

Sri Adi Widodo, Turmudi. (2017). Guardian Student Thinking Process in Resolving Issues Divergence. *Journal of Education and Learning*. Vol. 11 (4) pp. 432-438. DOI: 10.11591/edulearn.v11i4.5639

Guardian Student Thinking Process in Resolving Issues Divergence

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Abstract

The purpose of this study was to determine the thought processes of students' guardian in resolving the problem of divergence. This study included descriptive qualitative study. Instruments in the study are the researchers themselves with the help of personality tests KTS and Student Worksheet. Data collection procedures used techniques Think Out loud. Data analysis technique used to examine all the data collected, making the classification of personality types, examines the work of students in solving mathematical problems, verification of data. As for checking the validity of the data using the criteria of degree of trustworthiness. The results showed that the student's guardian do the thinking process of assimilation to the four stages of problem-solving Polya that stage to understand the problem, plan to resolve the issue, implement the plan and check the answers.

Keywords: *Thinking of Process, Problem Solving, Guardian*

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Introduction

Problems can occur if a person has certain rules that can be used to address gaps in the current situation with the objectives to be achieved. To achieve these objectives, one needs efforts to solve problems involving thought processes optimally. This is due to resolve the issue someone needs to find rules to overcome these problems. If someone has been able to override the gap current situation with the objective to be achieved (through self-created rules) then this person can be said to solve the problem.

Low ability to solve the problem due to teachers evaluation using multiple choice and evaluation questions used are mostly not solving the problem [1, 2]. Though the ability to solve problems became the focus of mathematics at all levels of education [3] and even the ability to solve the problem becomes one of the goals of mathematics learning is to foster critical thinking skills, logical, systematic, thorough, effective, and efficient in solving problems [4]. As it is known that with problem-solving, mathematics will not lose meaning because only the students are able to apply problem-solving concepts or principles that exist in mathematics.

Problems solving in mathematics is an activity to find a solution to a mathematical problem faced by using all the mathematical knowledge possessed by learners. Steps to solve the problem or solve the problems of mathematics refer to the opinion of Polya is to understand the problem, make a plan, implement the plan, and check the answers [5]. The indicators of students in solving problems is (a) understand the problem: it can determine what is known and asked of matter, can be recounted about the problem with its own language, (b) make a plan: can the terms sufficient and necessary condition of a problem, can use all of the information that has been collected, (c) execute the plan: it can use the steps correctly, algorithms and precision skilled in answering questions, and (d) to re-examine the answer: can perform the inspection results to the answers to the questions [1, 6]

In solving math problems, students usually do the thinking process. The thinking process of the student can not be seen and can not be felt by teachers, this is because the thought process is the activities that occur in the human brain [7]. Although the thought process can not be seen and be perceived by others, educators can find out the thinking of students by looking at the results of the students' work in solving the problem or by interview. This is done so that teachers know the consistency of information or data entered and processed by the brain as well as the students expressed by students through written or oral.

Transformation of information or knowledge can be done in two ways: assimilation and accommodation [8]. Assimilation is the process of integrating the new stimulus directly into the existing scheme, assimilation is a process and organizes the individual in adapting to the environment / new challenges so that the understanding of learners develops [8, 9, 10]. For example, a student has a scheme of multiplication as a sum of numbers n times. Then, the teacher provides new information on the exponential multiplication of numbers the same or n times. With the release of such information, students will find the process of multiplication as a sum of numbers n times differ by multiplying the same number n times because it has specificity, is writing. Students need to enter this new information into the scheme that has been owned by the multiplication process of trying to work the same number of the n times.

While the accommodation is the process of integrating the new stimulus by changing the old scheme or the establishment of new schemes to adjust to the stimulus received, the accommodation process will occur in every individual if the individual is not able to assimilate new experiences with a scheme that has been incorporated [8, 9, 10]. For example in the process of multiplication of the same number n times is done, students will modify the scheme which already owned that multiplication as a sum of numbers n times by adding a multiplication scheme exponentially as the same number n times. By modifying, students will gain a new scheme of the exponential is the multiplication number n times with the specificity of these numbers together which can then be written in the form $ab = c$ with a is number, b is number of repetitions, and c is the product that is also is the result of exponential.

The thinking process is done by every individual is unique, meaning that the thinking process of the student A is different to that done by other students. Differences in the process of thinking are because each individual has a different personality [11], different ways of thinking and thinking styles vary [12, 13].

One role of the teacher in the school mathematics is to help learners express how processes running in his mind when solving a problem, for example by asking students to tell the steps he was thinking of them with signs, gestures, and language, either in writing or orally [14]. Reveal the person's thinking process both written and oral is required to determine the error of thinking that happens and smoothing network knowledge learners [7].

To find the thought of a learner on the process towards a particular question, of course, not be seen from their behavior, but the specifics of the work of learners. To be able to know the mindset of the students, one of them can be a way to invite students to discuss with teachers so that learners want to say what was in his thinking at the time working on a particular matter. Based on this, the goal of this research is to know the thought process students the type of guardian in resolving the problem of divergences in the course of vector analysis.

Personality is a person's behavior is dynamic and is within himself and used to adapt to the environment. Usually used to categorize human personality. This is because personality has traits, characteristics, style or attributes that are associated with a typical individual. So it can be said that personality comes from formations that we receive from the environment, for example, the formation of a family in our childhood and also congenital innate inborn.

Guardian is one personality type that is raised by Keirsey, where the personality type is reliable, likes to help others, and diligent. Someone with personality guardian can be a friend, someone who is fully responsible and has character (soul) leader, guardian has a tendency to be obedient, very careful, simple, and strive to maintain the trust that has been given to him. Population someone with the personality of the guardian between 40-45% of the total population in the world. Personality guardian is divided into four dimensions, namely supervisor, inspector, Provider, and Protector [15, 16].

Research Method

This study was a descriptive qualitative research because it will be revealed in depth thought process guardians students in solving problems of the divergence. Selection of study subjects according to purposive sampling techniques, it because subjects used in this study were selected carefully so that relevant or appropriate to the objectives to be used in this study [17]. Subjects that will be used in this study must have a personality Guardian and is taking courses vector analysis. To determine whether the subject that will be used to have a personality guardian or not it should be given a personality test called the Keirsey Temperament Sorter (KTS) which has been modified and adapted.

Because this study is a qualitative research, the researcher acts as the primary instrument in collecting data, assisted with supporting instruments, namely (1) a classification of personality type, hereinafter referred to KTS and (2) a worksheet solving mathematical problems. Instruments personality test is a test to determine a person's personality type, taken from the book Please Understand Me II by David Keirsey and Marilyn Bates. KTS should be modified and adapted beforehand to match the characteristics of the subjects that will be used. After KTS modified and adapted, the instrument will test the construct validity and reliability were tested. Construct validity is done by people who are expert in the art that the background of the English language and psychology. People background the English language is used for the original version of the KTS use English. While the background in psychology because KTS used to know about a man's personality. After KTS has been validated, continued testing of KTS, of the test results shows that for preference KTS Vs Introvert Extrovert, Sensing vs. Intuitive, Thinking vs. Feeling, and Judging Vs Perceiving has a reliability index of more than 0,800. Referring to the opinion of Ahmad Rifai, a personality test kits at least have reliability index of 0.800. Under these conditions, the KTS can be used to determine a person's personality [18].

Students who will be the subject of research is Sup1, Sup2, Ins1, Ins2, Prv1, Prv2, Prt1 and prt2. Furthermore, the subjects were given a worksheet that contains the related issues of divergence is

1. If $\phi = 2xy^2z^3$ and $\vec{A} = 2yzi - x^2yj + xyz^2k$ define $\nabla(\phi\vec{A})$
2. Known to the height of a hill (in meters) is $p(x,y) = 10(2xy - 2x^2 - 4y^2 - 18x + 28y + 12)$ with x is distance to the east of the town J (in kilometers) and y is distance to the north of the city J (in kilometers). Determine the location of the top of the hill is located and the height of the hill.
3. Prove that $\nabla(\nabla \times \vec{A}) = 0$
4. If A and B is differentiable function, prove that $\nabla(A + B) = \nabla A + \nabla B$

Furthermore, the problem number 1 is called the F1, issue number 2 is called F2, issue No. 3 hereinafter referred to as P3, and problem number 4 hereinafter referred to as P4. The purpose of the worksheet is to be able to know the students' ability in solving mathematical problems based on the Polya step. This assignment sheet instrument is also validated by experts (experts). Validation is directed at the problem of conformity with the purpose of research, construction problems, and appropriate language used.

To get data research, the student was asked to send what was thought about the problem solving of mathematics, afterward was interviewed. The data that was received when the interview was recorded with a used handy cam. In this case, the method that was used to collect the data Think out loads or think aloud. Think aloud was the research method, where the subject was asked to express his

thoughts while the problem solving and ask for him to repeat again if there must be raised for the process of the problem solving, in this case, gave the opportunity to the subject to say something or what was he think about [19].

The analysis stage of the data used the analysis of the data that was developed by Moleong, that is (a) studied all the data's that were collected from various sources, (b) made classification of the temperament of the student by Keirse, (c) studied results of the worksheet in completing the problem of the solution, and (d) carried out the verification or the pulling of the conclusion from the data and the source of the data that has been classified and to transcript in the presentation/the explanation of the data [20]. To determine of trustworthiness was needed by several checked techniques. This inspection technique was based on four criterion that is the credibility, transferability, dependability, confirmability. In this research, only the credibility that was used. In the credibility, several techniques of the data inspection that could be used including being the extension of participation, observation perseverance, triangulation, the checking of the colleague, the adequacy of the reference, the case study of the negative, the checking of the member. In this research was technical that was used to determine the legality of the data in the credibility was the observer's perseverance and triangulation. The observer's perseverance was carried out by the researcher personally by means of carrying out observation in a thorough manner, conscientious and continually for the research, whereas triangulation was technical the legality inspection of the data that made use of the data that was other apart from the data that was received for the need of the checking or as the standard towards the data. As for the triangulation technique in this research was technical source triangulation that is confirming the data that was received from a source with the other source by meaning of comparing the data produced by the test written.

Results And Analysis

Understand the problem

The subject of Supervisor (Sup1 and Sup2) could write fluently and truly what was known and asked about in all the related divergence problem. Sup1 could connect directing the new experience in the available scheme of his thinking, so Sup1 carried out the process of thinking the assimilation in understanding the problem in the four problems of this divergence. Even so to the student protector (Prt1 and Prt2)

The subject Ins1 wrote fluently and truly what was known and asked about in the four related problems of divergence. Ins1 could be able to connect directly the new experience in the available scheme in his thinking. In F2, the subject Ins1 supposed the function $p(x,y)$ with t . This was done to facilitate considering in the further stages. The replacement of the symbol t this showed that the subject Ins1 also carried out the process of thinking the abstraction in understanding the problem F2. Whereas Ins2 wrote fluently and truly what was known and asked about only in the problem of the type searched (F1 and F2), whereas for the problem of the type proved (P2 and P3) only writing that was asked about. The results of interview showed that the subject Ins2 well-off connect directly to new experience in the available scheme in his thinking so that Ins2 carried out the process of thinking the assimilation in understanding the problem in the four divergence problems.

The subject Prv1 wrote fluently and truly what was known and asked about in the four related divergence problem. Prv1 could integrate direct the new experience in the available scheme in his thinking. Whereas Prv2 wrote fluently and truly what was known and asked about in the four related problems of divergence. Prv2 could integrate direct the new experience in the available scheme in his thinking. Moreover, Prv2 in P3 used the symbol $\bar{\nabla} (\bar{\nabla} \times \bar{A})$ as the replacement of div curl , this showed that the subject also carried out the abstraction of thinking in understanding the problem.

From the student guardian that was used as the subject of the research could be concluded that the guardian student could integrate directly the new experience in the available scheme in his thinking. So as to be able to be stated that the guardian student carried out the process of thinking the assimilation in understanding the problem in the four problems of this divergence.

Make a plan

Sup1 could accept information from the problem so as the plan that was used was enough to resolve the problem. Sup1 could integrate directly the perception or his new experience in the available scheme his thinking. So as to be able to be said that Sup1 carried out the process of the assimilation by planning the divergent problem resolution and the solution plan to the problem that was made by Sup1 could have been made as the guide in problem-solving. The same thing also was done by Sup2, where the subject could accept information from the four problems so as to be able to plan the problem resolution.

The subject Ins1 could accept information from the problem of divergence so the plan that was used to resolve the problem of divergence was enough to be made the guide. Ins1 could integrate directly the perception or his new experience in the available scheme him. In the problem P1, the subject used divergence as the replacement $\vec{\nabla}$. Even so in the other divergent problem. Moreover, for P3, the subject Ins1 used the term curl to explain cross product $\vec{\nabla}$ with \vec{A} . Even so F2, the subject was still using the symbol t as the replacement of the function p(x,y). Almost same was carried out by the subject Ins1, the compilation of the plan that was carried out by the subject Ins2 was enough to be made the guide resolved these problems, except in the problem F1. In F1, the subject had the scheme that $\vec{\nabla}(\vec{\nabla} \cdot \vec{A})$ was current the law distributive so as the subject Ins2 said that $\vec{\nabla}(\vec{\nabla} \cdot \vec{A}) = \vec{\nabla} \cdot \vec{\nabla} \vec{A}$.

Planning Prv1 in the problem of divergence was enough to be made the guide resolved these problems. Prv1 could accept information from the four problems so as to be able to plan the problem resolution. Prv1 could integrate directly the perception or his new experience in the available scheme. In the subject Prv2, planning that was compiled was enough to be made the guide resolved these problems. Prv2 could accept information from the four problems so as to be able to plan the problem resolution. Prv2 could integrate directly the perception or his new experience in the available scheme. Moreover, the understanding Prv2 about $\vec{\nabla}(\vec{\nabla} \times \vec{A})$ as div curl in making a plan to solve problem.

Whereas planning that was done by Prt2 in the problem of divergence was enough to be made the guide resolved these problems. Prt2 could accept information from the four problems so that the make a plan the problem solving. Prt2 could integrate directly the perception or his new experience in the available scheme in his thinking. Different from planning that was compiled by Prt1 in the problem of divergence was not yet enough to be made the guide to resolve these problems. Prt1 only wrote the condition was enough and the next necessary condition. The subject Prt1 still could not accept information from the four problems so as to still could not plan the problem resolution. Results of the interview were received that Prt1 could accept information from the divergent problem, so as the subject Prt1 could reveal the plan that will be carried out to resolve the problem. Prt1 could integrate directly the perception or his new experience in the available scheme in his thinking although only wrote the condition was enough and the next necessary condition.

Carry out Our Plan

The subject Sup1 could carry out the plan that was compiled in the part beforehand. Sup1 could resolve the four divergent problems correctly without experiencing the problem. Only in the problem F2, the subject Sup1 experienced few hindrances with results x that were negative. In relation this problem the researcher carried out the interview towards the subject Sup1 to know process of his thinking. From results of the interview was received that the subject Sup1 could be stated that the subject Sup1 could integrate directly his new experience in the available scheme in his thinking. Whereas the Subject Sup2 the difficult to resolve problem of divergence in P3. From results of the interview was received that the subject Sup2 could carry out the plan that was compiled in the part beforehand. Sup2 could resolve the four divergent problems correctly without experiencing the problem. Sup2 could integrate directly his new experience in the available scheme in his thinking.

The subject Ins1 the problem solved of divergence was in accordance with steps in the stage compiled the plan. The subject Ins1 could resolve the four divergent problems correctly without experiencing the problem. The subject Ins1 could integrate directly his new experience in the available scheme in his thinking. It can be concluded that the subject Ins1 carried out the process of thinking the assimilation in carrying out the plan to resolve the problem. Regarding planning and understood the problem, where the subject Ins1 used the process of thinking the abstraction, then in the stage carried out the plan to problem solved the divergent problem of the subject Ins1 still used the process of thinking the abstraction. This was caused by the subject Ins1 still used the symbol $\vec{\nabla}$ as the divergent, curl as cross product between $\vec{\nabla}$ with \vec{A} , and symbol t as the function p(x,y). Therefore the subject Ins1 used the process of thinking the assimilation and the abstraction in carrying out the plan in divergent problem. Whereas the Implementation of the plan that was carried out by the subject Ins2 was in accordance with steps in the stage compiled the plan. Whereas the Subject Ins2 could resolve the problem of divergence although results of the end of this problem were not yet true. Although in resolving the problem of divergence was not yet true but the subject Ins2 could carry out the plan that was compiled. The subject Ins2 could integrate directly his new experience in the available scheme in his thoughts.

The subject Prv1 could carry out the plan that was compiled in the part beforehand. Prv1 could resolve the four divergent problems correctly without experienced problem. The subject Prv1 could integrate directly his new experience in the available scheme in his thinking. Whereas Prv2 could carry

out the plan that was compiled in the part beforehand. Prv2 could integrate directly his new experience in the available scheme in his thinking. It can be concluded that the subject Prv2 carried out the process of thinking the assimilation in carrying out the plan to resolve the problem. Although in the problem F2, the subject Prv2 experienced the incompatibility in the process of the algorithm, that is the process add up $10(-17,055 - 17,744 - 29,463 + 56,556 + 75,992 + 12)$. Necessarily the addition of this equality was 782.86, but the subject Prv2 wrote 662.98 so as the subject Prv2 was wrong in resolving the problem F2. Disequilibrium was experienced by Prv2 was caused by the subject Prv2 not more thinking in the process of the algorithm. The process of thinking the abstraction that was carried out by the subject Prv2 for the problem F2 and P3 in the stage beforehand, it still was carried out by the subject Prv2. This could be shown permanently the use of the symbol h as the replacement of the height in the problem F2, and the symbol of divergence of curl A in the problem P3. So as in step carried out the plan, the subject Prv2 carried out the process of thinking the assimilation and the abstraction.

The subject Prt1 could carry out the plan that was compiled in the part beforehand. Prt1 could resolve the four divergent problems in true and correctly. The subject Prt1 could integrate directly his new experience in the available scheme in his thinking. So as to be able to be concluded that the subject Prt1 carried out the process of thinking the assimilation in carrying out the plan to resolve the problem. Whereas the subject Prt2 could carry out the plan that was compiled in the part beforehand, unfortunately, the subject Prt2 still could not resolve the four divergent problems in correctly. Like in the problem F1, subject Prt2 carried out the mistake of concept on the divergent definition. To express the process of thinking further, the researcher held the interview towards the subject Prt2. The subject Prt2 experienced the incompatibility in relation to the divergent definition. By carrying out the process of the assimilation, the subject Prt2 broke that the definition $\bar{v} = \frac{d}{dx} + \frac{d}{dy} + \frac{d}{dz}$. The impact of the definition that was concluded by Prt2 then the answer from Prt2 became wrong. In the problem P3, subject Prt2 also carried out the re-mistake so as the answer from Prt2 became wrong. From the incompatibility in the operation delta, subject Prt2 also experienced the incompatibility with the A vector assumption, where the Prt2 supposed with the A is $A_x + A_y + A_z$, with A_x was a function that only contained the value z . By carrying out the assimilation, subject Prt2 continue to suppose that $\vec{A} = A_x + A_y + A_z$. The impact of definition concluded by the subject Prt2 then the answer from the subject Prt2 became wrong.

From the guardian that was used the subject of the research could be concluded that the guardian well-off the problem solving of divergence according to plan that was compiled in the previous step. The guardian integrated directly the perception or his new experience in his available scheme. So it can be said that the guardian student carried out the process of the assimilation in carrying out the plan to resolve the divergence problem.

Look a back

The subject Sup1 did not write anything to the worksheet. Based on the interview it was known that Sup1 carried out the stage checked came back fluently although did not write him to the sheet of the answer. This was caused by the habit sup1 that only saw the step in problem solved already in accordance with the rule or not yet and results have been appropriate or not yet. The process of thinking about like this also being carried out by the Prv1 and Prv2. It different the Prt1 that carried out the stage checked came back by means of wrote came back steps in resolving the divergent problem. The process of thinking Prt1 also was carried out by the subject Prt2, Sup2, Ins1. This was done to confirm that steps that were carried out were appropriate with current or not rules. Whereas the Subject Ins2 carried out the stage checked came back with two methods that are by means of seeing the step by each step in the problem solving and wrote came back the answer.

From the guardian that was used as the subject of the research could be concluded that the guardian look to check again the answer fluently that is by means of reconsidering the step for the sake of the step and wrote came back the answer that has been carried out has been in accordance with mathematical rules or not yet. Was based on this matter then the student guardian integrated directly the perception or his new experience in the available scheme him. So it can be said that the student guardian carried out the process of the assimilation in carrying out the plan to resolve the problem of divergence.

Conclusions

Based on the analysis and discussions that were analyzed in the Part beforehand was received by the conclusion that the type student of the identity guardian carried out the process of thinking the assimilation of all the step in the divergent problem solving.

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