph. So, it can be concluded that 13 was unable to present concepts in various representations. This was confirmed through the interviews conducted. Based on results interview obtained that S13 answered that No Can draw chart Because No understand the steps .

S13 did not write any answer to question number 5, so it can be concluded that S13 was unable to link various mathematical concepts internally or externally. Based on the results of data analysis on each indicator, students with moderate abilities only mastered 3 indicators. S13 did not understand and comprehend what was being asked so no answers were written. In accordance with research by Hakim & Adirakasiwi (2021) which states that students with average abilities do not understand the meaning of the questions asked in the questions given. For analysis which are presented on Figure 10 as follows:

S22 (Low Ability)

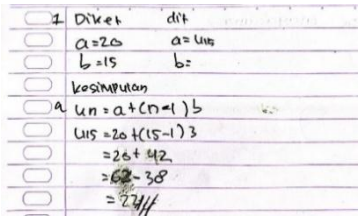

Figure 10. S22's answer to question 1

In Figure 10, there are S22's answer results with an indicator of restating a concept that has been studied, based on the answer results, S22 has used the correct formula in finding the number of eggs on the 15th day. However, S22 wrote what is known with an incorrect answer, namely b of 15 which should be 3. So, it can be concluded that S22 has not been able to restate a concept that has been studied. This was confirmed through interviews conducted by researchers with S22. Based on results interview obtained that the S22 is capable answer It is known that a is 20, b is 15 because the answer was written incorrectly. For analysis which are presented on Figure 8 as follows:

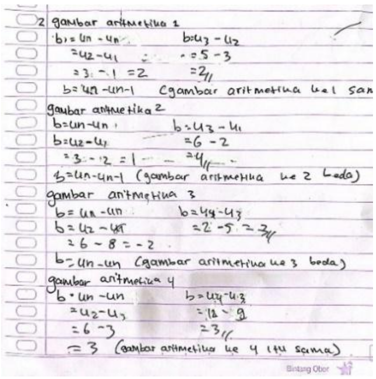

Figure 11. S22's answer to question 2

In Figure 11, there are the results of S22's answers with the indicator of grouping objects based on mathematical concepts, based on the results of S22's answers, he was able to determine the images that were included in the arithmetic sequence. S22 was able to determine that images 1 and 4 were arithmetic sequences and images 2 and 3 were not included in the arithmetic sequence. So, it can be concluded that S22 has been able to classify objects based on mathematical concepts. This was confirmed through the interviews conducted. Based on results interview obtained that the S22 is capable answer 1 and 4 as line arithmetic However No can explain about line arithmetic .

S22 did not write any answers to questions 3, 4, and 5, so it can be concluded that low-ability students are only able to master one indicator. Low-ability students still make many mistakes, for example in question number 1 so that the final answer is wrong. This is in accordance with research conducted by Alzanatul Umam & Zulkarnaen (2022) which states that errors can cause errors in calculations which cause the final answer obtained to be wrong.

Based on the results of the data analysis conducted, high-ability students were able to master all indicators including restating concepts that had been learned, classifying objects based on mathematical concepts, applying concepts algorithmically, presenting concepts in various representations, and linking various mathematical concepts internally or externally. This is in line with the research of Putri Khairani et al (2021) which states that students with high ability in distinguishing examples and excluding examples from concepts that have been taught are included in the very good category. Students with moderate ability are able to master three indicators including the indicator of restating concepts that have been learned, classifying objects based on mathematical concepts, and applying concepts algorithmically. In other indicators, there are still errors because students do not know the solution to the problems given. This is in line with Setiani et al (2022) which states that there are still errors because students do not understand the process of solving it. However, low-ability students are only able to master one indicator, namely the indicator of restating the concepts that have been learned. In other indicators, low-ability students have not been able to fulfill one of them, namely the indicator of classifying objects based on mathematical concepts. This is in line with Rahmawati & Roesdiana, 2022) which states that low-ability students have not been able to fulfill the indicator of conceptual understanding ability, namely classifying objects based on mathematical concepts.

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This study revealed that students' mathematical concept understanding in the Sequence and Series material is still diverse. Students with high understanding can master all indicators of conceptual understanding, while students with moderate understanding can only fulfill several indicators, such as being able to re-explain concepts and group objects based on mathematical concepts. Meanwhile, students with low understanding have difficulty in understanding the concept as a whole and are only able to fulfill one indicator. Several factors that contributed to this finding include students' initial understanding of basic mathematical concepts, challenges in distinguishing arithmetic and geometric sequence patterns, and difficulties in applying formulas correctly. Students with better understanding tend to be able to relate concepts to more complex situations, while students with poor understanding of concepts tend to simply memorize formulas without understanding how to use them in various types of problems.

The advantage of this study lies in the in-depth analysis of the level of students' understanding of mathematical concepts in the Sequence and Series material. The qualitative approach used allows for broader exploration of frequent error patterns. However, this study has limitations, namely the limited number of research subjects so that the results cannot be generalized to a wider population. The results of this study provide implications that learning strategies are needed that are more oriented towards understanding concepts, such as exploratory methods and discussions that encourage students to build their own understanding. In addition, teachers need to pay more attention to the patterns of errors that students often make in order to provide more appropriate guidance in understanding the concept of Sequences and Series. This study can also be a reference for further studies that examine the effectiveness of various learning approaches in improving students' understanding of mathematical concepts.

Conclusion and Suggestions

From all the discussions above, the researcher concluded that the ability to understand mathematical concepts of class X students on the material of Sequences and Series is still diverse. Students with high understanding are able to meet all indicators of understanding concepts, while students with moderate understanding only master several indicators, and students with low understanding have difficulty in understanding almost all concepts. overall. The main factors that affect students' level of understanding include difficulties in distinguishing arithmetic and geometric sequence patterns, as well as limitations in applying formulas correctly. Students who understand the concept well tend to be able to connect the theory to various types of problems, while students who do not understand the concept tend to memorize formulas without understanding their use. Based on these results, a more interactive and exploration-based learning strategy is needed to help students understand the concept more deeply . This study can also be a reference for further studies that examine the effectiveness of various learning approaches in improving students' understanding of mathematical concepts.

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