

The Students Decision Making in Solving Discount Problem

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Abstract

This research is reviewing students' process of decision making intuitively, analytically, and interactively. The research done by using discount problem which specially created to explore student's intuition, analytically, and interactively. In solving discount problems, researcher exploring student's decision in determining their attitude which concern in the used of intuitively, analytically, and interactively. Result of this research showing that the student's decision making in solving discount problem begin with their intuitively, then interactively and continued with analytically; afterward return to intuition, interaction and end up with analytical. Those three components (intuitively, interactively and analytically) repeated occur until obtaining result which is desire.

Keyword: making decision, intuitive interactive, analytical thinking and mathematic problem

1. Introduction

Research subject about decision making has becoming a phenomenon in some research (Cokely & Kelly, 2009; Ketterlin, Geller, & Yvanoff, 2009; Wang & Ruhe, 2007). Result of the study giving enough information about student's cognitive process in a domain needed to create instructional correction, the cognitive process of decision making can be applied into many other systems which based on decision, while the used of intuition is one way of approaching decision making in managerial field.

Decision making is involving someone cognitive process (Wang & Ruhe, 2007). Decision making is a process that chooses a preferred option or a course of actions from among a set of alternatives on the basis of given criteria or strategies (Wang, Wang, S. Patel, & P. Patel, 2004; Wilson & Keil, 2001). According P. Facione and N. Facione (2007) that the decision can be regarded as an outcome or output of mental or cognitive processes that led to the selection of a course of action among several alternatives available. So that, in exploring someone's decision making will be needed a theory as guidance. Based on the above opinion, the researchers concluded that the decision is an alternative course of action of a series of actions or strategies that the students in making decisions by using intuitively, analytically or interactively at about discounts that are designed to explore the intuitively, interactively or analytically.

One of the theories of a cognitive process is "Dual process Theory (DPT)". The DPT is a Theory of a cognitive processing which contains of two systems; those are system 1 and system 2. System 1 assumed has a quick otonomy process to produce default respond, system 2 interfered by specific order in a higher reasoning or analytical process (Evans, 2013). The popularity of dual process theory is increasing, along with the increasing of criticism from many researchers. They were showing a lot of critic to this theory account. Such as unclear definition of it, lack of coherence and consistency in purposing cluster to the system's attribute with those two accounts. Therefore, this DPT phenomenon gets a lot of attention from several researchers (Evan, 2013; Gigerenzer, 2011; Keren & Schul, 2009; Osman, 2004).

First observation result, there are students with cognitive condition which is not totally included to system 1 (intuitive) and it is also not totally included to system 2 (analytical). This showed from their interview and works done by the researchers to subject. From mathematic problems which given by researchers, subject showing indication of a characteristic based on interaction. In solving mathematic problem subject doing simplification of processing and using large number of data in order to understand it; interactively process and a quick exploration in knowledge; information which giving less advantages will be discarded.

In line with observation result of high school students it has been diagnosed. Diagnose is an integral part of the studies decision making. It is also become a bridge to identify students who are probably at a risk of failure. Diagnose giving valuable information about cognition of the students in a domain which targeted. Students as a domain will directed to decision making process of discount problem, able giving detail and precise information about their thoughts. This information needed to give the students a chance to have an appropriate education which concern in mathematic study.

This research examine probability of a student in taking conclusion of solving mathematic problem which given. The studies were based on working analysis of a test result and interview. Specifically, the analysis doing based on a dual process theory, therefore the student's cognition condition which claimed by previous researchers that the student's cognition condition only in system 1 or system 2, or the cognition of student in system 2 as an improvement from system 1 (Hogarth, 2005; Keren, & Schul, 2009) answered. Next on, it becomes important for there are phenomenon which need further exploration to answer many critics appear about the Dual Process Theory.

This research goal is to exploring decision making of a student through intuition and analytical strategy to the problems given. How are the students making decision by using intuitive, analytic, or interactive to the problems which created to explore those three components? Researcher needs instruments which enable her to explore main goal. Instrument builds from theories of Decision Making, Dual Process Theory and also Interactive Metaphor Theory, from Computer Processing Information Theory. These theories enable the researcher to differentiate characteristic of intuitively, characteristic of interactively and characteristic of analytically. Furthermore, researcher will need theoretically point of view to identifying students from many different side of making decision based on intuitively, interactively and analytically to solve discount problem.

2. Theoretical Framework

2.1 Dual Process Theory and Decision Making

Daniel Kahneman interpret style of process which been saying intuition and analysis. Intuition (or system 1), is closely like associate analysis defined as an automatic and quick, it used to have a strong emotional bonding in the analysis process. Kahneman said that analysis type based on a formed habit and it is difficult to change or manipulate. Analytic (or system 2) is slower and more stable and always based on consciousness and consideration (Kahneman, 2003).

Afterward, for the past few years there are some researchers who specialized themselves to exploring ideas that there is fundamental dualism in human thoughts. Since, 1970the Dual Process Theory has been developed by the researchers in many aspects human's psychology, which included deductive analysis, decision making, and social judgment. These theories comes in different kind of forms, but each of it agree in purposing two different kind of processing mechanism to task given, which employing different procedures and able resulting something different, and sometimes having opposite result. Usually one of the process mark as something fast, easy, automatic, unconsciousness, inflexible, very contextual, and light of memory's working. While the other mark as something slow, effortful, controlled, consciousness, flexible, de-contextualized, and demanded memory's working. This theory claimed that a center of human cognition consist of two multi-purpose analysis system, which usually called as system 1 and system 2. The first operation system having fast process characteristic (fast, easy, automatic, unconsciousness, etc.) while other operation system which slower than the first (slow, effortful, controlled, consciousness, etc.) (Stanovich, 2004).

System 1, Barg (1994) was doing re-conceptualized ideas to an automatic process called as "automatic" which consist of four components, such as: consciousness, intentionality, efficiency, and controllability. A mental process labeled as "automatic" for people never realized the process of it, they cannot even realized existence of a stimulus (subliminal), how the stimulus categorized or interpret (stereotype of unconsciousness activation or constructive characteristic) or stimulus effect which occur in someone's action or decision (misattribution). Another way of a mental process to be labeled as automatic is by being unintentional. Intentionality, refer to consciousness or "start up" from a process. The mental process will automatically bias and will begin with self-unconsciousness or unwilling to begin. The third component from automaticity is the efficiency. Efficiency refers to number of cognitive resources which needed to process. The automatic process is efficient for it needs several sources. The fourth component is ability to control. It refers to someone consciousness ability to stop a process. Process which automatically uncontrolled, means that the process will be precede until it finish and a person will not able to stop it. Barg (1994) conceptualized automation as a component view (every consciousness consist of combination, will, efficiency, and control) which contradictive with history concept of automaticity as all-or-without dichotomy.

System 2 is the last and specific evolution for human. This is also known as explicit system, system based on rules, rational system, or analytic system. A person who categorized in system 2 will be thinking consecutive and slow. This is a general-domain, which been processing in the main working memory. Because of it, the person has limited capacity and slower than system 1 which correlated with general intelligence. This is also known as rational system for its reasoning based on logical standard (Evans, 2003; Tsuji, 2009). Therefore, several characteristic which related with system 2 are base on rules, analytic, controlled, demand cognitive capacity, and slow.

Decision theory widely applied in various subject, such as cognitive informatics, computer study, management study, economic, sociology, psychology, politics and statistic. Several decision strategies have proposed from different point and domain application such as maximum utility and Bayesian method. But there are deficiencies in the model of fundamental decision, mathematic decision, and strict cognitive process for the decision making. The decision in a real world assumed as repeated application from important cognitive process. Research result showing that all category of a decision strategy accordance with Ruhe (2007).

3. Method

3.1 Subject and Design

The study was conducted in SMAN 3 Jombang City. Subjects consisted of 40 students in grade 3 with details of 11 men and 29 women. Each subject was given about the discount problem. Purpose of the test is to recognize condition of their thinking condition (intuitively, interactively, and analytically). Then it was choosing subject to be interviewed with thinking condition. Subject A (Intuitively is wrong, but analytically is right), and subject B (Intuitively is right while the analytically is also right) with the consideration that the type of the subject has the potential to meet the desired conditions of the research process. Another method is by designing qualitative research and it will be able to explore decision making by the students. Data collected with method of "think aloud" (van Someren, Barnard, & Sandberg, 1994) which been doing by asking the subject of research repeating working on the test as before and asking them to tell how the process of their decision making done in the same time. By using this method, cognitive process of decision making related with the discount problem which can be recorded and analyzed.

3.2 Material

Problem discounts designed to determine intuitively, analytically and interactively students. Problem is adapted from NCTM (2008) and has been tested legibility, adapted to the high school mathematics curriculum, as well as in consultation with high school mathematics teacher. The problem is as follows:

"If the store 1 gives a discount of 50% and then discount 30%, stores 2 gives discount 70%, which of the two stores that offer the cheapest price?"

3.3 Procedure

Here is the procedure of research conducted to obtain data intuitively, analytically and interactively, the order in which participants perform three decision making process. Before every assignment be given decision making, each student was told that they would solve the problem of discount. 1) Discount problems is given to all students and then all the students were asked to respond intuitively to write the answers on the paper provided (Glockner, & Betsch, 2008). This is a step to obtain data on student intuitively right/wrong; 2) Researchers collect all the students to correct answers. This is a step to determine the data intuitively students'; 3) Restore the jobs of paper to each student and researcher asks each student do the analysis about the discount given to the use of reason (Betsch, 2007). This is a step to determine the data analytically students; 4) Researchers collect back student work to determine student analytically right/wrong. Data obtained from this step is saturated with the condition to think intuitively wrong but analytically right and completely intuitive and analytic right; 5) Researchers chose the subject to think aloud done, the chosen subject based upon consideration of communication skills as well as advice from a teacher. This step occurs from the interaction between students and researchers and obtained data on students' decision making process; 6) Data analysis and conclusions based on the results of think aloud.

4. Findings and Discussion

Of the 40 students were given matter, the results are as follows:

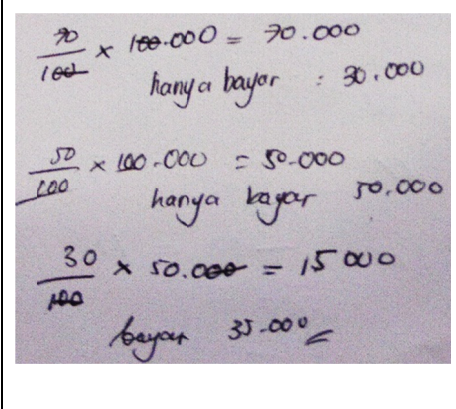
Table 1. Percentage of the work of 40 students in solving discounts

Intuitively		Analytically	
wrong	right	wrong	right
60%	40%	75%	25%

Results of the analysis provided below is based on the selection of subjects who meet wrong intuitively and right analytically called the subject A, as well as right intuitively and right analytically called subjects B. Researchers analyze and found the subject A having a spontaneous wrong answer but then after subject A asking to explain the answer subject A realized the mistake. Subject B has a spontaneous right answer, because the subject and felt that a discount of 50% then 30% discount is not necessarily greater than the 70% discount.

Subjects A direct answer spontaneously and fast “discount of 50% and then 30% discount”. Then researcher asking to subject A “are you sure?”, subject A answer “sure”. This aspect showing that subject A answer with intuitive (Evans, 2008; Evans & Stanovich, 2013; Scheffer, 2015).

The next step researcher asking subject A to think back the answer and then subject A start showing the thinking process by finishing calculation of its answer, with the result which showed as picture below.



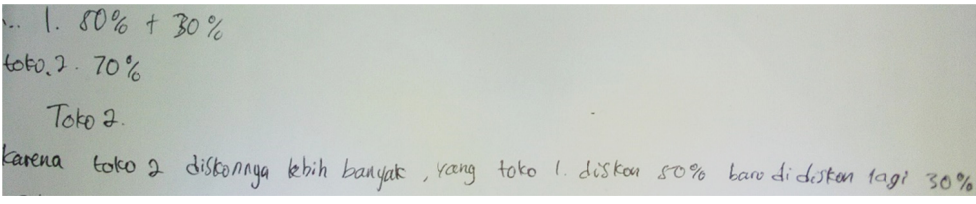
The image shows handwritten mathematical work on a piece of paper. It consists of three separate calculations, each starting with a fraction over 100 multiplied by 100,000. The first calculation is $\frac{70}{100} \times 100.000 = 70.000$, followed by the text "hanya bayar : 30.000". The second calculation is $\frac{50}{100} \times 100.000 = 50.000$, followed by "hanya bayar 50.000". The third calculation is $\frac{30}{100} \times 50.000 = 15.000$, followed by "bayar 35.000".

English translation:
 Hanya bayar = *only paid*
 Bayar = *pay*

Figure 1. The works of subject A

Base on the work of “think aloud”. Subject A revealing that at the beginning the answer is wrong and that the true answer is 70% discount. Subject A realizing the mistake after analyzing the works, and with detail calculation in the work, subject A reflecting its own thinking process.

Subject B doing the same thing as subject A that is answering fast and spontaneous but the answer is different. Afterward researcher asking to subject B “are you sure?”, Subject B answer intuitively (Evans, 2008; Evans & Stanovich, 2013; Scheffer, 2015). But the difference is subject B starting the answer with intuitive (system 1) and immediately checking the answer with analytic (system 2)



1. $50\% + 30\%$
 toko 2. 70%
 Toko 2.
 Karena toko 2 diskonnya lebih banyak, yang toko 1. diskon 50% baru didiskon lagi 30%

English translation:

Toko: Store

Jadi toko 2 diskonnya lebih besar daripada toko 1, karena toko 1 memberikan diskon 50% terlebih dahulu kemudian dilanjutkan diskon $30\% =$ So store 2 discount is greater than store 1, because store 1 give a 50% discount first and then followed a 30% discount

Figure 1. The work of subject B

Subject B repeat analyzing to the works and found the same answer as the first answer. The fundamental differences between subject A and subject B is that subject B is not reflecting to the answer it was thinking before.

Evan's (2011) research found that the difference between intuitive process and analytic process is in the process of choosing intuitive item task's information and it is still a 'relevant' process, while the analytical process operating more in a chosen item to produce conclusion or assessment. In our research, we would like to explore student's decision making with intuitive, analytical thinking and interaction. Our research has limitation subject and procedure which used, for the subject need a special interference to solve the problems occur. This research will be continued to a second chance by choosing subject base on the study experience to have a further examine in decision making process if related with intuitive, analytic and reflective thinking.

5. Result and Implication

In the result above subject A doing an accommodation process, which knowledge of subject A modified to combine a new different experience with previous knowledge. In the previous knowledge cognitive structure of subject A interpreting that discount of 50% and then 30% discount assumed as 80% discount which is bigger than 70% discount. But after analyzing this problem subject A experience accommodation which has been a process of cognitive modification. After experiencing this new cognitive modification subject A understanding that discount of 50% and then 30% discount is smaller than 70% discount.

To above result subject B has done assimilation and producing structure which fit in with problem's structure. In this case, the structural thinking of subject B has completed for it used to interpret problem's structure so that the assimilation process done perfectly. Subject B doing interpretation problem that the discount of 50% and then 30% discount assumed as two different part of discount which first is 50% discount and second is 30% discount. 50% discount understands as main discount which has smaller value than the 70% discount. Subject B analyzing that the second discount (30%) is only giving a small effect. So that, subject B more focus on the main discount that is comparing between 50% discount and 70% discount.

Those things above indicating that there were interaction of cognitive process in decision making of subject A and subject B. the changing process from intuitive to analytic which caused by interaction of system 1 (intuitive) with system 2 (analytic). system 2 is not only observing the operation of system 1 (standard role), but also interaction between those two system. While the system 2 still have to observing its own function in observation of system 1. In other word, we can conclude that it will need "system 3" (to observing system 2). While observation and criticism of system 1 is one of the reason than system 2 developing in the first place where there has been interaction between system 1 and system 2 (Leron, 2006). And then in student's process of decision making there is equilibrium, with a result that they are keep doing assimilation and accommodation process. Below is picture 3 scheme of student's decision making

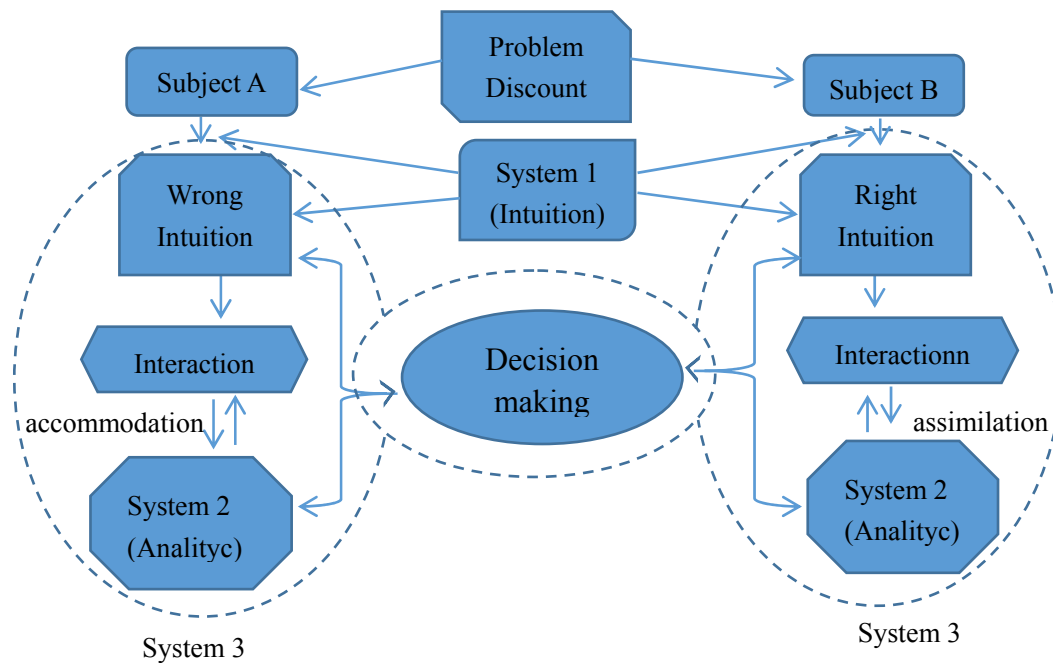


Figure 3. Scheme of student's decision making

In the earlier decision making was doing with intuitive. In the next decision making process, it was doing by involving three systems which supporting each other, those system are: system 1 (intuitive), system 2 (analytical thinking) and 3rd system (interactive). We are positively sure that decision making process of the students with intuitive, analytical thinking and interactive will giving more contribution in the next research and to the school, it will also improving teachers sensitivity and awareness of their student's thinking process.

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