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STUDENTS' THINKING PROCESS IN SOLVING PROBLEMS IN TERMS OF *GUARDIAN* AND *IDEALIST* PERSONALITY TYPES

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ABSTRACT

This study aims to describe the thought process of students in solving problems in terms of personality types guardian and idealist in class XI SMA Negeri 5 Palu. This research is a qualitative descriptive research. The main instrument in this research is the researcher himself and supporting instruments are The Keirsey Temperament Sorter (KTS), math the problems, and interviews. The results of this study show that guardian students and idealist students are able to perform all stages of the thinking process in solving math problems, namely receiving information, processing information, and forming conclusions. Guardian and idealist students at the stage of receiving information read the problem well. Guardian students read enough once to understand the problem, while idealist students read repeatedly to understand the problem. At the information processing stage, guardian students can explain the problem solving plan while idealist students have difficulty explaining the solution plan. At the conclusion formation stage, guardian students consistently solve the problem according to what was previously planned. idealist students at the conclusion formation stage can solve the problem even though at the information processing stage they cannot explain the solution plan.

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1. INTRODUCTION

Students' thinking process in solving problems can be seen in problem solving or problem solving done by students in working on problems (Retna et al., 2013). Problem solving is not the main goal of learning mathematics, but it also serves as an important measuring tool in learning mathematics. Problem solving is an integral part of the mathematics learning process (NCTM, 2000). When students solve problems, it is not to

apply math, but to learn new math (Walle, 2008). When solving problems, students carry out a thinking process in their minds so that they can arrive at an answer.

The thinking process produces something called thinking results that lead to certain goals (Widyastuti, 2015). Sudarman (2011) defines the thinking process as all mental activities that occur through changing information into new knowledge. Solso at al (2007) revealed that the thinking process has three stages, namely 1) concept formation, 2) logic, and 3) decision making. While the thinking process according to Suryabrata (2011) has three steps, namely 1) formation of understanding, 2) formation of opinion, and 3) drawing conclusions or forming decisions. Meanwhile, Pujiono (2017) defines the thinking process as a series of mental activities that occur to obtain new information which includes the stages of receiving information, managing information, storing information, and recalling information used when needed.

This study uses two of the four steps of the thinking process Pujiono (2017) namely receiving information and processing information. The information formation step in this study refers to the conclusion drawing or decision making proposed by Suryabrata (2011) and also refers to the making decision step by Solso at al (2007). So based on the opinions of several experts Solso at al, (2007); Suryabrata, (2011); Pujiono, (2017) the thinking process referred to in this study is a series of mental activities carried out by a person in managing and transforming information in memory to find a solution to a problem. Indicators of each step of the thinking process are presented in table 1.

Darma (2013) argues that the essential aspect of learning, namely the student's thinking process, seems to be ignored so that it has an impact, namely many students who cannot fully understand mathematical concepts so that they tend to get unsatisfactory math learning outcomes. Steiner and Cohors-Frensenberg (in Rizal, 2011) stated that, the main task of mathematics education is to explain the thinking process of students in learning mathematics with the aim of improving mathematics teaching at school. It is very important for teachers to know the thinking process of students in solving math problems so that teachers can find out the type and location of their mistakes. Understanding the thinking process of students can be a source of information for teachers in teaching (Hasanah et al., 2013). By knowing students' thinking processes, teachers can identify the types of errors made by students. These errors can be used as a source of information for learning and improving student understanding. Errors made by students must be very different, and the way they think is also different. According to (Dewiyani, 2012), students with different personality types will have different thinking processes.

According to Euis (2007) personality is a dynamic organization within an individual whose psychophysical system determines a person's characteristics, behavior, and way of thinking. Each individual has differences in behavior, actions, speech, and thinking. Individual characteristics affect a person's thought process. A person's thought process can determine their personality type. Individual characteristics are closely related to the personality of humans (Muryati, 2016). In the world of education, to know the characteristics of individuals both in the learning process and to know the learning style that is good and right can be known from the student's personality type. Human personalities are so diverse, it is even possible that the number is the same as the number of humans living on earth (Hamidah & Suherman, 2016). Kieirsey (1984) classifies personality into four types, namely guardian, artisan, rational, and idealist. The classification is based on how one gets their energy (extrovert or introvert), how one gets information (sensing or intuitive), how one makes decisions (thinking or feeling), and how one observes and judges (judging or perceiving).

Students with the guardian type like the teacher to clearly explain the material and give instructions in a precise and real way, the material must be started in reality. Before doing a task, guardian types want detailed instructions, and if possible include the usefulness of the task. Artisan types like change and dislike stability. This type is always active in all circumstances and always wants to be the center of attention of everyone, both peers and teachers. Tends to spontaneously apply newly discovered solutions. Rational type likes explanations that are based on logic. Able to grasp material requiring high intellect, faster in observing problems, carrying out strategies systematically and coherently after being given by the teacher, likes to look for additional material by reading books. Idealist type likes material about ideas and values. Prefers to complete tasks individually rather than in groups, can view problems from various perspectives, likes reading and writing.

Research on the thinking process in solving mathematical problems in terms of the kiersey personality type has been carried out by several researchers, namely the mathematical thinking process using Polya's Steps (Hamidah & Suherman, 2016), mathematical thinking process (Agustin, 2018), the thinking process of assimilation, accommodation, and abstraction using Polya's Steps (Anjani et al., 2021). Researchers conducted research on the thinking process of students using aspects of the thinking process of receiving information, processing information, and forming conclusions in solving problems in terms of the guardian and idealist personality types.

Based on the above, this research aims to (1) describe the thought process of students in class XI MIPA SMA Negeri 5 Palu who have guardian personality type in solving math problems; and (2) describe the thought process of students in class XI MIPA SMA Negeri 5 Palu who have Idealist personality type in solving math problems.

2. METHOD

This research was conducted at SMA Negeri 5 Palu City, with the research subject being 2 students of class XI even semester of the 2022/2023 academic year. The selection of research subjects was based on several criteria, namely (1) the students had received the material of the equation of the tangent line of a circle; (2) the students already had enough learning experience so that they were expected to be able to solve the problems on the material of the equation of the tangent line of a circle; (3) students in grade XI may be able to communicate their thoughts orally and in writing well. The subject selection procedure in this study is (1) preparing the KTS (Keirsey Temperament Sorter) test; (2) giving the KTS test to all students of class XI MIPA 7; (3) grouping students based on the Kiersey personality dimension; (4) selecting 2 research subjects based on the Kiersey personality dimension; (5) grouping subjects into personality types; (6) determining the criteria for selecting research subjects; (7) selecting research subjects.

Data collection techniques consist of documentation, interviews, and test questions. Data processing techniques in this study were carried out by giving written tests and interviews, then the data will be used as material to be analyzed from the results that have been done by the subject, namely (a) selecting 2 students consisting of 1 student with a guardian personality type, and 1 student with an idealist personality type; (b) determining the time of data collection by considering study time and schedule; (c) collecting data on students' thinking processes by giving assignment questions in solving the problems given, after students work on the problem the researcher asks questions that aim to see the students' thinking processes referring to table 1 and using audio recorder tools; (d) analyzing the data of the 2 students; (f) testing the credibility of data using time triangulation is a technique of testing the credibility of data by obtaining data from the same source at different times and asking students to carefully examine the results of data analysis that has been carried out by

Table 1 Indicators of Thinking Processes in Solving Math Problems

Thinking Process Aspects	Indicator
Reception of Information	• Read the information in the problem. • Identify the relevant information known and asked in the problem.
Processing of Information	• Connecting existing knowledge with the information obtained • Determining plans, formulas, and procedures that will be used to solve the problem
Formation of Conclusion	• Implementing plans, formulas, and procedures from the knowledge possessed to solve the problem • Make the final conclusion

researchers with the suitability of the researcher's interpretation of the data (information) that has been given to the subject so that credible data is obtained; (g) comparing the results of data analysis on each research subject to obtain conclusions on the creative thinking process data of students who have a guardian personality type and students who have an idealist personality type.

The main instrument of this research is the researcher himself and the supporting instruments of this research are the task questions of the equation of the tangent line of the circle and interview guidelines. Data analysis techniques in this study were carried out by: (1) reviewing all available data from various sources, such as from interviews and written data, then reducing the data by selecting the main things that are in accordance with the focus of the research; (2) presenting data in narrative text; and (3) concluding the thinking process based on each personality type.

3. RESULTS AND DISCUSSION

3.1. Results

From the results of the analysis of the personality type grouping instrument according to Keirsey, the data obtained, the number of guardian personality type 18 students, artisan type 7, rational type 6, and idealist type 4. Each group of guardian and idealist personality types selected one subject each based on the consideration of the teacher who teaches in class XI MIPA 7 about students' ability to communicate and can express their opinions or thoughts orally and in writing. Students selected as research subjects in the guardian personality type category were given the initials GU and in the *idealist* category were given the initials ID.

Subject GU in solving math problems can solve well and get the correct answer. The following is an analysis of the Guardian subject's thinking process based on the stages of the thinking process

1) Reception of Information

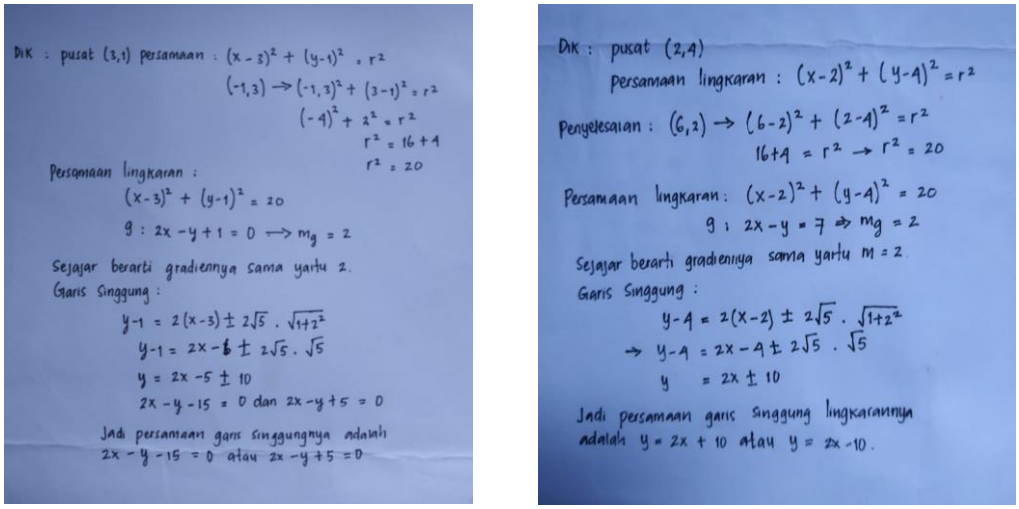
At the stage of receiving information, subject GU can read the problems given carefully and the problem is read enough once. Subject GU can also determine relevant information known and asked in the first and second problems. Subject GU can connect the known and questionable information.

2) Processing of Information

At the information processing stage, the GU subject can determine the formula for finding the equation of the tangent line of a circle. The guardian subject can also explain the plan that will be used in solving the problem, namely by finding the equation of the circle

first to find out the radius of the circle in problems I and II. then GU mentions that the line $2x - y - 7 = 0$ is parallel, therefore the gradient is the same, namely 2. Next, find the equation of the tangent line to the circle with the known information and the information that has been obtained.

3) Formation of Conclusion



Picture 1. Student GU Problem Solving Results (from left to right: answers to questions I and II)

At the stage of forming conclusions, the subject GU can carry out the plan according to the plan made previously. Starting with finding the equation of the circle to find the radius, although GU did not write down the formula used to find the equation of the circle but revealed it directly during the interview process. After getting the radius of the circle then the GU subject looks for the equation of the tangent line of the circle, GU writes and enters the center of the circle, radius, and gradient in the formula without writing the formula on the answer sheet. GU can operate the formulas used in accordance with prior knowledge so that the right results are obtained in questions I and II. The GU subject can also write the conclusion of the results obtained.

Subject ID in solving math problems subject ID can solve even though there is a mistake in using the formula to find the radius of the circle. The following is given an analysis of the thinking process of subject ID based on the stages of the thinking process.

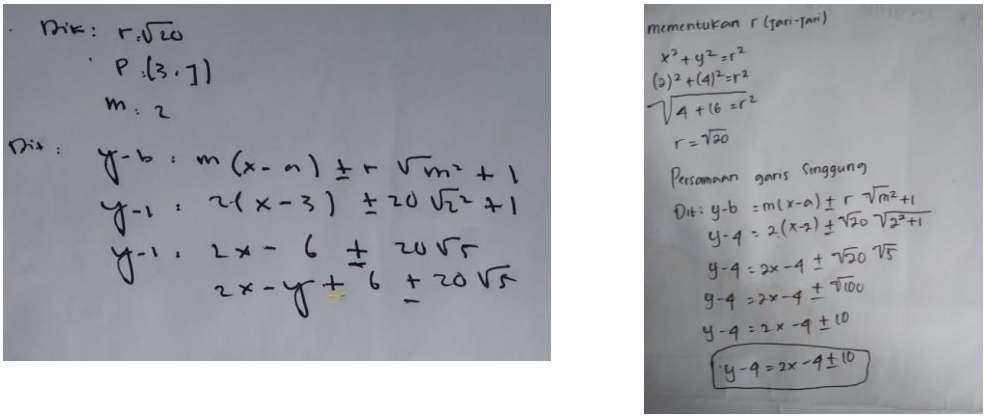
1) Acceptance of Information

At the stage of receiving information, subject ID reads the problem carefully and repeatedly. In determining the known and questionable information in questions I and II, the ID subject explained it well.

2) Information Processing

At the information processing stage, subject ID has difficulty determining the formula to be used to solve problem I and problem II. In addition, the ID subject also cannot determine the plan that will be used in solving the problem.

3) Formation of Conclusions



Picture 1. Student ID Problem Solving Results (from left to right: answers to questions I and II)

At the conclusion formation stage, ID subject can solve the problem even though at the information processing stage ID cannot determine the solution plan. In problem I, subject ID wrote the radius of the circle without any completion process, then subject ID determined the equation of the tangent line of the circle by entering the known information into the formula but ID was still mistaken in the concept of solving the problem so that the answer obtained was still not correct. In problem II, Subject ID when finding the radius of the circle uses a formula that is understood, the concept of the formula and its solution is not wrong so that it gets the value of the radius of the circle, ID also does not write the conclusion of the results obtained in problem I or problem II.

3.2. Discussion

Based on the results and analysis that have been described, the following is a discussion of the students' thinking process that can be presented by the researcher. Students who have a *guardian* personality type and students who have an *idealist* personality type can perform all stages of the thinking process. Starting from receiving information, processing information, and forming conclusions.

Thinking Process of Guardian Students in Solving Problems

At the information reception stage, students who have a *guardian* personality type can determine the information known and asked correctly. This is in accordance with research Hamidah & Suherman (2016) which states that guardian students can directly identify known things and things asked in the problem smoothly and correctly.

At the information processing stage, *guardian* students can determine the formula for finding the equation of the tangent line of a circle. The guardian subject can also explain the plan that will be used in solving the problem. This statement is in line with research Anjani et al (2021) which states that guardian students can explain and write correctly and fluently how to solve problems, and present the solution steps correctly.

At the conclusion formation stage, *guardian* students can carry out the solution plan in a short time and consistently carry out according to what was previously planned. and can operate the formulas used in accordance with prior knowledge so as to obtain the right results. guardian students can also write conclusions from the results obtained. This is in accordance with research Hamidah & Suherman (2016) guardian students can determine smoothly and correctly how to re-check the results that have been obtained by looking at the suitability between the results that have been obtained and those known in the problem.

Idealist Students' Thinking Process in Solving Problems

At the information reception stage, students who have an *idealist* personality type can determine the information known and asked correctly. This is in accordance with research Hamidah & Suherman (2016) which states that guardian students can directly identify known things and things asked in the problem smoothly and correctly.

At the information processing stage, *idealist* students have difficulty determining the formula that will be used to solve the problem. In addition, ID subjects also cannot determine the plan that will be used in solving the problem. This statement is in line with research Hamidah & Suherman (2016) which states that idealistic students cannot determine what steps will be used to solve the problem. This is in line with Dwianjani & Candiasa, (2018) opinion that the ability to determine the solution strategy is the most important factor affecting problem solving ability.

At the conclusion formation stage, *idealist* students can solve the problem even though at the information processing stage idealist students cannot determine the solution plan. students can believe in the truth of the results that have been obtained. This is in accordance with research Hamidah & Suherman (2016) students cannot mention what steps will be used so that students do not get the correct answer. This statement is also in line with Agustin (2018) who argues that students who have an idealist personality type are students who are able to connect all indicators of mathematical thinking even though not perfectly.

4. CONCLUSION

Based on the results of the study, several conclusions were obtained, namely, *guardian* and *idealist* students at the stage of receiving information read the problem well. Guardian students read enough once to understand the problem, while idealist students read repeatedly to understand the problem. At the information processing stage, guardian students can determine the formula to be used and can explain the problem solving plan while idealist students have difficulty using the formula to be used and cannot explain the problem solving plan. At the conclusion formation stage, guardian students consistently solve the problem according to what was previously planned and make conclusions from the solution results. *Idealist* students at the conclusion formation stage can solve the problem even though at the information processing stage they cannot explain the solution plan and do not write the conclusion of the answer results.

Here are some suggestions based on the research that has been done

1. The completion results show that in the thinking process students who have the idealist type are still not maximized in drawing conclusions and there are errors when finding the radius of the circle. In addition, students with idealist type are also lacking in implementing the solution plan. Based on this, it is hoped that teachers can encourage idealist students to better understand the problems faced and be able to carry out all stages of the thinking process in solving math problems.
2. At the time of the interview there were questions that were not understood by the subject so that it did not explore the students' thinking process, so it is advisable for other researchers to ask questions that can other researchers to ask questions that can make the subject understand the question and can explain the answer so that it can obtain research data to explore more deeply the students' thinking process.

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