

Prospective Teachers' Awareness And Regulated Thinking Process During Problem Solving in Algebra

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Abstract: *The purpose of this study is to describe prospective teachers' awareness and regulated thinking process during problem solving algebra. Awareness in this study refers to attention and recall information. While regulated thinking refers to the planning, monitoring, and evaluation. This research is a qualitative case study strategy. Subjects numbered 65 prospective teachers, but taken two prospective teachers. The results showed that awareness and regulated thinking process refers to attention, recall information, planning, monitoring and evaluation. Prospective teachers' awareness and regulated thinking process during problem solving algebra moving is not linear, meaning not sequential and repetitive.*

I. Introduction

According to Flavell (1976) and Nool (2012) metacognition is knowledge and awareness of one's cognitive processes. Furthermore, according to Brown (1987) and Nool (2012) defines metacognition as the ability to monitor, regulated and evaluate thinking. Then according Schraw&Moshman (1995) metacognitive includes cognitive knowledge and cognitive regulated. Recently according to Wilson (2001), Wilson & Clark (1995) and Magiera (2011) says, metacognition refers to the awareness, evaluation and regulation of individual thinking.

According to Wilson (2001), Wilson & Clark (2004) and Magiera (2011) metacognitive awareness is a recognition of problem solvers during the process of solving a problem of strategies used in solving the problem, linking knowledge and content, and knowledge of the specific tasks required to solve a given problem. Metacognitive regulation are problem solvers using cognitive resources for planning, setting objectives, priority actions, or choose a new action. metacognitive evaluation as problem solvers decision regarding his thinking, restriction of thinking about the problem situation, restriction strategy in solving the problem and solving the resulting quality.

According Solso (2008) states that, awareness component covering attention, architecture, recall of knowledge, emotive, novelty, emergence, selectivity and subjectivity. But in this study focused on attention and recall information. While the components of thinking settings according Scraw&Moshman (1995) includes planning, monitoring and evaluation. So metacognition in this study refers to the awareness and regulated thinking.

Met cognition

According to Flavell (1976) and Nool (2012) said metacognition is knowledge and awareness of one's cognitive processes. Furthermore, according to Brown (1987) and Nool (2012) metacognition is the ability to monitor, regulated and evaluate a person's thinking. According to Wilson (2001), Wilson & Clark (2004) and Magiera (2011) suggests metacognition refers to the awareness, evaluation and regulation of individual thinking. Then Wilson (2001), Wilson & Clark (2002), Wilson & Clark (2004), and Magiera (2011) defines consciousness metacognition as a recognition of problem solvers during the process of problem solving, problem-solving strategies and the relationship between their knowledge of what needs to be done, what has been done, and what can be done in problem solving situations. Metacognitive regulation are problem solvers using cognitive resources for planning, setting objectives, priority actions, or choose a new action. Metacognitive evaluation as problem solvers decision regarding his thinking, restriction of thinking about the problem situation, restriction strategy in problem solving and solving the resulting quality. Some researchers found that metacognition is a key to successful problem solving (Schoenfeld, 1987; Gourgey, 1998; Nool, 2012).

Awareness Framework

The main characteristic awareness framework is attention, architecture, recall of knowledge, emotive, novelty, emergence, selectivity and subyectivity (Solso, 2008). Only the component architecture which is a physiological process, while the other component is an element of psychological processes. Physiological and psychological processes contribute to the awareness and interact with each other.

Attention (attention) is the power of mental concentration on matters of external and internal (Solso, 2008). According to Stenberg (2012) Attention is centering on information processing. Attention is likened to a spotlight that focuses light beam in the direction of interest. For example in solving the problem of prospective teachers to concentrate on the processing of information about what is known of the problem, what has been done, what is being done and what will be done. Then where the position of problem solvers in the process of solving problems. Attention able to bring the conscious mind and the memories masalalu which is a feature that cooperated with the recall process information.

Recall of knowledge is a process of making information on the individual concerned and the world around (Solso, 2008). Awareness makes humans gain access to knowledge through the recall process (recognition) to personal information about themselves and the world. The process is carried out mainly with the help of the attention.

Regulated Thinking

The setting of cognition that metacognitive activities that help control a person's thinking or learning (Scraw&Moshman, 1995). Three skill settings, namely, planning, monitoring and evaluation. Planning includes the selection of appropriate strategies and resource allocations that impact performance. Examples make predictions before reading, stringing strategies and allocate time or selectively pay attention before starting the task. Monitoring is an online awareness of completeness and performance of one's duties. The ability to test yourself when learning is a good example. Scraw (1994) found that adults were able to estimate the understanding of a passage before reading associated with accuracy on a test the completeness of post-reading. Evaluation is to assess the results and the process of setting one's thinking. For example, to re-evaluate one's objectives and conclusions. So setting a prospective teacher thinking in solving algebra problems, namely, prospective teachers stringing strategy, allocate the appropriate time, to monitor and assess the completeness of performance and process berpikrinya.

Awareness characteristics and regulated thinking in Solving Problems of Algebra

In this study, researchers provide a mathematical problem to prospective teachers is a system of linear equations with infinitely many solutions, do not have a solution and have a single solution. Prospective teachers are required to resolve the issue by voicing your thoughts and what you do (think aloud). Researchers studied the results of the work and the results of prospective teachers think aloud and then identify awareness and setting a prospective teacher thought for resolving problems of algebra.

The characteristics awareness and regulated thinking prospective teachers in solving algebra problems as Table 1.1 below,

Metacognition Component	Description	Subcomponent	Description
Awareness tningking	Make a statement about thinking mathematics indicate think about: <ul style="list-style-type: none"> • What is known about the prospective teacher algebra problems, mathematical knowledge relevant to the issues algebra and algebra strategies to solve the problem • Where the prospective teachers in the process of solving problems • What needs to be done, what has been done or what can be done prospective teachers in solving algebra problems. 	Attention	<ul style="list-style-type: none"> • Concentrating his mind on the informations processing of a matter
		Recall information	<ul style="list-style-type: none"> • Recalling the concept of systems of linear equations • Recalling the concept of matrix • Recalling the concept of a quadratic equation • Recalling the concept of completing the system of linear equations by elementary row operations, the method of elimination, substitution, mix and graphs
Regulated thinking	Made statements indicating berpikir about: <ul style="list-style-type: none"> • Plan an algebraic problem-solving strategies • Setting goals • Choosing a problem-solving strategies • improve the effectiveness and limitation of thought 	Planning	<ul style="list-style-type: none"> • Choose elementary row operations strategy in solving problems • Choose the elimination strategy in menyelesaikan problem • Choose substitution strategy in solving problems • Selecting a mixed strategy in solving problems
		Monitoring	<ul style="list-style-type: none"> • Presence on the right track (on the

	<ul style="list-style-type: none"> improve the effectiveness of election strategy 		right track) <ul style="list-style-type: none"> What to do Selection of important information to solve algebra problems Suitability of the strategies used
		Evaluation	<ul style="list-style-type: none"> Assessment results Assessment of the difficulties currently Assessment of progress, ability, or understanding

Awareness and Regulated Thinking Framework Theory

Theoretical framework awareness and regulated thinking in this study include algebra problem, prospective teachers, metacognition, thinking awareness, regulated thinking, characteristics of awareness and regulated thinking and metacognition role in problems solving algebra. Algebra problems in this study refers to a system of linear equations issue that has infinitely many solutions, do not have a solution and have a single solution. Prospective teachers are having problems in terms determine a system of linear equations has infinitely many solutions, do not have a solution and have a single solution. Prospective teachers are also having problems in describing graphs of SPL and make conclusions based on the graph.

Metacognition important in solving the problem. Metacognition refers to awareness and regulate thinking. Awareness thinking referring to attention and recall information. Settings think refers to the planning, monitoring and evaluation. Metacognition role in filtering information, call information, strategic planning, performance monitoring and assessing the performance results.

Awareness and regulatedthinking a prospective teacher is important in problemsolving in algebra. With awareness and regulated thinking, prospective teachers can Concentrating his mind on the information processingof the system of linear equations, matrix operations can define strategies in accomplishing SPL. Can draw graphs of SPL and may conclude a graph of solutions. Algebra problems in this research is to solve systems of linear equations that have infinitely many solutions, do not have a solution and have a single solution. Prospective teachers completing algebra problems by voicing his thinking (think aloud). Based on the description of the think aloud and the work of prospective teachers, prospective teachers metacognitive process can be identified. Metacognitive process refers to the awareness and regulation think that has a component attention, recall information, planning, monitoring and evaluation. Metacognition instrumental in realizing and prospective teachers organize thinking in solving algebra problems. Awareness and settings characterized think that awareness and setting a prospective teacher thinking in solving the problem can be described.

II. Research Method

This research is a qualitative case study strategy. Subjects numbered 65 prospective teachers, but taken two prospective teachers. Instruments of reseach, including job sheets and transcript think aloud. Instruments assignment sheet of this study as follows,

<p>1. Given systems of linear equations</p> $x_1 + x_2 - x_3 = 2$ $x_1 + 2x_2 + x_3 = 3$ $x_1 + x_2 + (a^2 - 5)x_3 = a$ <p>Determine all values of a so that the system of linear equations above meet each of the following,</p> <p>a. has infinitely many solutions</p> <p>b. do not have a solution</p> <p>c. has a single solution</p> <p>2. Draw a graph of any system of linear equations in the problem no.1.</p> <p>3. What can you conclude from the graphs in Question 2?</p>

Exposure to the research data on the subject 1 (S1)

Researchers gave the assignment sheet on the subject 1 to be completed by voicing his thinking (think aloud). S1 is a student majoring in mathematics education who has passed elementary algebra course and has followed the practice of field experience program (PPL). S1 completing algebra problems in the time duration of 14: 24 ' : 53' '. S1 resolve the problems started with reading about the system of linear equations (SPL), write down the augmented matrix, operates an elementary row in the matrix is enlarged, reread the question, write mariksecelon line in the form of a system of linear equations, determining the terms of SPL infinitely many solutions and determine the value of a provide that the SPL does not have a solution and determining a value,

determine the terms SPL has a single solution, write back in a matrix form, operate a matrix, determining the terms of SPL has a single solution.

In Question 2, S1 resolve the problem starts with reading the questions, menyubstitusikan a system of linear equations. Then S1 determines the cutoff point of each equation and draw the graph each system of equations. Each graph of an equation in the form of a field.

On Question 3, S1 reading matter, concluded that the SPL has infinitely many solutions when two graphs from an equation coincide. Do not have a solution when the third graph of an equation does not intersect. Having a single solution when the third graph of an equation intersect at one point.

The structure of the settlement as well as the structure of consciousness and thought setting S1 in solving algebra problems as in Figures 1 and 2 below,

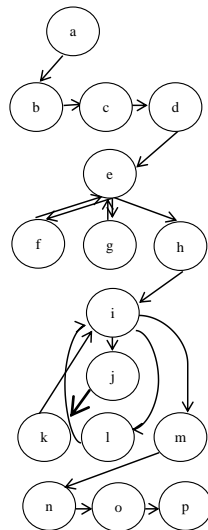


Figure 1: Structure of Problem Solving Algebra S1

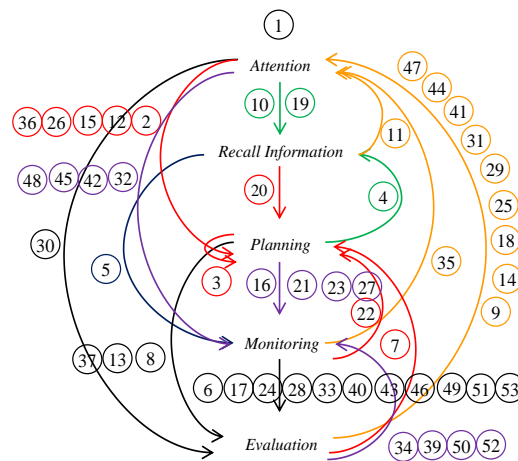


Figure 2: Structure of awareness and regulated thinking S1

Explanation:

- a : problem systems of linear equations
 - b: writing the augmented matrix of SPL
 - c: operate an elementary row in the matrix of the enlarged
 - d: forming a matrix ecelon line
 - e: determining requirements
 - f: spl has infinitely many solutions
 - g: spl not have a solution
 - h: spl have a solution
 - i: find the value of a
 - j : Substituting the value of a system of linear equations
 - k: Draw curve system of linear equations with infinitely many solutions
 - l: Draw curve with a system of linear equations do not have solutions
 - m: Draw curve system of linear equations with a single solution
 - n: Summing spl which has infinitely many solutions coincident curve
 - o: Summing spl that has no parallel solution curve
 - p: spl concludes that having a single solution curve intersect at one point
- : attention
 - : recall information
 - : planning
 - : monitoring
 - : evaluation

The structure of problem solving algebra in Figure 1 can be explained that components of the complete problem resolution, namely, a, b, c, d, e, f, g, h, i, j, k, l, m, n, o and p. Thus the structure of the complete problem solving algebra S1. Based on the structure awareness and regulated thinking S1 in Figure 2 can be explained that components of awareness and regulated thinking complete S1 is attention, recall information,

planning, monitoring and evaluation. Thus the structure of awareness and regulated thinking S1 in solving algebra problems categorized as complete.

Based on the structure awareness and regulated thinking S1 appear that the process awareness and regulated thinking S1 move is not linear. No linear move means moving not sequential and repetitive. For example moving from attention, planning, planning, recall information, monitoring, evaluation, planning and evaluation.

Exposure to the research data on the subject 2 (S2)

The process of awareness and regulation think S2 is identified by providing a system of linear equations problems. S2 asked to solve a system of linear equations by voicing his thought processes (think aloud). S2 solve the problem begins with 1) read the questions, 2) write the SPL in the form of augmented matrix, 3) operate matrix with elimination Gaus thus forming mariksecelon line, 4) define a strategy for SPL to have an infinitely many solutions, 5) determine the value of a so SPL has infinitely many solutions, 6) understand about the SPL does not have a solution, 7) define strategies to SPL does not have a solution, 8) determine the value of a so that the SPL does not have a solution, 9) understand about the SPL have a single solution, 10) define a strategy for SPL has a single solution, 11) determines the value of a so that SPL has a single solution, 12) to understand the problem in drawing the graph, 13) to draw a graph based on each equation.

S2 in determining the SPL has a single solution by declaring the determinant of the matrix is not equal to zero. S2 is also in drawing the graph is not based on a system of equations with a predetermined value. S2 draw a graph based on each equation, so it does not tampak intersecting graphs and charts do not intersect. S2 also can not conclude graph has infinitely many solutions, do not have a solution and have a single solution for S2 does not draw a graph based on a system of linear equations has infinitely many solutions, do not have a solution and have a single solution.

Based on the results of work and think aloud S2, can be described the structure of algebra problem solving and awareness structures and arrangements think S2 as shown in Figure 3 and Figure 4 below.

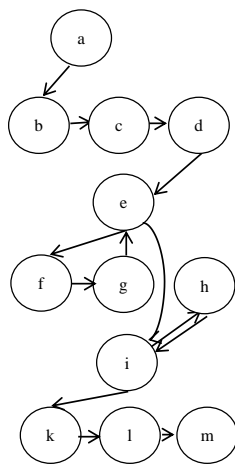


Figure 3: Structure of Problem Solving Algebra S2

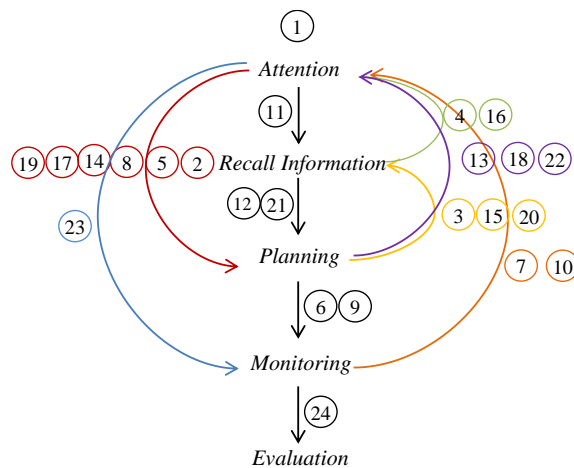


Figure 4: Structure of awareness and regulated thinking S2

Component j, n, o and p does not appear in the structure of problem solving algebra S2. It can be concluded that the structure of an algebraic problem solving S2 incomplete. Components awareness and thought setting S2 Full namely, attention, recall information, planning, monitoring and evaluation. Thus the structure of awareness and setting berpikir S2 in menyelesaikan algebra problems included in the category is not complete.

Based on Figure 3 and 4 can be explained that the process awareness and regulation S2 thinking in solving algebra problems do not move linearly. That is not sequential and repetitive moves.

III. Discussion

Discussion this study focused on the research question of how the process of awareness and regulated thinking a prospective teacher in solving algebra problems. The process of awareness and regulation of thinking in this study rests on the theory of metacognition Magiera & Wilson (2011, 2002) that metacognition refers to the awareness, setting and evaluation of thinking. Components of consciousness thinking in Solso (2008), namely, attention, architecture, recall of knowledge, emotive, novelty, emergence, selectivity and subjectivity. But in this study focused on attention and recall information. Further components thinking settings according to

Wilson (2002), namely, planning, monitoring and evaluation. Based on these opinions, the process of awareness and regulation of thinking in this study refers to attention, recall information, planning, monitoring and evaluation.

Awareness and Regulated Thinking Process Prospective Teacher's in Solving Problems of Algebra

The process of awareness and setting a prospective teacher thinking in solving algebra problems can be described as follows,

Attention

Prospective teachers solve the problem begins with reading the questions according to Schoenfeld (1981). By reading about these prospective teachers to concentrate on processing the information of the problem to be solved. Some prospective teachers to concentrate on the processing of information by reading the questions aloud, anyone reading about it softly and repeatedly, there is a point just reading about it, and no one read about in full.

Prospective teachers in concentrating on processing the information on the matter, there are write back SPL are known to exist also directly write in the form of a matrix. Prospective teachers there is also a direct understanding about, some are still confused that they read the questions repeatedly.

recall Information

Once the prospective teachers write SPL, they call information on how to write the SPL in the form of a matrix. Then call the information how the SPL has infinitely many solutions, do not have a solution and have a single solution. In the graph drawing prospective teachers also call the information how to describe graphic based SPL so the graph coincides, not intersect and intersect at one point. After drawing a graph prospective teachers also retrieve information about the graph that coincides, not intersect and intersect at one point so that prospective teachers can make a conclusion based on the graph.

Planning

Prospective teachers making strategy in determining the SPL has infinitely many solutions, do not have a solution and have a single solution. In determining the SPL has infinitely many solutions, and has had no single solution some prospective teachers operate an elementary row in a matrix by specifying the main one that found echelon line matrix form. Furthermore, prospective teachers determine the terms of a SPL has infinitely many solutions, do not have a solution and have a single solution that discovered the value of a.

Based on a value, a value menyubstitusikan prospective teachers in the SPL. Then the prospective teachers draw the graph by determining the point on the axis x_1 , x_2 and x_3 . By determining the point of intersection of these prospective teachers can determine the coordinates of points on each graph equations that can be drawn from an SPL.

Monitoring

Monitoring carried out at the time of prospective teachers to monitor the strategy that has been made, monitor the relevance of the information used. Teachers prospective monitoring is marked by asking himself about the accuracy of the strategy used, the suitability and completeness of information called the performance, Scraw (1994).

Evaluation

Gruru prospective perform evaluations when deciding the truth or falsity of monitoring results from the strategy that has been applied, whether or not the job is completed, Scraw (1994) and Magiera&Zawojewski (2011). Evaluation is marked with the statement "just now any moment", "oh yea right", "o ya own", "so ..", "so ..", "means ..", or "I can not make a conclusion".

The process of awareness and regulation think prospective teachers do not move linearly. Moving is not linear means not moving sequentially. move from one component to another and back again kekomponen original. This is consistent with the findings Kuzzle (2011) and Baidawi (2016) that moves metacognitive process is not linear, but cyclical, dynamic and repetitive.

In operating the elementary row prospective teachers have no problems, only the less scrupulous. In determining the terms of an SPL has infinite solutions, do not have a solution and have a single solution. Prospective teachers are also not experiencing difficulties. For a graphic image of an SPL prospective teachers still experiencing difficulties.

In making conclusions based on the chart, as a prospective teacher can already conclude that the graph which coincides have infinitely many solutions, which do not intersect the graph does not have a solution and a

chart that has a cut-off point has a solution. But there is still a prospective teacher can not make conclusions based on the graph because the graph is still fixated on the image of each equation is not in the SPL.

IV. Conclusion

Based on the findings in the field of awareness components and regulated thinking prospective teachers in solving algebra problems in accordance with the theory studied in this research that relies on attention, recall information, planning, monitoring and evaluation. The process of awareness and regulated thinking prospective teacher's in solving the problem is not linear move that is not sequential and repetitive.

The process of awareness and regulated thinking a prospective teacher begins with attention. At this stage of prospective teachers to concentrate attention on the processing of information that was obtained from the matter. For example concentration on the processing of information about the SPL and the value of a so SPL has infinitely many solutions, do not have a solution and have a single solution. Concentration in the processing of information on a graph of SPL and conclusions based on the graph. At this stage of prospective teachers recall information recall information about linear equations, systems of linear equations, matrices, matrix operations, methods of elimination, substitution method and mixed method. This information is then associated with the information on the matter.

The next step is planning, at this stage prospective teachers determine the completion strategy SPL with matrix operations, determining the terms of SPL has infinitely many solutions, do not have a solution and have a single solution. In the graph drawing prospective teachers menyubstitusikan define strategies with a value of at SPL.

For stage monitoring prospective teachers to ask themselves about the matrix operation that has been done, a value that has been found, charts and conclusions that have been made. And the last stage evaluation. At this stage prospective teachers decide the truth of elementary row operations, the truth of a value that has infinitely many solutions, a single solution and no solution mempunyai. at this stage prospective teachers also decide the truth in drawing graphs, and make conclusions.

The work of prospective teachers showed that prospective teachers have understood the question, can determine the solution of a problem although there are two subjects which still operates a rigorous in the matrix. Difficulties prospectively teachers can be found at the time of drawing graphs of SPL that has infinitely many solutions, do not have a solution and have a single solution. Difficulty in drawing the graph has an impact on prospective teachers in decision making conclusions graph that has infinitely many solutions, do not have a solution and have a single solution.

The benefits of this research is, make a small contribution to refine the components of consciousness and thinking in solving problems setting aljabar. Knowing how to identify the processes and structures of consciousness and thought setting prospektif teachers in solving the problem. And also can menentuan steps to resolve the problem of algebra.

Suggestion

Components awareness and regulation of thinking in this study was limited to attention, recall information, planning, monitoring and evaluation. With these restrictions selanjutnya researchers can develop by adding new components. It could also focus on the transition of consciousness to a setting or inter komponenpengauran awareness and thinking.

The problem in this research is still limited to algebra problems. Algebra problems focused on the issue of system of linear equations with matrix operations. SPL problem is not only limited to the matrix operation, for example by substitution method, elimination method, the method of elimination and substitution, and the graphical method. Problems can be developed by raising other issues such as mathematic problem, open-ended problem or other problem.

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