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ANALYSIS OF MATHEMATICS PROBLEM-SOLVING ABILITY BASED ON IDEAL PROBLEM-SOLVING STEPS GIVEN STUDENT LEARNING STYLES

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Abstract

Mathematical problem-solving ability is an ability in which students try to find solutions that are carried out in achieving goals, also requires readiness, creativity, knowledge and abilities and their application in everyday life. The lack of students' mathematical problem-solving abilities also causes the teaching and learning process of mathematics to not achieve the expected learning outcomes. This research aims to describe the mathematical problem-solving abilities of students with visual, auditory, and kinesthetic learning styles in solving sequence and series questions based on IDEAL problem-solving steps. In this study, the research method used is qualitative. This research was conducted at SMA Negeri 1 Kartasura. There are 36 students in class XI IPA 2 for the 2021/2022 academic year, with details of 11 male and 25 female students. Furthermore, data collection was carried out, namely holding a written test with sequences and series material. Meanwhile, in this study, the triangulation technique used is time triangulation. The results of the analysis and discussion show that students with a visual learning style have good abilities in solving mathematical problems. Students with a visual learning style have no difficulty solving math problems based on the IDEAL Problem-Solving step.

Keywords: Learning Style; Mathematic; Problem-Solving.

Abstrak

Kemampuan pemecahan masalah matematis merupakan kemampuan dimana siswa berupaya mencari jalan keluar yang dilakukan dalam mencapai tujuan, juga memerlukan kesiapan, kreativitas, pengetahuan dan kemampuan serta aplikasinya dalam kehidupan sehari-hari. Kurangnya kemampuan pemecahan masalah matematis siswa juga menyebabkan proses belajar mengajar matematika itu tidak mencapai tujuan hasil belajar yang diharapkan. Penelitian ini bertujuan untuk mendeskripsikan kemampuan pemecahan masalah matematis siswa dengan gaya belajar visual, auditori, dan kinestetik dalam menyelesaikan soal-soal berurut dan berangkai berdasarkan langkah-langkah pemecahan masalah IDEAL. Dalam penelitian ini, metode penelitian yang digunakan adalah kualitatif. Penelitian ini dilakukan di SMA Negeri 1 Kartasura. Jumlah siswa kelas XI IPA 2 tahun pelajaran 2021/2022 sebanyak 36 siswa, dengan rincian 11 siswa laki-laki dan 25 siswa perempuan. Selanjutnya dilakukan pengumpulan data yaitu mengadakan tes tertulis dengan materi urutan dan deret. Sedangkan dalam penelitian ini teknik triangulasi yang digunakan adalah triangulasi waktu. Hasil analisis dan pembahasan menunjukkan bahwa siswa dengan gaya belajar visual memiliki kemampuan yang baik dalam memecahkan masalah matematika. Siswa dengan gaya belajar visual tidak mengalami kesulitan dalam menyelesaikan soal matematika berdasarkan langkah Pemecahan Masalah IDEAL.

***Kata kunci**: Gaya Belajar; Matematika; Problem-Solving.*

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INTRODUCTION

Every branch of science must have mathematics; in other words, mathematics always has a role in every branch of science because every branch requires calculation (Putri et al., 2019). Since kindergarten (TK), elementary and secondary schools, and higher education cannot be separated from learning mathematics. Mathematics exists in every individual's daily life, both consciously and unconsciously. Therefore, mathematics is very important for every individual to pursue education. Peranginangin et al., (2019) mentions 5 main standard competencies of mathematical thinking processes in learning mathematics, including problem-solving, connections,reasoning and proof, representation, and communication. Peranginangin et al., (2019) also emphasized that problem-solving cannot be separated from learning mathematics because problem-solving is integral to learning mathematics.

The importance of problem-solving skills is stated in the Minister of Education and Culture of the Republic of Indonesia No. 22 of 2016, that the implementation of the learning approach used is a learning approach whose basis is problem-solving. Furthermore, the importance of students' mathematical problem-solving abilities was also stated by Branca (Osman et al., 2018): (1) the general goal in teaching mathematics is the ability to solve problems, even the ability to solve the problem itself is referred to as the heart of mathematics; (2) problem solving which consists of strategies, procedures, and methods are the core and main process in learning mathematics; (3) basic skills in learning mathematics, namely the ability to solve mathematical problems. The ability to solve mathematical problems is also a major part of the objectives of learning mathematics to be achieved. Through solving mathematical problems, students can learn to deepen their understanding of mathematical concepts, for example, by using mathematical applications to solve real-world problems. Further development of problem-solving abilities can train students to think systematically, logically, critically, analytically, and creatively (Huang et al., 2020; Putri et al., 2019; Ramdan et al., 2018).

However, the mathematical ability still needs to improve in Indonesia. The results of the Program for International Student Assessment (PISA), which was released on December 3 2019, show that on students' mathematical reasoning scores, Indonesia ranks 72nd out of 78 countries. This is, of course, very unfortunate, considering, as explained earlier, that mathematical abilities, especially in problem-solving, are important for students (Febriana et al., 2020; Rosyada et al., 2021). The low ability of students' mathematical problem solving was also found in SMA Negeri 1 Kartasura. Mr A1 said that it was often found that students needed help understanding the problem. Students tend to have difficulty identifying problems, especially in the form of stories. Looking at the teacher's interview data and student answers above, itsnecessary to further investigate students' abilities in solving math problems.

Sequences and series are compulsory mathematics material learned in class XI at the high school level/equivalent. In the matter of sequences and series, there are several sub-materials which include Arithmetic Sequences and Series, Geometry

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Sequences and Series, and Applications of Sequences which include decay, growth, annuities, and compound interest. It is often found that students still need help solving a sequence and series problem properly, especially in story form questions. The research conducted by Rahmah et al., (2022) showed that out of 10 students, only 1 student could solve word problems well in sequences and series material, meaning that 9 other students still needed help to solve the problems properly. For this reason, an effort is needed to train students from an early age to develop problem-solving abilities. In extreme situations, this can be feared, causing students to look for scada solutions, even negative problem-solving solutions.

There are various models and problem-solving methods to solve a problem in mathematics. One of them uses the IDEAL Problem-Solving model. In 1993, Bransford and Stein. They published a model to solve the problem: the IDEAL Problem-Solving Model. Pratiwi et al., (2021) Explains that IDEAL Problem Solving can be applied to identify and provide solutions to students' abilities that are still weak in solving any problem. Problem-solving steps based on the IDEAL Problem-Solving model include (1) problem identification, (2) setting goals, (3) planning possible strategies, (4) implementing the planned strategy, and (5) reviewing and evaluating.

Permata et al., (2018) and Rahmawati et al., (2021) They explained that the IDEAL Problem-Solving model is a learning activity to assist students in solving problems whose goal is to increase student understanding through learning material that is being studied procedurally and conceptually. Indriyani et al., (2018) said that IDEAL Problem Solving could describe how students can solve problems. IDEAL Problem Solving was chosen because the problem-solving steps of the IDEAL Problem-Solving model are more detailed than previous problem-solving, such as problem-solving according to Polya. In contrast, IDEAL Problem Solving is made into two stages. Therefore, researchers are trying to find a more straightforward solution to a mathematical problem that has yet to be widely used.

In addition to problem-solving abilities, learning styles are also important to get attention in learning. According to Pritchard in (Hobri et al., 2020; Pohan et al., 2020; Szabo et al., 2020), learning style is a person's way of learning by using the usual, preferred or best tools or strategies for thinking, acquiring knowledge, skills, processing information or knowledge and demonstrating learning. Aisyah et al., (2021) and Handayani et al., (2022) revealed, "The assumption that a lesson gives the same results to all students when the teacher teaches the same methods, materials, and assessment procedures is a wrong assumption". In contrast, students' interests, emotions, personalities, and skills remain different. Teachers need to know the learning styles of their students so that teachers can determine learning media and learning methods that are suitable for their students. (Ganesen et al., 2020).

Nuraini et al., (2020) visual learning is a learning style in which data, concepts, ideas, and other information are packaged in pictures and techniques. This makes it possible to focus on learning visually while neglecting other learning styles. Therefore, researchers want to conduct further research to determine students'

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mathematical problem-solving abilities with a review of learning styles. Based on the description above, this study aims to describe the mathematical problem-solving abilities of students with visual, auditory, and kinesthetic learning styles in solving sequence and series questions based on IDEAL problem-solving steps.

METHOD

In this study, the research method used is qualitative. The researcher wants to describe students' abilities in solving problems or math problems regarding sequences and series in terms of their learning styles through data obtained in the field. There is no hypothesis in this study, and the data that will be generated is descriptive data or written words.

This study began by grouping students based on their learning styles through a student learning style questionnaire, namely visual, auditory, and kinesthetic learning styles. Furthermore, data collection was carried out, namely holding a written test with sequences and series material. Then a problem-solving analysis was carried out from the answer data and interviews with the research subjects obtained.

This study has data on students' learning styles and data on students' problem-solving abilities on sequences and series of math problems. Data on the grouping of student learning styles was obtained from the results of the learning style questionnaire. In contrast, data on students' problem-solving abilities in sequence and series of math questions were obtained from written test answers and student interview transcripts. In this study, the subjects were students of class XI IPA 2 SMA Negeri 1 Kartasura for the 2020/2021 academic year on the materials of Arithmetic Sequences and Series, Geometry Sequences and Series, and Applications of Sequences which include Decay, Growth, Annuities, and Compound Interest. This research was conducted at SMA Negeri 1 Kartasura. Based on the advice of the Mathematics Teacher, Mr A1, students of class XI IPA 2 were chosen as research subjects. There are 36 students in class XI IPA 2 for the 2021/2022 academic year, with details of 11 male and 25 female students.

They were taking research subjects in this study and used a purposive sampling technique. Taking research subjects using purposive sampling aims to detail the specificities that exist (Sugiyono, 2018). In this study, sampling was based on the results of a questionnaire on students' learning styles and initial abilities. The student's initial ability here is the ability that students already have before giving a written test. Students' initial abilities are used as a reference to enlarging the learning style review factor in knowing and describing problem-solving abilities. The selected students had the same initial abilities) and the highest questionnaire scores for each previously known learning style.

Data collection in this study aims to obtain data related to students' mathematical problem-solving abilities on sequences and series of questions with an overview of student learning styles. Data collection techniques used include Questionnaires, Tests, and Interviews.

In this study, the triangulation technique used is time triangulation. Time triangulation is used to check the confidence of research findings from the same source but at different times or conditions. Time triangulation in this study is by using the analysis of the

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results of the first test and the implementation of the first interview, which is then called data 1, as well as the analysis of the results of the first test and the second interview is called data II. If data I and II have the same tendency, then data I and II are declared valid. The qualitative data analysis technique is carried out through steps according to Miles and Huberman (Sugiyono, 2018), namely: Data reduction, data presentation, and conclusion.

RESULT & DISCUSSION

1. Description of the Research Location

This research was conducted at SMA Negeri 1 Kartasura. Based on the advice of the Mathematics Teacher, Mr A1, students of class XI IPA 2 were chosen as research subjects. There are 36 students in class XI IPA 2 for the 2021/2022 academic year, with details of 11 male and 25 female students. Teaching and learning activities are carried out in a hybrid manner (in a network) where learning is carried out without face-to-face meetings. For mathematics subjects, it is mandatory to carry out 5 lessons each week, with one hour of 45 minutes of lessons. The schedule for compulsory mathematics lessons for class XI IPA 2 is on Tuesdays at 09.30-11.45 WIB and Thursdays at 09.30-11.00 WIB.

2. Description of the results of the Learning Style Questionnaire

The learning style questionnaire instrument determines the selection of research subjects. In this study, there were 36 questionnaire items with details of 12 questionnaire items for each learning style. Several suggestions from the validator included a. It is better not to use words with scale or frequency elements. b. Statements should not also contain elements of "social desirability" or normative statements so that the choice of answers will focus on very appropriate or very inappropriate. c. Look at several items that are essentially similar or even the same. d. Consistent writing of sentence structure, paying attention to the subject element (me). e. Writing the word or connecting word "in" as a description of a place must be written separately. f. Please pay attention to the sentences' effectiveness; there are a few that I think need improvement.

Data collection for the learning style questionnaire trial was carried out on Friday, October 11, 2021, in class XI IPA 3. The results of the questionnaire will be calculated for internal consistency and reliability. After being calculated, the instrument is reliable, and 21 questionnaire items are suitable for use. The 21 questionnaire items were then used to determine the type of learning style of the research subjects, namely class XI IPA 2 students, which was held on October 28, 2021.

3. Description of Written Test Results

In this study, there were 2 written tests, each containing 3 questions. Several suggestions from the validator include: a. Pay attention to writing EYD on each item. b. Pay attention to the form of question number 3 for each type; is it easy for students? The question should be replaced because it is hoped that it will give the desired data results. c. Look again at the language in question 3, type 1.

Written test data collection was carried out twice. The first test will be held Monday, October 28 2021, at 09.00-10.00 WIB. Meanwhile, the second test will be carried out a week

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later on Monday, November 5 2021, at 09.00-10.00 WIB. Tests I and II are carried out in a hybrid manner through Google Meet media. The test was accompanied by researchers and a mathematics teacher, namely Mr A1, as the written test's supervisor to avoid collaboration between students when carrying out the test.

4. Description of Research Subject Selection

Six students selected the subjects of this study with the provision of 2 students for each type of learning style. The selection of research subjects was based on the highest learning style score for each learning style and looked at the student's initial ability data on the results of the PTS test (midterm assessment) as a reference. The selected student data with the highest learning style scores and students' initial abilities tend to be the same (shown in table 1 and table 2).

Table 1. Research subject data

Name Initials	Learning Style Questionnaire Score		
	Visual	Audio-tori	Kines-tetik
ABI	22	17	16
MDA	18	23	17
AN	24	17	20
FIH	18	18	22
AAA	17	18	23
EM	17	21	17

Table 2. Types of research subjects

Name Initials	PTS value	Types of Learning Styles	Subject
ABI	87	Visual	Subjek 2
MDA	88	Audiotori	Subjek 4
AN	87	Visual	Subjek 1
FIH	86	Kinestetik	Subjek 6
AAA	87	Kinestetik	Subjek 5
EM	86	Audiotori	Subjek 3

The data provided in the given tables represent the results of a study conducted on six students, where two students were selected for each type of learning style. The selection of the research subjects was based on the highest score obtained by each student in their respective learning style questionnaire. The data on the student's initial ability, as measured by the PTS test, was used as a reference to select the research subjects.

Table 1 shows the research subject's name, initials, and their respective scores on the learning style questionnaire. The learning style questionnaire scores are classified into three types: visual, auditory, and kinesthetic. Table 2 provides information on the types of research subjects, their initials, PTS value, types of learning styles, and subject numbers. The table shows that the selected research subjects with the highest learning style scores and initial abilities tend to be the same, and the table links the research subjects to their learning styles and subject numbers.

5. Students' Mathematical Problem-Solving Ability with Visual Learning Style

Students with a visual learning style consist of two subjects: Subject 1 and Subject 2. The analysis results found that with the type of visual learning style, students could carry out mathematical problem-solving on sequences and series based on IDEAL Problem-Solving steps well. Students with a visual learning style have an advantage in seeing and reading. According to (Putri et al., 2019), one of the characteristics of the visual learning style is being able to see and understand positions or numbers well. They are strengthened by the opinion of Pratiwi

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et al., (2021) and Soebagyo et al., (2022) that vision plays an important role for someone with a visual learning style. It is very important to have the ability to see and understand positions or numbers in sequences and series material. With this ability, it is easy for students to identify problems and plan problem-solving strategies according to the steps of IDEAL Problem Solving properly. In line with research conducted by Eshetu & Assefa, (2019) and Ulandari et al., (2019) which stated that students with a visual learning style could understand problems by writing down information known from the problem, writing down the things asked, and developing strategies to solve the problem.

Another characteristic of the visual learning style is that it is always thorough and even tends to detail. Indriyani et al., (2018) By having characteristics that tend to be meticulous, students with a visual learning style tend to avoid mistakes when calculating answers. This is consistent with the study's results that students with a visual learning style can implement strategies and re-examine answers carefully according to IDEAL steps. Problem Solving. These results are also in line with research by Pratiwi et al., (2021) which states that students with a visual learning style have good abilities in identifying problems, making plans or strategies, implementing plans or strategies, and looking back at answers.

Visual style students can: (1) Know and write down what information can be obtained from the problem. (2) Know and write down what is asked and the purpose of the problem. (3) Explore and develop strategic planning to solve problems and connect questions using previously learned formulas and material. (4) They are carrying out the chosen strategy coherently and gradually. (5) I was looking (checking) again and evaluating whether the steps taken were correct and following the original plan.

6. Students' Mathematical Problem-Solving Ability with Auditory Learning Style

Students with an auditory learning style consist of two subjects: Subject 3 and Subject 4. From the results of the analysis, it was found that in the type of auditory learning style, students are only able to carry out 2 steps of solving mathematical problems regarding sequences and series based on IDEAL Problem Solving properly, namely the Identify stage Problem and Define Goal From the research results it is known that students with an auditory learning style have difficulty in strategizing and connecting questions with the formula according to the steps of IDEAL Problem Solving. Students with an auditory learning style need help processing information; they only know and write down the things in the problem without being able to process and devise a problem-solving strategy. According to Peranginangin et al., (2019) the theory is that one of the characteristics of the auditory learning style is weakness in visual activities such as seeing writing, pattern numbers or formulas where this ability is needed in sequences and series material. In line with the results of research conducted by Rahmawati et al., (2021) stated that students with an auditory learning style needed help in formulating the right strategy were unable to connect questions with formulas and were not carefull.

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Students with an auditory learning style have not been able to (1) explore and plan strategies to solve the problems they face and relate questions to formulas and material that has been previously studied, (2) carry out strategies that have been selected coherently and gradually, and (3) see (check) again and evaluate whether the completion steps that have been implemented are correct and following the original plan

The results of data analysis also show that students with an auditory learning style need to re-check their answers properly; students with an auditory learning style tend to only look back at their answers at a glance - without recalculating their answers or checking their answers carefully. This is in line with research by Imamuddin M et al. (2019), which states that students with an auditory learning style are classified as low in the indicator of re-examining answers.

7. Mathematical Problem-Solving Ability of Students with Kinesthetic Learning Styles

Students with kinesthetic learning styles consist of subjects, Subject 5 and Subject 6. From the analysis results, it is found that in the type of kinesthetic learning style, students can only carry out 2 steps of solving mathematical problems regarding sequences and series based on IDEAL Problem Solving properly, namely the Identify stage Problems and Define Goals. Kinesthetic learning style, students tend to understand the material more easily if the learning process is accompanied by physical activity (Pratiwi et al., 2021). There is minimal direct physical use in learning activities in temporal sequences and sequences. Therefore, kinesthetic learning style students need help understanding and completing sequences and series material well. Students with a kinesthetic learning style have difficulty seeing patterns of a sequence or series and applying the right strategy according to the IDEAL Problem-Solving steps precisely so that it is constrained in performing calculations in solving problems.

Students with a kinesthetic learning style are not yet able to (1) explore and plan strategies to solve the problems they face and relate questions to previously studied formulas and material, (2) carry out strategies that have been selected coherently and in stages, and (3) see (check) again and evaluate whether the completion steps that have been implemented are correct and following the original plan.

In addition, the results of data analysis also show that students with a kinesthetic learning style tend to be negligent in carrying out the last step of IDEAL Problem Solving, namely checking answers again. After finishing working on the questions, students with a kinesthetic learning style do not check their answers to ensure everything runs smoothly in the calculations. The following research by Permata et al., (2018) and Rahmawati et al., (2021) states that students with a kinesthetic learning style tend to refrain from implementing these indicators in the indicator of re-examining answers.

Based on the research results obtained, one implication can be made as follows.

1. Theoretical Implications

This study provides an overview of students' mathematical problem-solving skills in sequence and series matters based on the IDEAL Problem-Solving step in terms of student learning styles. The results of the analysis and discussion show that students with a

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visual learning style have good abilities in solving mathematical problems. Students with a minimal learning style tend to be able to solve math problems based on the IDEAL Problem-Solving step.

Meanwhile, students with auditory and kinesthetic learning styles could only carry out the first 2 steps of solving mathematical problems based on the IDEAL Problem-Solving step, namely the Identify Problem and Define Goal stages. The other stages are Explore Possible Strategies, Anticipate Outcomes and Act, and Look Back and Learning with auditory and kinesthetic learning styles that have yet to be able to carry out well. Based on the study results, students with auditory and kinesthetic learning styles have difficulty processing information known from the problem, so they can design the right strategy or way to solve the problem. Students with auditory and kinesthetic learning styles also tend to ignore the answer retrieval step, which is useful for minimizing calculation errors. The results of this study can be used as material for theoretical studies to create scenarios for learning mathematics by paying attention to student learning styles.

2. Practical Implications

This study aims to obtain in-depth information about students' mathematical problem-solving skills in the material on the daily and series based on the IDEAL Problem-Solving step-in terms of students' learning styles. Knowing students' abilities in solving math problems based on IDEAL Problem-Solving steps will make it easier for teachers to find student weaknesses in working on problems. Among them are identifying problems, determining the objectives of the questions, compiling and implementing problem-solving strategies, and thoroughness in re-checking answers.

Students of each learning style have different abilities in solving daily and series problems by knowing the types. Students learning styles can help make it easier for teachers to determine appropriate learning methods in classroom learning. In preparing lesson plans with mathematical problem-solving indicators, further consideration must be given to students with auditory and kinesthetic learning styles. Students with this learning style need to improve at compiling and implementing problem-solving strategies and thoroughness in re-checking answers.

CONCLUSION AND SUGGESTION

From the results of research on mathematical problem-solving abilities based on IDEAL Problem-Solving steps in student learning styles, the following conclusions are obtained: First, in the type of visual learning style, students can carry out problem-solving based on IDEAL Problem-Solving steps well. Second, in the type of auditory learning style, students are only able to know and write down what information can be obtained from the questions and can know and write down what is being asked and the purpose of the questions. Third, in the type of kinesthetic learning style, students are only able to know and write down what information can be obtained from the problem and can know and write down what is being asked and the purpose of the problem.

From the results of the research that has been obtained, the following are some suggestions that can be conveyed by researchers: The results show that the visual learning style has good mathematical problem-solving

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abilities. In contrast, the auditory and kinesthetic learning styles cannot solve mathematical problems well. Other interested researchers can use the results of this study as a reference to conduct further research to address the abilities of students with auditory and kinesthetic learning styles who are still weak in solving mathematical problems. To further overcome this problem, other researchers can conduct research at different levels and materials and use different theories to solve mathematical problems—for example, the theory of John Dewey, David Johnson and Johnson, Lawrence Senesh, and Polya.

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