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Students Metacognition Strategies and Learning Achievement in Mathematical Economics

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Abstract

The purpose of this study to develop metacognition strategies students in optimizing learning achievement in mathematical economics. The applied a qualitative method consisting of data reduction, data display, and conclusions. Research informants were all students in mathematical economics courses totaling 23 students. Data collection techniques were by observation, interview and documentation. The findings showed that, metacognition approach makes students easier to overcome mathematical problems in economics. In addition, several obstacles occured in the process of metacognition are difficulties in concentration, lack of confidence, fear of trying and lack of reference books owned. Therefore, the suggested strategies to develop the students metacognition are more practice working on the problem, enhancing students confidence, increase motivation, and having a reference book.

Abstrak

Penelitian ini bertujuan untuk mengembangkan strategi metakognisi mahasiswa dalam mengoptimalkan prestasi belajar dalam pembelajaran matematika ekonomi. Metode kualitatif yang diterapkan terdiri dari reduksi data, penyajian data, dan penarikan kesimpulan. Informan penelitian adalah 23 orang mahasiswa yang menempuh mata kuliah matematika ekonomi. Teknik pengumpulan data dengan observasi, wawancara dan dokumentasi. Hasil penelitian menunjukkan bahwa pendekatan metakognisi membuat mahasiswa lebih mudah untuk mengatasi masalah matematika di bidang ekonomi. Selain itu, beberapa kendala yang terjadi dalam proses metakognisi adalah kesulitan konsentrasi, kurang percaya diri, takut mencoba dan kurangnya referensi buku yang dimiliki. Oleh karena itu, strategi yang disarankan untuk mengembangkan metakognisi mahasiswa adalah dengan lebih banyak latihan mengerjakan kasus soal, meningkatkan kepercayaan diri mahasiswa, meningkatkan motivasi, dan memiliki buku referensi.

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INTRODUCTION

Mathematical economics is particularly helpful in analysing a number aspects of economics such as in macro economics and micro economics. A student's skill in solving mathematical problems is influenced by the ability to understand mathematics (Rosita, 2014). It implies that lack understanding of mathematics results in students having difficulty in solving economic problems that make learning achievement are less than optimal. When economic problems presented using a mathematical context, the problem solving of economic issues should be done with mathematical procedures. In order to solve problems properly and correctly, students must be able to translate the context mathematically.

The reality in mathematical economics course shows that students more easily understand mathematical models by implementing questions or cases. When the lecturer explains the material and discusses the problems of mathematical economics, students can understand what the lecturer is conveying, but when working on a problem that is different from the lecturer delivered, then students have difficulty in understanding and solving problems. Students still feel confused in translating economic problems to be solved mathematically.

Students take time to understand the matter of mathematical material. The usual way is to do it over and over again and practice working on the problems. If there is still difficulty, students discuss with friends to understand the material and complete the practice questions. Students need practice in doing mathematical reasoning. Students need to learn how to study economics so they can think about economic problems precisely and systematically. One learning approach that directs students' way of thinking is the metacognition approach (Noto, 2015). In addition, metacognition strategies are important in solving mathematical problems (García, Cueli, Rodríguez, & Krawec, 2015).

Metacognition has an important role in regulating and controlling one's cognitive processes in learning. The learning and thinking process carried out becomes more effective and efficient. Plays a critical role in successful learning, it is important to study metacognitive activity and development to determine how students can be taught to better applytheir cognitive resources through metacognitive control (Livingston, 2003). Education at all levels of education, including university needs to implement strategies that develop metacognitive skills. Lack of development of metacognitive abilities, writing skills, and critical thinking skills can result in the low quality of education (Setiawan & Susilo, 2015). Metacognition is one's knowledge of one's own thought processes, or one's knowledge of their cognition and ability to regulate and control their cognitive activities in learning and thinking (Romli, 2012). Flavell (1979) stated that metacognition is thinking about thinking that is thinking about the thought process itself. Thus, metacognitive education is the ability of students in monitoring, planning and evaluation of the learning process.

Students who have good metacognition skills tend to be able to solve the problems they face well through the mobilization of awareness and thinking arrangements they do (Anggo, 2011). Metacognition as knowledge and skills can be taught, trained, or developed (Romli, 2012). The application of metacognitive strategies is expected to make teachers and students be independent, honest, confident, and dare to try new things in order to explore knowledge and improve their abilities. By teaching, training and developing metacognition in mathematical economic, it is hoped that students will more quickly and easily solve problems in economics mathematically.

Components of metacognition include: a person's knowledge of cognitive strategies and how to manage and control those strategies in learning, thinking, and solving problems; and self-knowledge and how to choose and use learning strategies, thinking, and problem solving in accordance with his situation (Romli, 2012). Metacognition can be supported by self-talk and interaction with peers by focusing on the process rather than learning outcomes (Schraw & Moshman, 1995).

Three skills that a person must possess to be able to control his cognitive are planning, monitoring and evaluation. Planning is the selection of the right strategy and allocation of resources that affect performance. Monitoring, refers to one's on-line awareness of task understanding and performance. Evaluation, is the result and learning process of a person (Schraw & Moshman, 1995).

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Cognitive-metacognitive framework that a function to organize analysis and interpret findings from mathematical performance. According to Garofalo & Lester (1985) cognitive-metacognitive framework consists of four activities involved in carrying out mathematical tasks: orientation (strategic behavior to assess and understand problems), organization (behavioral planning and choice of actions),execution (regulation of behavior to conform to plans), and verification (evaluation of decisions made and of outcomes of executed plans). Metacognitive strategies such as planning, monitoring, reviewing and evaluating, and metacognitive experiences are fundamental in controlling cognitive and using cognitive strategies (Brick, Macintyre, & Campbell, 2015). Through metacognitive strategies, students can manage and control their thought processes in understanding, analyzing, and solving economic math problems consciously and directedly so that learning objectives will be achieved optimally.

Student metacognition in mathematical economics can be developed through problem-based learning. The application of problem-based learning models can improve students' knowledge and metecognition skills as measured by declarations, procedural and considional indicators for knowledge, while skills indicators are measured by predictions, planning, monitoring and evaluating (Simanjuntak, 2012). Problem-based learning is used to improve the ability of metacognition that can improve understanding in depth so that problem solving can be logical (Anggo, 2011). The ability of learners in four types of reasoning (variable control, proportional reasoning, analogy, and deduction) can be improved through structured problem solving. Development of student reasoning through structured problem solving can improve algorithmic and conceptual understanding (Fahyuddin & Sampradja, 2015).

In improving mathematical reasoning students can also use the diagnostic errors approach and self questioning approach. In general, it can assists students in using their metacognitive structures because it involves students in the metacognitive process through giving comprehensive assignments, activating prior knowledge, and discussing in developing mathematical strategies and ideas (Rosita, 2014). Thus, the ability of students in mathematical argumentation and procedural mathematical reasoning for both approaches results in achieving the same ability. According to Polya (1957)how to solve mathematical problems can be done with steps that are understanding the problem, devising a plan, carrying out the plan, and looking back. With these steps, students will realize what problems they face, develop plans as the right solution to solve the problem, carry out a plan of solutions, and evaluate the results obtained. Metacognitive knowledge is also supported by student motivation. For example, students realize that it would be more useful to underline the main information of the reading with the aim to learn it, but do not do something based on their knowledge for motivational reasons (Murti, 2011). Thus in the development of metacognition also needed encouragement or motivation to carry out the activities in metacognition procedures.

The results of the indicate that metacognition will direct students' minds to think systematically in solving problems. With three stages which include planning, monitoring, and evaluation, students consciously and planned will be able to develop strategies or systematic steps in solving problems. The development of metacognition strategies for Accounting Education Department students is expected to improve students' critical thinking skills and optimize learning achievement in mathematical economics. With the process of metacognition, activities can be seen by students in the learning process, so that strategies can be improved in learning to optimize learning achievement. The problem-based metacognition approach is expected to improve students' critical thinking and analysis skills, especially in solving problems in the field of economics mathematically that are useful in economic decision making.

METHOD

This research conducted following a qualitative approach. The research subjects were students of the first semester of the Accounting Education Department, Universitas PGRI Madiun totaling 23 students in mathematical economics courses with the linear function chapter. Data collection techniques carried out by observation, interviews and documentation. The process of metacognition of students was analyzed based on observations and interviews related to planning,

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monitoring, and evaluation conducted in receiving material and solving mathematical economics problems with the linear function chapter. Students are given several questions related to the metacognition process carried out in solving problems. Documentation regarding the results of solving mathematical economics problems with linear function chapter. Documentation is used to match the results of the interview with the results of the problem solving. Data validity is done by triangulation of sources and techniques. Data analysis was performed by data reduction, data display, conclusion and verification.

Following are some of the questions asked to students in the process of metacognition in mathematical economic course adopted from previous research.

Table 1. List of Questions in the Stages of the Metacognition Process

Step	Indicator
Planning	1. What initial knowledge helped me to solve this economic mathematical problems? 2. What clues can be used to solve these economic mathematical problems? 3. What is the first step I will take? 4. Why did I read this section? 5. How long do I have to complete this economic mathematical problems?
Monitoring	1. How do I do? 2. Am I in the right step? 3. What are the next steps I need to take to solve this economic mathematical problems? 4. What information is important to understand? 5. Should I try a different way? 6. What steps will I choose if I cannot solve this economic mathematical problems?
Evaluation	1. How well have I done? 2. Do I need more or less specific thoughts than I am thinking right now? 3. Can I solve economic mathematical problems differently? 4. Can I apply this method to other problems? 5. Do I need to need more problems in economic mathematics so that I can understand more?

(Romli, 2012)

RESULTS AND DISCUSSION

Metacognition is used as a strategy in improving the critical thinking skills of Accounting Education Department students and optimizing the learning echievement of mathematical economics in linear function chapters. The development of metacognition strategies directs students' minds to understand the economic problems they face in order to be able to solve them mathematically appropriately. Metacognition in mathematical economic course prioritizes processes rather than outcomes.

Based on students 'answers to a number of questions about the metacognition process, students' activities were found in planning, monitoring and evaluation activities in solving problems. Metacognitive approaches that contain metacognitive questions will help the learning process according to the objectives of the metacognitive approach. Thus it is expected that students' mathematical abilities and understanding can be better formed (Hutauruk, 2016). Following are the students' activities in the metacognition process.

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Table 2. Student Activities in the Metacognition Process

Step	Student Activities
Planning	1. Understand the problem 2. Record the subject matter 3. Open reference books and notes 4. Determine the appropriate formula 5. Estimating the time needed to solve the problem
Monitoring	1. Work on easy problems first 2. Using mathematical formulas that have been taught by lecturers 3. Do not continue to work if I'm having trouble 4. Discuss with friends
Evaluation	1. Re-examine the results of the work 2. Thinking of using other methods 3. Reread questions and answers 4. Trying to work on a different problem

Based on table 2 above, in the planning students begin to understand the questions to be solved. Students still feel confused if they have to solve economic mathematical problems that look different from the example problems that were discussed together. The application of mathematical concepts to problems related to economics requires high concentration. Students who have difficulty understanding the questions will have difficulty in completing so the answers are incomplete. It takes about 10 minutes to really understand the problem and determine the initial steps to be taken. The first step taken by students to solve problems is to write what is informed in the problem and what is asked for the problem. Next open the reference books and notes that are owned to determine the appropriate formula in solving problems. Students who have difficulty in determining the mathematical formula that will be used, conduct discussions with friends. The shift in constructive metacognitive activity occurs because of the influence of group discussion which causes students to re-examine their mathematical thinking (Hastuti & Sutarto, 2017). The results of the discussion strengthen the confidence of students, so they are more confident in planning strategies for solving economic problems that must be solved mathematically. Metacognition awareness is the ability of a person to understand, control, and manipulate cognitive processes (Flavell, 1979). If students are able to manage their cognitive processes well, it will be easier to determine the strategies that will be used in the next stage of learning.

Implementation of the planning process in metacognition means students have involved the process of thinking and managing it to be able to understand the problem. The planning process is the core of the metacognition process. Students must really be able to determine the appropriate strategy or way to solve the problem. Before planning the strategy to be chosen, students can already predict the results that will be obtained. To achieve the expected results, students must be conscious and mature in planning steps or strategies in solving problems.

The next step is monitoring. Monitoring of the steps of preparing plans and strategies for solving economic mathematical problems in the metacognitive process facilitates the correct resolution of problems. Students work on problems that they think are easy first, then work on more difficult problems. The strategy used by students to make it easier to analyze economic mathematical problems is to use the methods presented by lecturers if they are still having difficulty using other strategies, namely to find various references to get easier and correct ways. Students have very few reference books about economic mathematics, so it is difficult if they have to use other methods. In the monitoring process, students have begun to focus on working on the problems with the steps that have been planned. If you have difficulty in working on problems, students will continue to work on other problems or by discussing with friends to overcome mathematical problems in economics.

The final stage is evaluation. The evaluation is carried out by involving students' awareness

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of their knowledge, controlling the results obtained to ensure the achievement of objectives, and monitoring the development of self-knowledge to ensure that the choice of solving strategies is correct. When students re-examine their mathematical thinking, there is a change in students' metacognitive activities from individual metacognitive activities to social metacognitive activities so that students rebuild new thinking structures in solving mathematical problems (Hastuti & Sutarto, 2017). Students realize if the formula they use is not appropriate then in doing so there will be many problems so the results are not as expected. Students who can manage their thoughts and stay focused will be satisfied with the results. In the evaluation process, students know the constraints faced and their weaknesses in the problem solving process. Students realize the obstacles faced in solving problems caused by their lack of understanding of the material, lack of references, unable to focus and lack of confidence. Students always want to try to work on different questions to increase their understanding of the material and improve the strategies used to minimize obstacles in working on problems.

Based on the interviews, students actually did the planning, monitoring and evaluation activities in solving problems in economic mathematics learning before applying the metacognition strategy, but these activities were not carried out systematically. Students who are able to organize and direct their thoughts through the stages of planning, monitoring and evaluation, in fact can solve problems correctly and on time. Before the application of the metacognition process in economic mathematics learning, the linear function of the class average value of 73.78, entered the category of "good". When the application of metacognition in directing the minds of students in completing assignments obtained an average grade of 88.48 included in the category of "very good".

Table 3. Average Grade of Class Before and After the Metacognition Process

Before	After	Increase
73.78	88.48	19.92%

Based on table 3, after the implementation of the metacognitive strategy the class rarata value is increased by 19.92%. These results indicate that students can begin to direct their cognitive in solving economic problems mathematically. The metacognition process builds the minds of students to strategize in solving mathematical economic problems. Students can design and organize their thoughts in solving problems completely and systematically. Previous study by Simanjuntak (2012) shows that the application of problem solving based learning models can be used in improving students' knowledge, skills and metacognitive behavior. In addition to focusing on problems to be solved, students must also be able to arrange time in order to be able to solve problems on time. The metacognitive strategies applied in learning numerical methods show the results that student activities in each learning experience increase. Students are increasingly accustomed to planning, monitoring, and evaluating their thought processes. Likewise with the students' mathematical understanding ability that is increasingly increasing in each learning process, the overall student's mathematical understanding ability shows an increase, so that all the success criteria can be achieved (Syahbana, 2013).

In building metacognition, students realize that there are several obstacles including difficulty in concentration, lack of confidence in their own abilities, fear of trying and lack of references they have. Research result Alfiyah & Siswono (2014) states that students' difficulties in the process of metacognition include not being aware of their strengths or weaknesses in solving mathematical problems, not estimating how long it takes not being aware of the mistakes made in solving mathematical problems, and not realizing how well they work in solving mathematical problems.

Strategies that can be used by students to develop metacognition in developing students' critical thinking skills and optimizing the results of mathematical economics course that is often the practice of working on problems with various forms of different problems, believe in one's own abilities, increase learning motivation, and have a reference book as a learning resource. In line with research Murti (2011) that metacognition develops with age and is also influenced by exercise

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and interaction with each other can provide the stimulus needed by individuals to become more aware of their cognitive processes. With cooperative learning in solving economic mathematical problems, it is expected to further increase self-confidence in students and among members provide mutual encouragement to support the metacognitive process.

CONCLUSIONS AND SUGGESTION

The metacognition approach is conducted through several steps including planning, monitoring, and evaluation. It makes students easier to to overcome mathematical problems in economics,, that lead learning achievement are optimal. Constraints experienced in the process of metacognition are difficulty in concentration, lack of trust in one's own abilities, fear of trying and lack of reference books owned. Strategies that can be used to develop metacognition in optimizing the learning achievement of mathematical economics course that is often practice working on problems, confidence, increase motivation, and have a reference book. It suggested the development of metacognition can be implemented in the learning of other subjects as well as the existence of metacognition assessment instruments that make students' metacognition abilities can be measured reliably.

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