

Analysis of Mathematical Problem-Solving Abilities in Sequences and Series of Grade XI Students at SMAN 1 Sakra Viewed from a Gender Perspective in the Academic Year 2023/2024

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Abstract: This research aims to describe the mathematical problem-solving abilities related to sequences and series among XI grade students at SMAN 1 Sakra, considering gender differences. The research follows a qualitative descriptive approach, utilizing interview-based test questions as instruments. These questions will be analyzed based on Polya's problem-solving indicators. From a total of 70 students, six were selected—three male and three female students—to represent different levels of mathematical problem-solving abilities: high, moderate, and low. The findings reveal that high-ability male students understand problems, plan and execute solutions (though with operational errors), and perform checks without writing conclusions. Moderate-ability male students partially meet the problem-solving criteria. Low-ability male students do not meet all the indicators. Among high-ability female students, understanding, planning, execution, and checking occur, but conclusions are missing. Moderate-ability female students also fall short in completeness and checking indicators. Low-ability female students only meet the understanding phase.

Keywords: Problem-Solving Abilities, Gender, Polya, Sequences and Series.

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Introduction

Having problem-solving skills is very important for students in solving mathematical problems. Through the problem-solving process, students are encouraged to think critically and creatively in connecting mathematical concepts, making these concepts meaningful in their minds. However, based on the PISA (2022) results, the average mathematics score of Indonesian students dropped by 13 points, from 379 to 366. This indicates that many Indonesian students still struggle with situations requiring mathematical problem-solving skills.

Priyo (2011) revealed that a lack of solid understanding leads to students experiencing difficulties in solving problems. These difficulties arise because, in learning mathematics, students do not build their own knowledge of concepts but tend to memorize mathematical concepts without understanding their content, leading to frequent mistakes and an inability to find solutions to their problems. Additionally, difficulties in solving problems are caused by a lack of student motivation in the learning process, which results from not following the learning process properly. Meanwhile, Lestari, Amrullah, Kurniati, & Azmi (2022)

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stated that learning motivation significantly affects students' mathematical problem-solving abilities. Furthermore, mastering concepts and having a good understanding are essential in learning mathematics.

In mathematics lessons, one of the relatively abstract topics is sequences and series. This topic has wide applications in mathematics and various other fields of science, encouraging students to think more critically in solving problems. However, the reality in the field is different. As Wulandari & Setiawan (2021) revealed, many students still struggle with solving descriptive problems related to sequences because they are confused about applying formulas in arithmetic sequences. Research by Handayani, Hartatiana & Muslimahayati (2020) found that errors in solving word problems related to arithmetic sequences and series include 25.92% conceptual errors, 10.36% data usage errors, 9.99% language interpretation errors, 8.88% technical errors, and 6.9% conclusion drawing errors. Due to these difficulties, it is necessary to investigate students' problem-solving abilities in solving mathematical problems.

Based on observations, it was found that the mathematics learning process in the classroom was not conducive. Many male students engaged in activities irrelevant to the ongoing learning process, in contrast to the majority of female students who followed the learning process well. In the learning process, it is very important to focus and pay close attention, as this can affect the amount of information received by students. If the information received is insufficient, it will affect the students' ability to solve problems related to the material.

Based on the exam results, it was found that there were various types of answers shown on the answer sheets. Some students answered the questions well, some made mistakes in the operational process, and some only wrote down the questions without providing solutions. There were even students who wrote down the questions and directly provided solutions without showing the process to obtain those solutions. According to teacher interviews, most male students submitted their answer sheets faster than female students, even though there was still plenty of time left to complete the exam. However, when the exam results were announced, it turned out that many male students' answers were incorrect. This is likely because most male students did not review their answers. Additionally, the female students' answer sheets showed a more detailed and structured process, unlike the male students who only wrote down the answers haphazardly.

Based on this, the researcher believes there may be a relationship between the behavior of male and

female students and their problem-solving abilities. Mulya (2004) stated that the behavioral differences between males and females are referred to as gender. Gender is the distinct difference between males and females in terms of roles, behavior, mentality, and emotional characteristics that develop in society. According to research conducted by Rizki, Prayitno, Hikmah, & Turmuzi (2021), the problem-solving abilities of males and females differ. Their study found that female students outperformed male students, except in the checking stage.

Based on this explanation, further study is needed on the relationship between gender and students' problem-solving abilities. Therefore, the researcher is interested in conducting a study to examine the problem-solving abilities of students at SMAN 1 Sakra in the topic of sequences and series from a gender perspective.

Method

This study employs a qualitative descriptive research method with the aim of describing the mathematical problem-solving abilities related to sequences and series among 11th-grade students at SMAN 1 Sakra from a gender perspective.

The sample for this study was selected using purposive sampling. The considerations for sample selection in this study are: 1) The sample has received material on sequences and series, 2) The difference in the number of male and female students in the class is not too large, 3) The consideration of the mandatory mathematics teacher. Based on the teacher's considerations, two classes were selected, namely class XI-A and XI-C, with a total of 70 students who will be given a problem-solving ability test. Subsequently, 6 students were chosen as research subjects, consisting of 3 male and 3 female students, representing high, moderate, and low mathematical problem-solving abilities for the interview subjects.

The problem-solving ability test given consists of 2 essay questions on the topic of sequences and series. The criteria for categorizing mathematical problem-solving abilities are shown in Table 1 below.

Table 1 : Criteria for Categorizing Students' Mathematical Problem-Solving Abilities

Number	Value Interval	Criteria
1.	$X \geq 14,7$	High
2.	$7,3 \leq X \leq 14,7$	Medium
3.	$7,3 \leq X \leq 14,7$	Low

In the planning stage, it was observed that male subjects developed a well-structured plan to solve the problems. This was evident from their answer sheets, where they correctly wrote down the formulas and solution steps, and were able to explain them well during the interview process. This is consistent with the findings of Ahmad, Arjudin, Novitasari, & Sridana (2024), which state that students with high problem-solving abilities can develop problem-solving plans based on the facts they have obtained.

Figure 3. Answer sheet of high-category male students at the implementation stage

In the execution stage, male subjects carried out the solution process according to the plan they had developed. However, misconceptions and errors in the operational process were observed. This was evident from their answer sheets and the interview results.

In the review process, male subjects checked their answers but did not write conclusions on the answer sheets

1.2 Mathematical Problem-Solving Ability in Male Students of the Medium Category

Based on the data analysis from the test questions and interviews, male subjects did not write down the given and asked information completely on the answer sheets.

Figure 4. Answer sheet of moderate-category male students at the problem-understanding stage

However, the interview results showed that male subjects were able to explain the given and asked information in the problems. According to the research by Rosita, Chaerul, & Effendi (2021), male students in the moderate category actually understand the purpose of the problems, but they do not write down and include the given and asked information in the problems. Male subjects do not write it down completely because they are only focused on the solution process.

Figure 5. Answer sheet of moderate-category male students at the planning stage

In the planning stage, it was observed that male students had developed strategic plans to solve the given problems, but these plans were incomplete. Based on the interview results, male students explained the planning process according to their answer sheets without realizing the mistakes they had made in question 1 and question 2. This will affect the process and results obtained in the subsequent stages.

Figure 6. Answer sheet of moderate-category male students at the implementation stage

In the execution stage, male subjects carried out the solution process according to the plan they had made. However, due to their inability to develop the plan properly, this resulted in errors during the execution of the plan.

data, us: 0

Figure 7. The answer sheet of male students in the medium category at the rechecking stage

At the rechecking stage, the male subject did not perform a recheck. The male subject had written a conclusion for the problem-solving solution. This is evident on the answer sheet, but the conclusion presented is not yet correct.

1.3 Mathematical Problem-Solving Ability in Male Students of the Low Category

1) Dit. jumlah suku pertama nomor 2 mana?
 Dik. $s_3 = 3$ $u_4 = a_1(n-1)b$
 $u_4 = a_1(4-1)b$
 $= a + 3b$
 $u_5 - u_4 = a + 4b - (a + 3b)$
 $u_6 - u_4 = \dots$ (1)
 $b = \dots$
 $b = \dots$

Figure 8. The answer sheet of male students in the low category

Based on the data analysis from the test questions and interviews conducted, it is evident that the male subjects have not been able to understand the given problems. This is apparent from the answer sheets, which do not clearly indicate what information is known and what is being asked by the questions. This aligns with the findings of Rosita, Chaerul, and Effendi (2021), which state that male students in the low category do not understand the problems. Additionally, they do not always make plans and do not include or write down the formulas used in their solutions. Furthermore, based on the interview results, the male subjects obtained the data they wrote down from their seatmates. This indicates that the male subjects have not understood the problems.

At the planning stage, it is evident that the male subjects were unable to determine a plan to solve the problem. This is shown in the interview results, where the male subjects did not understand the given problem. This indicates that the male students were not able to think or make a solution plan because they did not understand the material concepts well. This is in line with the findings of Wau, Harefa, and Sarumaha (2022), which state that students with poor problem-solving abilities and a lack of understanding of concepts are unable to think or make guesses in solving problems.

At the implementation stage, the male subjects were unable to fulfill this step because they did not understand the given problem, and therefore did not know the strategy or formula to use to solve the problem.

At the rechecking stage, the male subjects did not write a conclusion or perform the rechecking step. This was because there was no final result obtained in solving the problem. This is in line with the findings of Rosita, Chaerul, and Effendi (2021), which state that male students in the low category do not understand the problems, do not include formulas and strategies, implement plans that conflict with the problem's objectives, and tend not to recheck.

2. Mathematical Problem-Solving Ability in Female Students

2.1 Mathematical Problem-Solving Ability in Female Student of High Category

1) Diketahui: $s_3 = 3$
 $u_4 - u_3 = (a + 4b) - (a + 3b)$
 $u_5 - u_4 = (a + 5b) - (a + 4b)$
 $= b$
 $b \times 3b = 18$
 $3b^2 = 18$
 $b^2 = \frac{18}{3}$
 $b^2 = 6$
 $b = \sqrt{6}$
 $b = 3 \rightarrow s_3 = 3$
 Ditanyakan: $u_6 = ?$
 Jumlah 8 suku pertama: ?

2) Diketahui:
 Suku kedua = $\frac{1}{27}$
 Suku keempat = $\frac{1}{3}$
 Ditanyakan:
 - suku ke lima = ?
 - jumlah 3 suku pertama: ?

Figure 9. The answer sheet of female students in the high category at the problem-understanding stage

Based on the data analysis from the test questions and interviews, female subjects with high problem-solving abilities were able to understand the given problems well. On the answer sheets, the female subjects were able to consistently write the known and asked information completely and correctly. This aligns with the findings of Tarigan, Simanjourang, and Siagan (2022), which state that female students tend to be more meticulous, more careful, and pay more attention to the information presented in the questions. Therefore, at the problem-understanding stage, female students perform better than male students. The interview results also show that female subjects with high problem-solving abilities were able to clearly and accurately present the information in the questions.

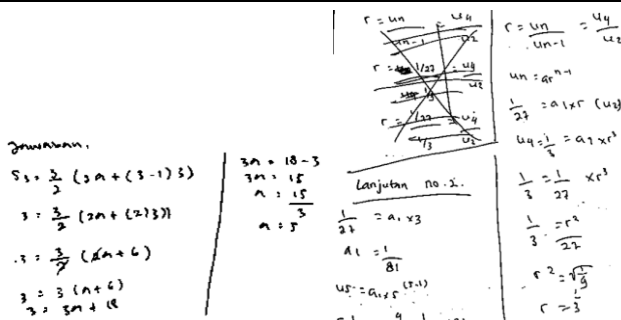


Figure 10. The answer sheet of female students in the high category at the planning stage

At the planning stage, the female subjects were able to create a good and systematic plan to solve the problem. This is evident from the answer sheets, where the female subjects correctly wrote the formulas and solution steps, and were able to explain them well during the interview process. This aligns with the findings of Mawardi, Arjudin, Turmuzi, and Azmi (2022), which state that subjects with high problem-solving abilities are able to write mathematical models by planning that connects what is known and what is asked.

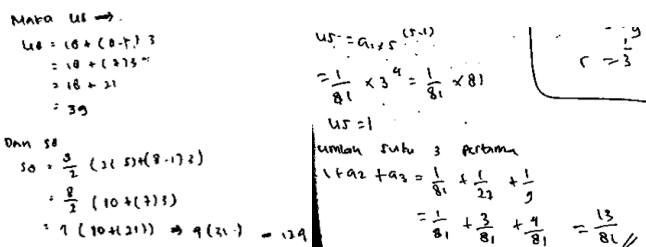


Figure 11. The answer sheet of female students in the high category at the implementation stage

At the implementation stage, the female subjects carried out the solution process according to the plan they had developed. This is evident from the answer sheets and the interview results. Female students in the high category were able to execute the plan well. This is shown by the subjects' responses, who recognized calculation errors in question number 1 during the interview process.

During the rechecking process, the female subjects reviewed the answers they had obtained but did not write a conclusion on the answer sheet.

2.2 Mathematical Problem-Solving Ability in Female Student of High Category

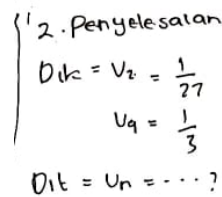


Figure 12. Student answer sheet for a female student in the intermediate category at the problem comprehension stage

Based on the data analysis from the test questions and interviews, the female subjects were able to understand the problems well. This is evident from the interview results, where female subjects with moderate problem-solving abilities were able to correctly present the known and asked information in the questions, although it was not written completely on the answer sheet.

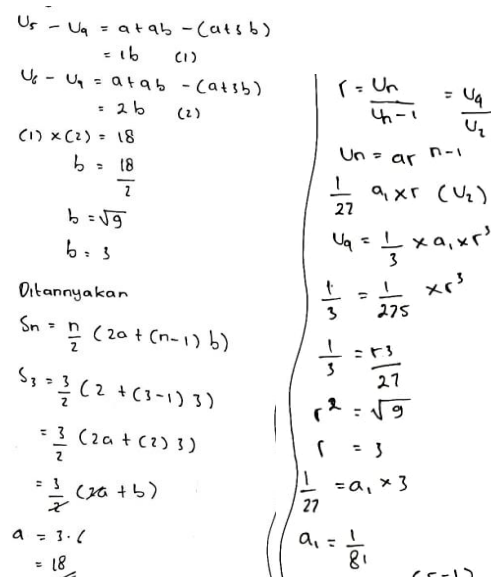


Figure 13. The answer sheet of female students in the medium category at the planning stage

At the planning stage, the female students were able to develop a good and systematic plan. This can be seen from the answer sheets and the interview results.

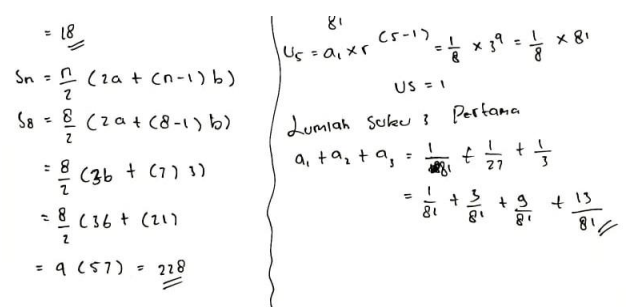


Figure 14. The answer sheet of female students in the medium category at the implementation stage

At the implementation stage, the female subjects carried out the plan according to the strategy they had developed. However, there were errors made in question number 1, resulting in incorrect answers. Additionally, in question number 2, there were numbers whose origins were unknown and errors in the use of symbols to indicate the final result. Based on the interview results, female students with moderate problem-solving abilities were aware of the mistakes and errors on the answer sheet for question number 2.

At the rechecking stage, the female subjects did not review or write a conclusion for the solution. Therefore, it can be concluded that the female subjects were not able to fulfill the rechecking stage.

2.3 Mathematical Problem-Solving Ability in Female Student of High Category

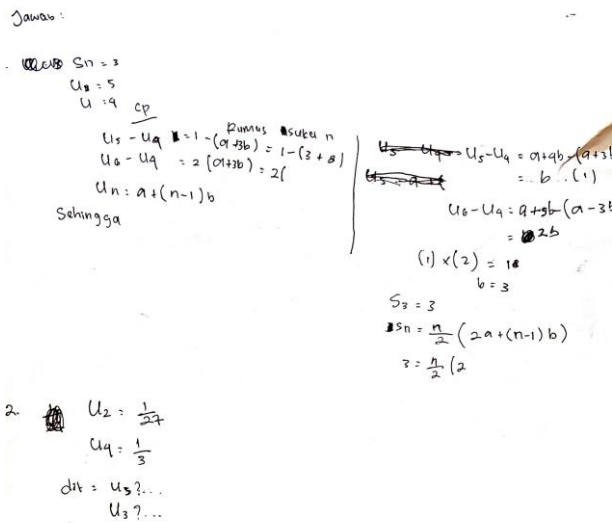


Figure 15. Student answer sheet for a female student in the low category

Based on the data analysis from the test questions and interviews conducted, it is evident that the female subjects were unable to understand the given problem for question number 1. However, for question number 2, the female students were able to write the known and asked information, although there was an error in one of the asked pieces of information. The interview results show that female subjects with low problem-solving abilities did not understand question number 1, while for question number 2, it was evident that the female subjects understood the known and asked information in the question. This aligns with the findings of Tarigan, Simanjorang, and Siagian (2022), which state that female students are generally better at

writing down the known and asked information according to the information provided in the question at the problem-understanding stage.

At the planning stage, it is evident that the female subjects were unable to determine a plan to solve the problem. Based on the interviews conducted with the female subjects, it is clear that those in the low category had difficulty understanding the given material, making it challenging when faced with questions related to that material. This aligns with the research by Nada and Yulia (2023), which states that a lack of mastery of the material or a lack of understanding of concepts affects students' critical thinking abilities, including their understanding of the methods or steps to solve the problems.

At the implementation stage, the female subjects were unable to fulfill this step because they did not know the strategy or formula to use to solve the problem. This aligns with the findings of Ramda, Gunur, Makur, and Efrem (2020), which state that students experience confusion in completing the next steps if they do not know the formula to use.

At the rechecking stage, the female subjects did not write a conclusion or perform the rechecking step. This was because there was no final result obtained in solving the given problem.

Conclusion

Based on the results and discussions presented, the mathematical problem-solving abilities of students, viewed from a gender perspective, are as follows:

a. Male students with high mathematical problem-solving abilities are able to understand problems well, although they do not write down the known and asked information completely. They can develop plans, execute plans according to the strategies made, but are less meticulous in the calculation process, and can recheck even though they do not write conclusions. Male students with moderate mathematical problem-solving abilities can understand the given problems, but do not write them on the answer sheet. They can develop and execute plans, but not completely, and are unable to recheck. Male students with low mathematical problem-solving abilities are unable to understand problems, develop plans, execute plans, and recheck.

b. Female students with high problem-solving abilities can understand problems, develop plans, and execute plans. Female students with moderate mathematical problem-solving abilities can understand problems, but do not write them on the answer sheet. They can develop and execute plans, but not completely, and are unable to recheck. Female students with low problem-solving abilities can understand problems, but are unable to develop plans, execute plans, and recheck.

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