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Students' Critical Thinking Skills in Solving on The Topic of Sequences and Series

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ABSTRAK

Salah satu keterampilan matematika yang paling penting dari abad ke-21 adalah keterampilan berpikir kritis. Pada awal tahun 2020 sistem pendidikan Indonesia menerapkan pembelajaran online akibat Covid-19. Penelitian ini bertujuan untuk menganalisis kemampuan berpikir kritis matematis dalam memecahkan barisan dan deret pada saat penerapan pembelajaran online. Penelitian ini menggunakan metode deskriptif kualitatif dengan populasi seluruh siswa kelas 12 SMA Negeri 25 Garut. Pemilihan sampel dilakukan secara purposive sampling, dengan pertimbangan subjek telah mempelajari materi barisan dan deret serta dipilih sebanyak 32 siswa sebagai subjek penelitian. Instrumen yang digunakan adalah tes dengan tipe deskripsi. Teknik pengumpulan data dilakukan dengan cara memberikan soal secara online melalui google form. Hasil penelitian menunjukkan kemampuan berpikir kritis matematis siswa kelas 12 SMA Negeri 25 Garut dalam menyelesaikan materi barisan dan deret berada pada kategori sedang dengan persentase rata-rata 56,92%.

Kata Kunci: kemampuan berpikir kritis, barisan, deret, pembelajaran online.

ABSTRACT

One of the most important mathematical skills of the 21st century is critical thinking skills. In early 2020 the Indonesian education system implemented online learning due to Covid-19. This study aims to analyze the ability of mathematical critical thinking in solving sequence and series at the time of online learning application. This study uses a qualitative descriptive method with a population of all students in 12th grade on SMA Negeri 25 Garut. The sample was chosen based on purposive sampling, with the subject having studied the sequence and series materials and selected a class of 32 students as a research sample. The instrument used is a test with a description type. The data collection technique is done by providing questions online through a google form. The results showed the mathematical critical thinking skills of 12th-grade students on SMA Negeri 25 Garut in solving sequence and series materials were in the medium category with an average percentage of 56.92%.

Keywords: critical thinking skills, sequence, series, online learning.

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1. INTRODUCTION

21st century changes in science and technology, as well as the acceleration of information systems and communication, make the world seem to be in your hands (Rizky & Sritresna, 2021). However, the changing times of this century, manifestly have an impact on human resources whose quality must continue to improve.. The improvement of human resources can be achieved through education (Rudianti, Aripin, & Muhtadi,2021).

21st century skills are skills needed to deal with future changes and problems in a pattern of society that has undergone many changes (Stukalo, & Simakhova, 2020). Furthermore, these changes require the world to be able to develop with education as a means that can foster students to master 21st century skills. Those 21st century skills, including 4C (creativity, critical thinking, communication, and collaboration) are new skills that if well prepared will help prepare students for the global era (Marlina, & Jayanti, 2019; Sutarsa & Puspitasari, 2021).

One of the goals in mathematics learning is to improve student's ability in critical thinking (Mukhlis, Dafik, & Hobri, 2018; Marlina, & Jayanti, 2019; Nurdiansyah, Sundayana, & Sritresna, 2021). Critical thinking can not be separated from education and is an important cognitive ability so schools try to improve it (Fridanianti, Purwati, & Murtianto, 2018; Hidayat, Akbar, & Bernard, 2019; Afriansyah, 2021). This purpose is in line with the goal of mathematics learning in schools by curriculum 2013, which requires students to have good mathematical thinking skills needed to solve a problem (Agoestanto, Sukestiyarno, & Rochmad, 2017; Salwah, Ashari, & Ma' rufi 2020). Students' ability to solve mathematical problems involves several factors including higher-order thinking skills and one of the higher-order thinking skills is mathematical critical thinking skills (Mukhlis, Dafik, & Hobri, 2018; Susilo, Darhim, & Prabawanto, 2019a; Afriansyah, et al., 2021)

The mathematical critical thinking skill is the ability to evaluate arguments, the arguments in question are arguments related to the mathematical problems or mathematical problems given (Abdullah, 2013; Sadiyono, 2014; Gaol, Prabawanto, & Usdiyana, 2019; Susilo, Darhim, & Prabawanto, 2019). In addition, critical thinking is seen as decision-making based on careful evaluation and consideration (Rizti & Prihatnani, 2021). However, mathematics learning at schools does not fully support the students' mathematical critical thinking skills. The results of 2018/2019 school year national examination showed the percentage of correct answers on sequence and series material nationally was 36.20% and 20.37% for the Garut District level. The results of informal interviews conducted by researchers on several high school students in Garut Regency stated that students usually can memorize a certain mathematical formula, but will have difficulty when having to use the formula in solving problems in the form of stories or problem solving related to contextual problems (Iswara, Darhim, & Juandi, 2021a).

One of the topics in mathematics learning that requires critical thinking skills in 11th grade is sequence and series materials (Hardiyanti, 2016). This material is a material that often appears in national exam questions and college entrance exams in the form of story questions or problem-solving problems. The selection of the material is because students tend to think less critically in solving higher-order thinking skills (HOTS) questions in the form of the story correctly (Kharisma, 2018; Rofi' ah, & Masriyah, 2018; Iswara, Darhim, & Juandi, 2021)

Based on the explanation above, it is crucial to bear in mind that recognizing students' mathematical critical thinking skills is an essential aspect of the learning process. Since students' critical thinking skills in solving problems are diverse, this study focuses on investigating students' critical mathematical thinking in solving sequence and series material. The research questions of this study are "how is the description of students' mathematical critical thinking skills in solving sequence and series problems?".

2. METHOD

The type of study is a qualitative descriptive approach with the aim of describing students' mathematical critical thinking in solving the problems of sequence and series. The data obtained is the result of students completing the mathematical critical thinking test. The population in this study is all students of class XII SMAN 25 Garut at 2020/2021 academic year with a sample of 32 students selected by purposive sampling. The instrument used is the 4 problem of critical thinking skills test with description type. The category of students' critical thinking skills can be seen in Table 1 (Nisa et al, 2020; Marjuwita et al, 2020). In this research, the analyzed indicators of critical thinking include focus, reason, inference, situation, and collaboration (Ennis, 2011; Qing, Huang, & Tian, 2013).

Tabel 1. The Criteria of Mathematical Critical Thinking Skills

Percentage of Achievement	Kategori
$80 < \text{PP} \leq 100$	Very High
$68 < \text{PP} \leq 79$	High
$56 < \text{PP} \leq 67$	Medium
$44 < \text{PP} \leq 55$	Low
$0 \ < \text{PP} \leq 43$	Very Low

3. RESULT AND DISCUSSION

Based on the results of data analysis, from the 4 questions given via google form on the topic of sequence and series in grade 12 on SMAN 25 Garut it was found that mathematical critical thinking skills have varied categories in each of the aspects tested. The data is processed to determine the average of the final score and then converted into qualitative data to determine the category of mathematical critical thinking skills. Furthermore, Students' answers were

spread into five categories; very high, high, medium, low, and very low. The distribution of answer categories and scores of students can be seen in Figure 1.

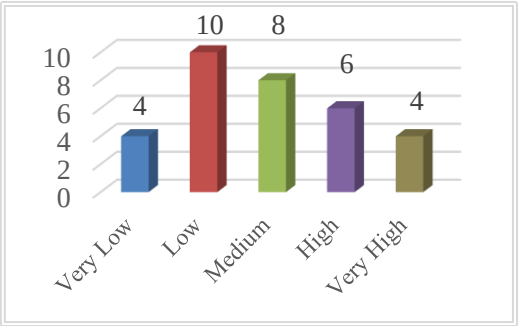

Figure 1. The Distribution of Answer and Score Students.

Based on Figure 1, it can be seen that the distribution of students who scored with very high of critical thinking only 4 students (12.5%), critical thinking with the high category are 6 students (18.75%), critical thinking with the medium category are 8 students (25%), critical thinking with the low category are 10 students (21.25%), and critical thinking with the very low category are 4 students (12.5%). Furthermore, the percentage value of students' critical thinking skills when viewed from each indicator is presented in the following table.

Tabel 2. Critical thinking skills for each indicator

Indicators	Percentage (%)	Category
Focus	44,5	Low
Reason	65,8	High
Inference	42,6	Low
Situation	57,9	Medium
Clarity	69,8	High

Based on Table 2, it can be seen that the percentage of students' critical thinking skills on indicators of focus is 44.5% in the low category, then the percentage on indicators reason is in the high category with 65.8%, then the indicators inference those with low category values are 38.6%, as for the indicators situation to the medium category is 57.9%, meanwhile, the indicators collaboration are in the high category with 69.8%. Based on the series of data above, the average percentage of students 'critical thinking skills is 55.32%, which means that students' mathematical critical thinking skills in the sequence and series material can be said to be in a low category.

From the results of the tests conducted, it is known that the students' analytical skills were passable, most of the students were able to analyze and evaluate based on the arguments given. Furthermore, students have been able to make clarifications by conducting tests based on

the given problems even by including some of the variables tested. But, only a few students can evaluate a question with inductive proof. Here are some questions and answers from students.

Question 1. Determine the formula for the n^{th} term from the number pattern 6,12,20,30,42,56,72 ...

Student answers:

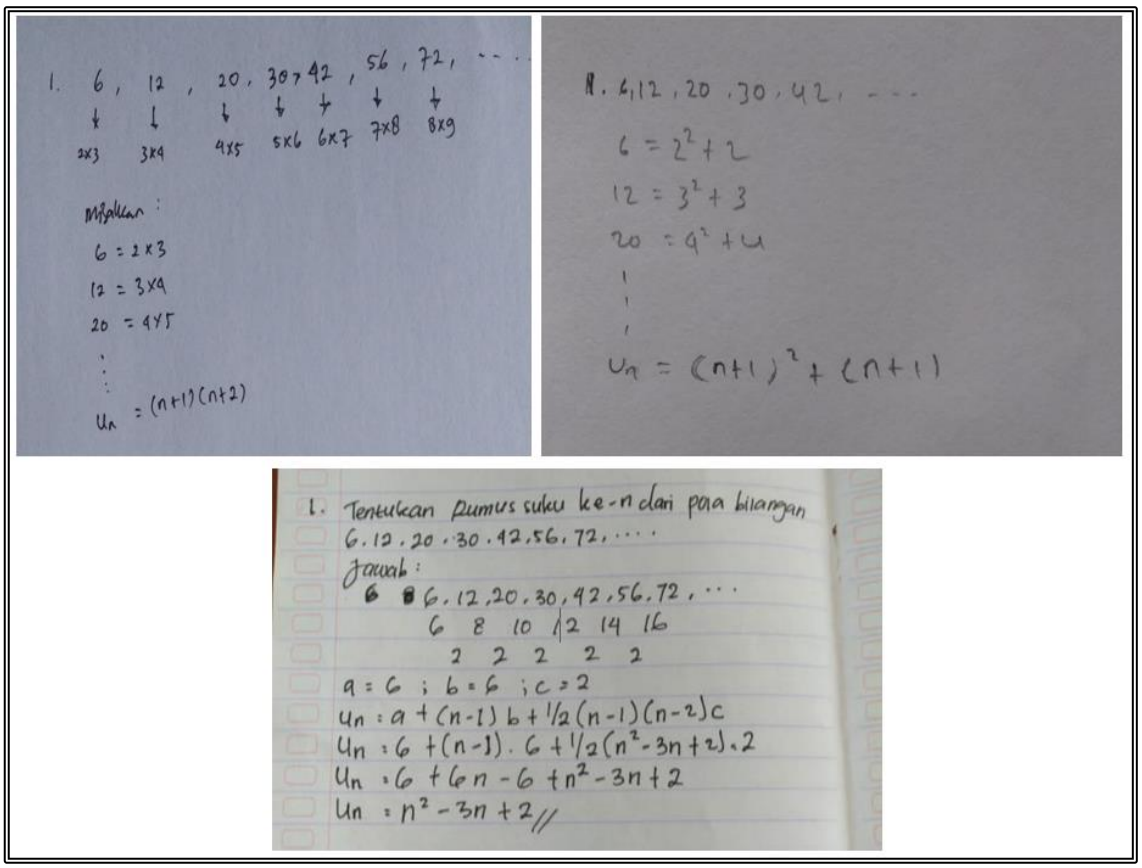

Figure 2. The Example of Student Answers of Question 1

From some of the answers above, students have been able to analyze by making considerations or strategies in finding a certain pattern well. On the inference aspect, problem-solving steps it is following what was asked about. The reasons are used to make conclusions as well sufficient to support the conclusions drawn, relevant, sufficiently detailed, and clear. In this aspect of the situation, the subject has been able to sort out the information on the questions properly and carefully, so that the subject will only use important information and leave that information alone not important.

Students who have critical thinking skills tend to more quickly identify information, systematically study problems, formulate innovative questions, utilize ideas or information, can evaluate and modify to produce the best ideas (Ennis, 2011). The ability of students to analyze and evaluate an argument is also seen in the following sample answers.

Question 2. A researcher grows 8 cells. Each cell divides itself into 3 parts every 2 minutes. After a few minutes the number of cells became 17496. Other researchers grows 8 cells as well. Each cell divides itself into 3 parts every 7 minutes. Try to check how many cells are obtained at the same time as the first researcher.

Student answers:

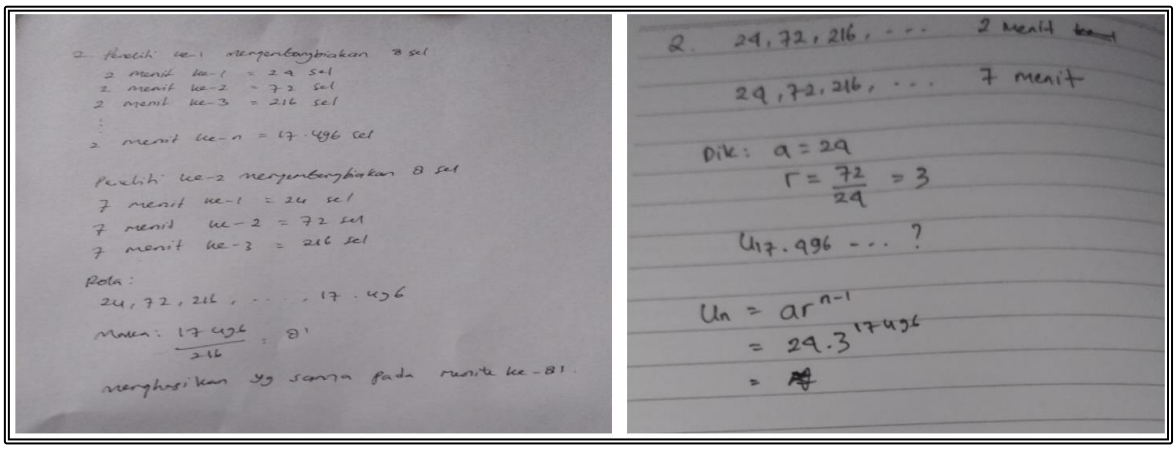

Figure 3. The Example of Student Answers of Question 2

Based on the example of student answers above, it can be seen students are unable to evaluate a given argument. The subject can write down what is known from the problem appropriately. but the subject did not examine the things being asked in the question so that there was an error in interpreting the questions. This can be understood because students are poorly trained on the question asked about the number of bacterial breeding. So that the aspects of reason, inference, and situation are not achieved

The misunderstanding of students in solving this geometric sequence problem occurs because students do not fully understand the content of the problem from the question. The majority of students tend not to be able to interpret the meaning of the problem on the problem mathematically in geometric lines, especially regarding the problem of bacterial reproduction (Fridanianti, Purwati, & Murtianto, 2018). Another case is the ability of students in composing clarifications that are visible in developing in the following examples of answers.

Question 3. One day Syifa wanted to cut up paper for craft materials. At first, syifa cut the paper into 10 pieces, then a sheet of 10 pieces was cut again into 10 pieces. The activity continues to be carried out so that the total number of deductions becomes 352. Based on the problem, make a mathematical model and determine how many times Syifa cut, if to cut the paper into 10 pieces is done 3 times cutting?

Student answers:

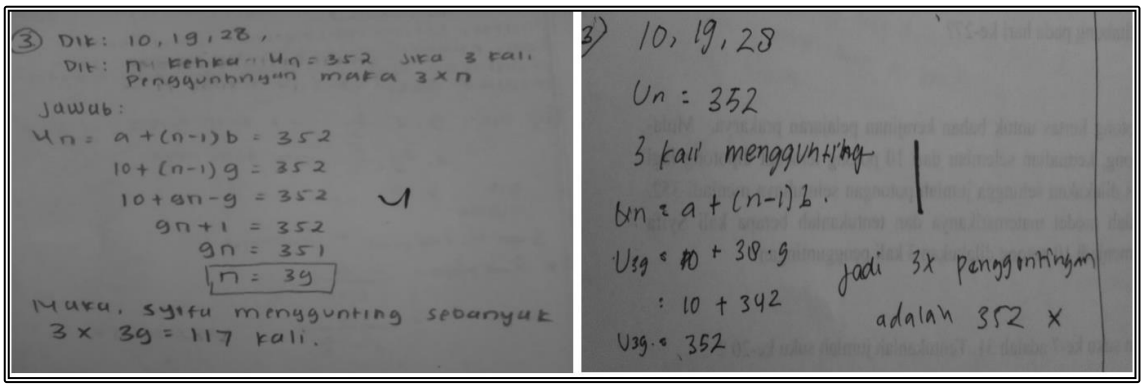

Figure 4. The Example of Student Answers of Question

Question 4. Try to investigate why the sequence of numbers 1, 3, 6, 10, 15,. . . is called triangle sequence!

Student answers:

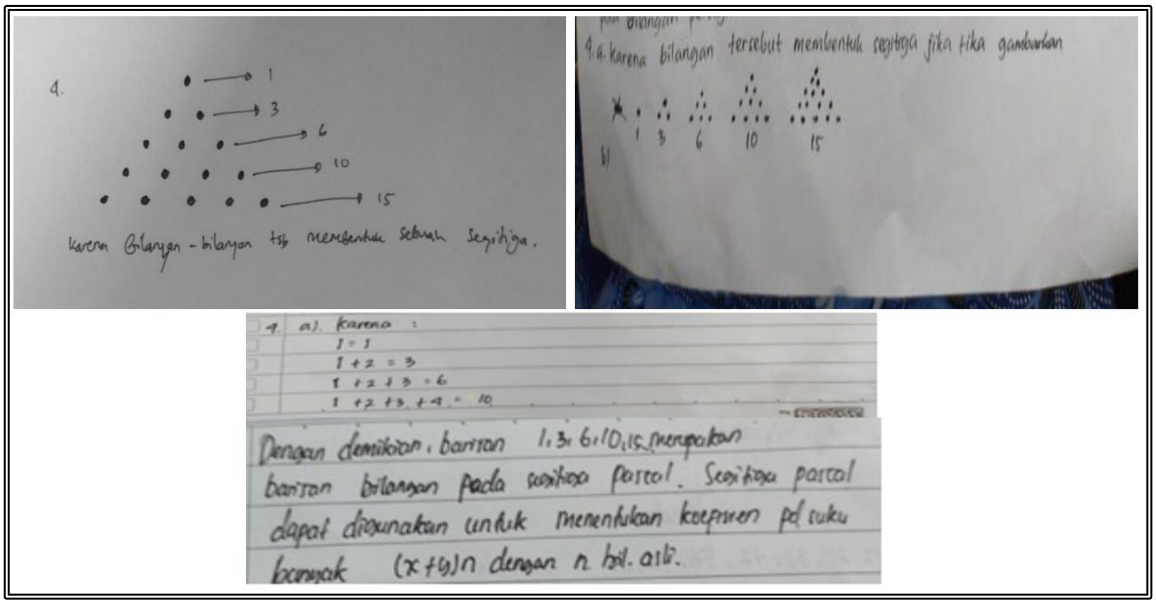

Figure 5. The Example of Student Answers of Question 4

Based on Figures 4 and 5, students' answers in solving questions number 3 and 4 are known that students can evaluate and clarify the formula by providing arguments even though deductively, this can be understood because students are poorly trained to prove the formula inductively. In the clarity aspect of the subject is able to provide further explanation of the final conclusion that has been written, the subject is able to explain the terms contained in the question as well as can compile examples of questions similar to the given question.

In addition to these definitions, critical thinking can also be interpreted as thinking with a particular quality that is essentially good thinking and meets specified criteria or standards of adequacy and accuracy (Iswara, Darhim, & Juandi, 2021b).

4. CONCLUSION

Based on the results and discussion described above, it can be concluded that in general, the description of the critical thinking ability of students is in the medium category. The categories of each critical thinking indicator include the focus indicator being in a low category, the reason indicator being in the high category, the inference indicator being in a low category, the situation indicator being in the medium category, and the clarity indicator being in the high category. For the next researcher who is interested in developing research on critical thinking skills with learning achievements, it can examine more deeply the aspects that affect learning achievements during the covid-19 pandemics. In addition, it is expected that the research will not only stop to know the relationship between variables but continue with the administration of treatment or develop into experimental research.

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