Students' Problem-Solving Abilities in Solving the PISA Test in Terms of Learning Style

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Abstract
This research applies a qualitative descriptive approach. The purpose of this research is to describe students' problem-solving abilities in solving the PISA test based on each type of learning style, namely visual, auditory, and kinesthetic. The students involved in this research were 35 students, class X from SMA Negeri 1 Kedungwaru, Tulungagung. The method of obtaining data was by using students' answer sheets and interview results. The results obtained from this research indicate that students carry out Polya steps when solving the PISA test. Based on the characteristics of learning styles, it shows that (1) a student with a visual learning style finds it easier to write than to tell when solving the test and uses previously seen methods, (2) a student with an auditory learning style is good at speaking and able to understand information by listening to explanations from other people, and (3) a student with a kinesthetic learning style is used to practicing directly without being connected to what has previously been seen and heard. Therefore, teachers should pay attention to each type of student learning style to achieve learning goals effectively and well.
Keywords: problem solving, PISA test, learning styles.

Introduction

As time progresses, science develops increasingly. One of the sciences that continues to develop is mathematics. In the world of education, mathematics contributes a lot and has a significant role (Suryaningtyas & Setyaningrum, 2020). This is shown by the existence of mathematics at the elementary school level, junior high school, high school, and even college. Mathematics learning in schools aims to train students' thinking skills, such as critical thinking skills, analytical thinking skills, creative thinking skills, logical thinking skills, and so on (Rizqiani & Hayuhantika, 2019). In addition, mathematics learning aims to develop problem-solving skills, so that students are able to explain how to solve problems (Lahdenperä et al., 2022).

Problem-solving is an effort made by individuals to solve the problems they are facing (Suryaningtyas & Setyaningrum, 2020). According to Saputra & Andriyani (2018), problem-solving is an activity that links several rules or concepts that have been previously learned to obtain the solution to a problem. Problem-solving not only relies on memory but also elaborates the complex activities using several procedures and skills in solving it. Therefore, solving mathematical problems includes understanding the problem given, interpreting into mathematical form, choosing the appropriate algorithm, checking the calculations, and drawing conclusions based on the solution obtained (Arumsari et al., 2024; Khairunnisa & Setyaningsih, 2017).

The ability to solve mathematical problems is not as expected. The results of the PISA survey evidence this. The PISA results are used to measure student achievement and see the extent of students' knowledge and skills in problem-solving. In 2018, Indonesia was ranked 72 out of 78 participating countries (OECD, 2019). Then in 2022, Indonesia rose to 68 out of 81 participating countries (OECD, 2023). The results for 2022 still show that Indonesia is in the lower ranking. In addition, the average mathematics score fell 13 points to 366 from the previous 379. Thus, these results show that students' mathematical problem-solving abilities are still relatively low (Dewantara, 2019). In practice, students are still not used to solving problems with real context characteristics such as PISA problems (Hidayati et al., 2020; Saputri & Mampouw, 2018). Students are still accustomed to solving problems that require memorization and procedural problems exemplified by teachers without connecting them to everyday life.

PISA conducts future-oriented assessments, namely assessing students' abilities in using knowledge and skills, so that it can be seen to what extent students are ready to face real-life challenges (NCTM, 2000). The PISA test not only applies concepts but also how the concepts are used in various situations in everyday life (Jurnaidi & Zulkardi, 2014; Septiadi, 2022). According to (Khairunnisa & Ramlah, 2021), the PISA mathematics test is an international standard question that raises problems in everyday life and relates them to mathematics. Therefore, students need to be accustomed to solving everyday issues such as in PISA test, this is to improve students' mathematical problem-solving abilities.

Student success in problem-solving is related to learning styles. This is supported by Nur (2010) who stated that students' ability to solve problems is influenced by learning styles. Furthermore, according to (Waskitoningtyas, 2017) stated that learning styles affect students' success in solving mathematical problems. During the teaching and learning process, students use their senses to receive information. Therefore, each student has their way of understanding the material received. The way each student receives the information is called a learning style (Bire et al., 2014).

According to Huda et al. (2017), learning style is a style chosen by students to understand the material during the learning process. There are three types of learning styles, namely visual, auditory, and kinesthetic (De Porter & Hernacki, 2015). Students with a visual learning style tend to use their sense of sight to understand the information or material being studied. Furthermore, students with an auditory learning style tend to use their sense of hearing to understand the information or material being studied. While

students with a kinesthetic learning style tend to use movement or prefer to practice during the learning process (Wahyuni, 2017). Each student tends to learn. Thus, students need to be helped and directed to recognize their learning style. This is because students who recognize their learning styles will be aware of their abilities and know their needs so that the learning outcomes obtained will be maximized.

Based on the description above, the researcher will conduct a study entitled "Students' Problem-Solving Abilities in Solving the PISA Test in Terms of Learning Style" to determine students' problem-solving abilities in solving the PISA test based on their learning styles, namely visual, auditory, and kinesthetic.

Method

This research applies a qualitative descriptive approach. This research was conducted to understand the phenomena experienced by the research subjects, such as perceptions of actions, behaviors, and others by describing them in written or oral form written in narrative form (Moleong, 2015). This research aims to describe in detail the problem-solving abilities of students in solving the PISA test based on each type of learning style, namely visual, auditory, and kinesthetic. This research was conducted at SMAN 1 Kedungwaru which is located in Tulungagung Regency, East Java. The class used for the research location is class X-7. The number of students involved in this study was 35 people.

The data in this research were obtained by giving PISA test to 35 students. This PISA test is an application of the material Linear Equation Systems: Three Variables. Furthermore, the researcher selected three students from each learning style based on the PISA test results and suggestions from the mathematics teacher. The chosen students were students who could communicate well to facilitate communication between students and researcher during interviews. The three students included: students with a visual learning style, an auditory learning style, and a kinesthetic learning style. This was intended so that each type of learning style could be represented. The flowchart of research subject selection can be seen in Figure 1. During the interview process, the researcher recorded the interview results using a cellphone.

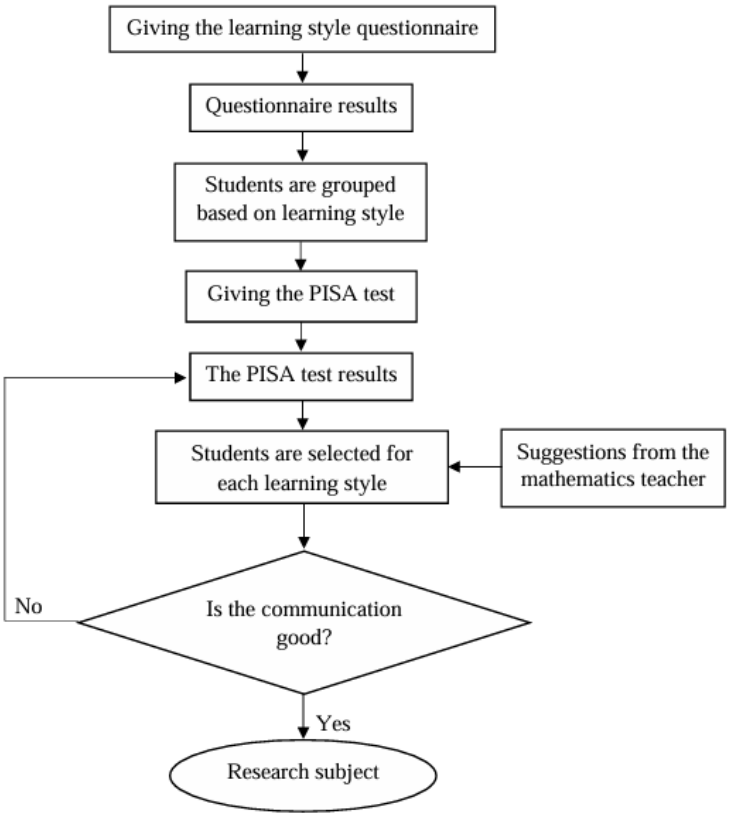

Figure 1. Flowchart of research subject selection

The data obtained from this research are in the form of student answer sheets and interview results from each type of learning style. The data is then analyzed to determine students' problem-solving abilities in solving the PISA test. Data analysis on problem-solving abilities is based on Polya's steps indicators. An explanation of the four steps according to Polya which are used as guidelines in solving mathematical problems can be seen in Table 1.

Table 1. Polya's four steps in problem-solving.

Problem-solving Steps	Descriptions
Understand the problem	In this step, students understand what the question is asking and what information is available to solve the problem, represent problems in symbols or simple words that can facilitate problem-solving.
Devise a plan	In this step, students figure out what method they will use to solve the problem
Carry out the plan	In this step, students use the method chosen to solve the problem. This may involve performing calculations or solving equations.
Look back	In this step, students evaluate the problem-solving method and check the answer to make sure it is correct.

Results and Discussion

The results of the research were obtained from the results of the PISA test and interviews with students. Three students were interviewed: students with a visual learning style, an auditory learning style, and a kinesthetic learning style. The following will describe the problem-solving abilities of the three students who have been selected.

A Student with a Visual Learning Style (SV)

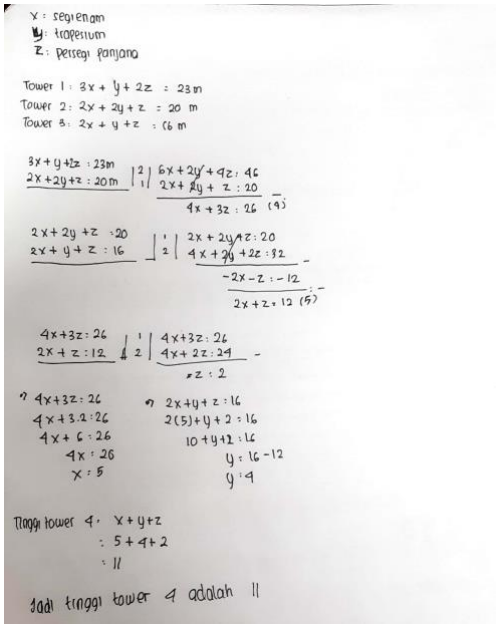

Figure 2. SV's answer sheet

Based on the answer in Picture 2, it shows that SV can understand the test well. This can be seen when SV can write down what is known by representing the problem in a mathematical model to make it easier to solve the PISA test. Even though SV does not write the questions, through interviews SV can explain what needs to be completed in the test. This is supported by research by (Machromah et al., 2021) that students with a visual learning style in the step of understanding problems can write and retell the problems given systematically and clearly.

At the step of devising a plan, SV makes a plan to solve the PISA test. The plan was to solve this problem like solving the Linear Equation System: Three Variables problem. This is supported by research by (De Porter & Hernacki, 2015) that students with a visual learning style find it easier to understand and remember something they have seen. Students did not immediately write the plan on the answer sheet but recounted it through interviews.

At the step of carrying out the plan, based on the answer sheet in Picture 2, SV can implement plans that have been prepared and solutions to problems are interrelated. This follows the research results of (Machromah et al., 2021) that students with a visual learning style at the step of carrying out the plan can solve problems sequentially. This follows the characteristics of students with a visual learning style, including being diligent and careful in doing something (De Porter & Hernacki, 2015). It's just that when interviewed, SV was reluctant to retell what had been written because she felt his answer was enough to answer the questions asked. This is as expressed by (De Porter & Hernacki, 2015) that students with a visual learning style tend to solve problems in written form rather than verbally.

At the looking back step, SV checks the problem-solving and the correctness of the answers. In line with research by (Ishartono et al., 2021), students with a visual learning style recheck to ensure the correctness of the answers based on known concepts.

A Student with an Auditory Learning Style (SA)

Based on the answer sheet and interviews, show that SA can understand problems well. SA can write down what is known and what will be looked for. SA can retell again what needs to be solved in the problem. This is similar to students with a visual learning style, where students can mention the information obtained in the problem and identify it (Ishartono et al., 2021).

At the step of devising a plan, SA did not write it on the answer sheet but recounted through interviews about the plan that had been made. SA thought about previous mathematical knowledge to solve this problem, namely by thinking about solving the Linear Equation System: Three Variables. This is supported by research by (Mardiana et al., 2024) that students with an auditory learning style can make good problem-solving plans.

At the step of carrying out the plan, SA solves this PISA test based on the plan that has been made, meaning using the solution of the Linear Equation System: Three Variables. This is supported by research by (Laila et al., 2021) that students with an auditory learning style can carry out problem-solving plans well. SA solves the Linear Equation System: Three Variables by remembering the teacher's explanation. This follows the characteristics of students with an auditory learning style who can understand information or knowledge by listening to what has been explained by others (De Porter & Hernacki, 2015; Wahyuni, 2017).

At the step of looking back, SA checks problem-solving. This is supported by research by (Laila et al., 2021) that students with an auditory learning style can check the results of problem-solving well. Based on the interview results, it was shown that SA can answer the questions asked and re-explain the process of solving the PISA test completely and clearly. This is following the character of students with an auditory learning style who are good at speaking and can explain something in detail using their language (De Porter & Hernacki, 2015; Mardiana et al., 2024; Wahyuni, 2017).

A Student with a Kinestetic Learning Style (SK)

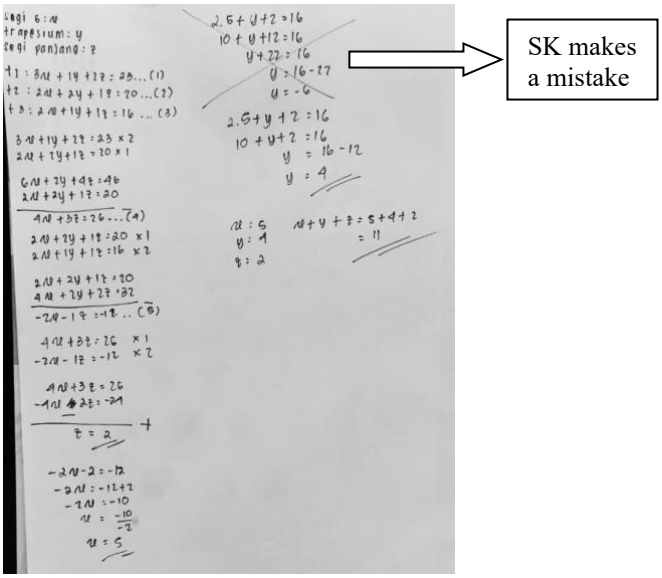

Figure 3. SK's answer sheet

Based on the answer sheet in Picture 3, shows that SK can understand the problem well. SK can write down what is known and can explain it again through interviews. SK understands problem by representing the problem in mathematical form before solving it. Although SK did not write down what needed to be looked for but can explain it again during the interview. These results are supported by research (Ishartono et al., 2021) that at the step of understanding the problem, students with a kinesthetic learning style can rewrite the information collected in the problem and confirm through interviews.

At the step of devising a plan, SK did not write it on the answer sheet but explained it again through an interview about the plan that had been made. At this step, SK thinks about the elimination method in the material on Linear Equation Systems: Three Variables. SK explains in detail the plan for solving the PISA test. This is supported by research by (Laila et al., 2021) that students with a kinesthetic learning style can make good problem-solving plans.

At the step of carrying out a plan, SK can carry out the plan that has been prepared previously. During the process, SK knows the material used to solve the problem but does not relate this problem to what has been seen before, such as similar questions, or to what has been heard before, such as the teacher's explanation. This follows the characteristics of students with a kinesthetic learning style who like to practice and try directly (De Porter & Hernacki, 2015).

At the step of looking back, SK checks the answer to ensure it is correct. After checking, the answer was invalid, therefore SK rechecked the previous steps to find the error. In Figure 3, it can be seen that the SK error is a mistake in writing the number. This shows that SK can check the correctness of the answers and recheck the steps to solve the problem. This is supported by research by (Ishartono et al., 2021) that students with a kinesthetic learning style can check and assess the correctness of their answers based on the concepts they have obtained.

Conclusion and Suggestion

Based on the results and discussions presented, the researcher concluded that students with visual, auditory, and kinesthetic learning styles could solve the PISA test well. The three students also followed Polya's steps in solving the PISA test. Students with visual and auditory learning styles did not make mistakes, unlike a student with a kinesthetic learning style who makes a mistake and can correct them. Each type of learning style shows that a student with a visual learning style finds it easier to solve test in written form than orally and use methods that she has seen before. Then, a student with an auditory learning style shows that students are good at speaking and can understand information by listening to explanations from other people. Furthermore, a student with a kinesthetic learning style is accustomed to solving tests by trying directly without linking to what has previously been seen and heard. Based on what has been explained by the researcher, it would be good for teachers to pay attention to each type of student learning style to achieve learning goals effectively and well. Further research is expected to develop more in-depth research on student learning style, or those that cover the PISA test model.

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