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By M. Satriawan

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Students' Relational Thinking of Impulsive and Reflective in Solving Mathematical Problem

M A Satriawan¹, M T Budiarto², T Y E Siswono³

¹Mathematics Education Program, Postgraduate Program, Universitas Negeri Surabaya, Jl. Ketintang, Surabaya 60231, Indonesia

²Departement of Mathematics Education, Universitas Negeri Surabaya, Jl. Ketintang, Surabaya 60231, Indonesia

E-mail: m.satriawan@mhs.unesa.ac.id

Abstract. This is a descriptive research which qualitatively investigates students' relational thinking of impulsive and reflective cognitive style in solving mathematical problem. The method used in this research are test and interview. The data analyzed by reducing, presenting and concluding the data. The results of research show that the students' reflective cognitive style can possibly help to find out important elements in understanding a problem. Reading more than one is useful to identify what is being questioned and write the information which is known, building relation in every element and connecting information with arithmetic operation, connecting between what is being questioned with known information, making equation model to find out the value by using substitution, and building a connection on re-checking, re-reading, and re-counting. The impulsive students' cognitive style supports important elements in understanding problems, building a connection in every element, connecting information with arithmetic operation, building a relation about a problem comprehensively by connecting between what is being questioned with known information, finding out the unknown value by using arithmetic operation without making any equation model. The result of re-checking problem solving, impulsive student was only reading at glance without re-counting the result of problem solving.

1. Introduction

Thinking activity cannot be separated from daily life. In fact, thinking is an activity which cannot be avoided. Thinking process of each person is different one other. One of thinking processes is relational thinking, where it can be said as the ability to understand analogy between object and event which considered differently and applying an abstract rule in a new situation [1].

Relational thinking involves using fundamental properties of number and operations to transform mathematical expressions rather than simply calculating an answer following a prescribed sequence of procedures [2]. This is because of relational thinking considers mathematical proposition which presents relation between two mathematical objects, A and B with second mathematical proposition which presents the relation between concept A and C, and then sum up the relation between B and C. In the process of learning mathematic, problem solving is an important thing for students. Generally, a problem is



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inexpediency between a fact and expectation. This means a problem is a situation that confronts a person, that requires resolution, and for which the path to the solution is not immediately known [3].

Every individual has his/her own characteristic solving mathematical problem which makes everyone different one another. Problem solving is an effort to find a way of difficulty, a way around an obstacle, and attaining an aim that is not immediately understood [4]. This difference is caused by several factors; one of which is cognitive style. Cognitive style is understood to be an individual's preferences and habitual approach to organize and represent information [5]. Knowledge about cognitive style gives a lot of information about individual differentiation. Cognitive style functions as an individual's characteristic and consistent approach to organize and process information [6]. There are 19 types of cognitive style. In general this type of cognitive style is used to classify learners based on their decision making speed and its differences can be explained by speed, accuracy, and electiveness shown for searching and manipulating the information [7]. Frequency of reflective-impulsive students in class generally counted as much as 76.2%. Besides that, reflective-impulsive style is a cognitive style which is easier to be noticed by teacher in teaching and learning process than any other cognitive styles.

This research focuses on impulsive-reflective students because based on author's observation, the amount of students is bigger than group of fast and accurate students, and group of slow and inaccurate students. Then in grouping this cognitive style is based on students' taken times to solve the problem in a certain level of accuracy from the answer given [8]. Reflective students are defined as students who need more time in solving problem, but their solution or answer given is accurate, it is therefore the given answer tends to be correct. Students who need short time in solving problem but give inaccurate and tend to be having wrong answer are classified as impulsive students. Impulsivity is a cognitive style in which individuals act before they think. Reflectivity refers to a cognitive style in which individuals think before they act, usually scanning information carefully and slowly [9].

The objective of this research is to describe relational thinking of junior high school students in mathematics problem solving based on cognitive style of reflective and impulsive. According to cognitive development theory, students of junior high school are in formal operational stage where they start to think abstractly, reason logically, and draw a conclusion from information given [10]. Stephen (2012) stated that relational thinking allows students to develop a strong understanding and foundation of algebra. It is importance to think of relational thinking for the students in learning mathematic because it is related to problem solving. Therefore it is beneficial for teacher to collect information on how the students relate information from the problem given with the concept they have understood. Relational thinking enables students to develop their understanding and strong foundation about algebra [11]. The research did not focus on male or female, but focuses on students' reflective-impulsive cognitive style.

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2. Method

This is a descriptive research with qualitative approach. It is a research that uses qualitative data and describes to produce information about students' relational thinking in solving problem. This research is a description towards the result and interview of the research subjects. The researcher learned, analyzed, and explained descriptively about students' relational thinking in solving mathematical problem from the perspective of reflective-impulsive cognitive style from the data of test result in written form and interview.

The procedure of this research was done in several stages starting on arranging additional instrument draft and doing validation of instrument by validation experts of mathematical education field. The experts were given research instrument of contextual exercises algebraic materials in a form of validation sheet including Draft I which was going to be validated. The validation sheet is used to collect the data about opinion, suggestion, and comment of the expert about Draft I. The instrument is categorized as valid if the conclusion on validation sheet can be used with a little revision or without revision. In collecting data, the researcher gave a writing test to research subject, then it was continued with interviews. Data analysis in

this research is by data reduction, presentation and conclusion. The objective of data analysis is to facilitate the interpretation of data and make the data meaningful. All techniques were purposed to elaborate the data, configure the data and manage the data.

This research was conducted in junior high school's students; with research subjects were 2 students of grade VIII. The researcher's consideration to take this class, simply because according to the theory of cognitive development from Piaget, the age of 13-15 is in a stage of formal operational when they start to be able to think abstractly, to give reason logically, to draw a conclusion from information they have and able to use their own opinion. The research subjects in this research were two students consisting of one student with reflective style and another one with impulsive cognitive style. Both students had similar ability, were communicative, and had same sex. Communicative students in this research are students who are able to deliver the meaning of what they have written orally and systematically. While, to find students who have similar ability, the researcher had discussed the teacher of the students.

Selecting research subjects was done by giving a test of cognitive style from Kagan (1964). The instrument used was cognitive style test (*matching familiar figure test*). In a class, the researcher gave a cognitive style test and then students were formed into two groups, reflective group and impulsive group. After both groups were fulfilled, the researcher chose one of the students from each group who could communicate fluently and was willing to be interviewed.

3. Results and discussion

This research purposes to describe a process of relational thinking of students' reflective and impulsive cognitive style in solving mathematical problem. The trends of reflective students are more thoroughly than the impulsive students. For a complete description, it can be seen on table 1.

Table 1. A Summary of students' relational thinking of reflective cognitive style and impulsive cognitive style in solving mathematical problem

Stage of Polya problem solving	Relational Thinking Description	
	Reflective Student	Impulsive Student
Understanding the problem	➤ Relating information which has been got with accumulation, subtraction, division, and multiplication operation. ➤ Relating between known information in a question with something being questioned to answer what is being questioned.	➤ Relating information which has been got with accumulation, subtraction, division, and multiplication operation. ➤ Relating between known information in a question with something being questioned to answer what is being questioned.
Devising a plan	Relating every step which is going to be used in solving problem, such as: using multiplication operation to decide the value which has not been known yet and using substitution to decide what is not known.	Relating every step which is going to be used in solving problem, such as: using multiplication operation to decide the value which has not been known yet and using substitution to decide what is not known.
Carrying out the plan	➤ Making equation and using substitution to decide value which has not been known. ➤ Using multiplication and addition to decide what is not known.	➤ Using multiplication operation and division operation to decide value which has not been known.

Stage of Polya problem solving	Relational Thinking Description	
	Reflective Student	Impulsive Student
		➤ Using multiplication, addition, Subtraction operation to decide what is not known.
Looking back	Reading, calculation, and re-checking every step which has been done in solving problem.	Reading at glance, giving correction, without re-calculating result of problem solving.

3.1 Relational thinking of reflective student

According to the result of the research, it is found that students' relational thinking of reflective can solve mathematical problem when understanding the problem and finding out important elements in solving the problem, that is by identifying what is being asked and finding out the information in a question, and also mentioning what is being asked and write down completely what is known. Reflective student builds relation in every element by relating information which has been known with accumulation, multiplication, division, and subtraction operation. Based on the results of the interview reflective student also built a relation about a problem entirely, that is what has been known has a relation with clues in doing arithmetic operation. It means that information which is achieved by reflective student is linked with accumulation, subtraction, division, and multiplication operation. Furthermore, there is a relation between what is known and what is being questioned; therefore what is being known is used to answer what is being questioned.

Reflective students wrote steps which are going to be used to solve the problem. Students' understanding towards the problem relates with identified information. However, knowledge has relation with the choice of arithmetic operation which is going to be used in planning problem solving. The operations used are multiplication and addition. Students' understanding about symbols, characteristics or rules to produce a model can be seen when the students make equation model from information which is got in problem solving task. Moreover, student used substitution way to find out the value of each A, B, C, and D, and value of P, Q, and S. Reflective students also build relation between unknown numbers and arithmetic operation, that is by understanding the goal of using addition operation to find out buying price and selling price and using addition and subtraction operation to find out the total price and profit.

In the stage of problem solving plan, reflective students build a relation between numbers and arithmetic operation used and the relation between multiplication and division in executing plan. This can be seen when students solve the problem given, the students use a same way with what has been planned that is by doing multiplication, accumulation, subtraction and substitution operational to solve a question. While in the stage of re-checking, students build relation by reading, re-checking every step and re-calculating the result of operation. Re-calculation has a relation with what is on the question and answer sheet, while the clue has relation with suitability of arithmetic operation used in answering question.

According to the result of problem solving and explanation above, it can be seen that reflective students write down in detail and complete in every step of solving the problem. According to the time needed, reflective students seem to need a longer time to solve the problem. Besides that, during interview, students answer the question clearly and carefully. It is in line with Kagan who stated that reflective student has slow characteristic in answering question even it tends to be a right answer [12]. Furthermore, Kagan stated that people with reflective cognitive style tend to be cautious and use all alternatives. Time needed is longer in responding, but error made tend to be small. Moreover, as stated by Philip et al, reflective students consider various alternative before responding, so the possibility of right answer is high [13].

3.2 Relational thinking of impulsive student

According to the result of the research, it can be seen that impulsive students' relational thinking in solving mathematical problem when understanding problem on indicators find important elements in understanding the problem, that is by mentioning what is being asked and write down various information which have been known. Impulsive students build relation in every element. Information which has got by impulsive student is connected with accumulation, subtraction, division, and multiplication operation. Impulsive students build connection about the entire problem by using information which has been known to answer the question.

Students write down plan steps which are going to be used to solve the problem. Impulsive students build relation between unknown numbers and arithmetic operation by using adding operation to know buying price and selling price and using adding operation to know selling price and using adding and subtraction operation to know total price and profit.

In the stage of problem solving plan, impulsive students combine relation on plan execution, which is used to solve the problem based on the plan which has been made before, such as: solving multiplication, accumulation, subtraction, and division operation to solve the question. Impulsive students only use multiplication and division operation on indicator of making problem model to find out the price of each A, B, C, and D, and each price of P, Q, R, and S. While in stage of re-checking problem solving, impulsive students build relation by reading at glance without re-calculating the result of problem solving.

According to the result of the problem solving and explanation above, it can be seen that impulsive students do not write down in detail every step in solving the problem. There are relationships between reflective-impulsive aspect and relational thinking both students' connection of each information which has been known in exercise of problem solving with arithmetic operation in understanding the problems. There are a lot of numbers appear without any explanation. The time needed in solving the problem is also short and in doing interview, impulsive students tend to give a quick response without firstly analyzing the problem encountered. This is in line with Kagan who stated that impulsive students use alternatives briefly and quickly to solve something [12]. Then, impulsive students also use a short time to give response, but tend to make error because they do not use all the alternatives. Moreover, Philip et al, also stated that impulsive student is a fast-response student in every situation, but the first response given tend to be wrong [13].

4. Conclusion

Relational thinking of reflective and impulsive subjects in solving mathematical problem is different. In the stage of executing mathematical problem solving, reflective subject is really cautious, so when there is any mistake, reflective subject will directly realize and correct it. However, impulsive subjects tend to be quick and less cautious in solving the problem encountered, so when there is any mistake, impulsive subject does not realize it and only know a part of information of question. Therefore, researcher suggests that the teacher give more attention to the students with different cognitive style, in addition, the process of learning should also be considered to recheck the result of work to avoid the incorrect answer.

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