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Understanding of Linear Algebra Concepts through the TAPPS (Thinking Aloud Pair Problem Solving) Learning Model at the Faculty of Computer Science, Dharma AUB University of Surakarta

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Abstract. Education aims to improve the quality of human life which is technically through lectures. A good lecture produces a positive influence on students' ability. The interaction between lecturers and students in the class is an important role in achieving the goals. Linear Algebra is an important subject in the Mathematic. Many students think that Linear Algebra are difficult. Linear Algebra at the Faculty of Computer Science, Dharma AUB University of Surakarta have not been able to improve students' understanding of Linear Algebra concepts. Because of class that are centered on lecturers. Based on the description above, the author applies the TAPPS (Thinking Aloud Pair Problem Solving) cooperative learning model to increase concept understanding of Linear Algebra. Formulation of the problem in this research: "Is there an increase concept understanding of Linear Algebra after using the TAPPS learning model?". This research is a qualitative descriptive group with the type of Classroom Action Research. The data used are field notes and documentation. Based on the research results, it can be concluded that there is an increase in understanding of the concept of Linear Algebra through the TAPPS (Thinking Aloud Pair Problem Solving) model.

Keywords: Concept Understanding, TAPPS (Thinking Aloud Pair Problem Solving)

INTRODUCTION

Education aims to improve the quality of human life which is technically and operationally carried out through lectures. According to (Budiyono, 2015) policies in the learning process include planning, implementation, assessment and supervision of learning. Good lectures produce a chain effect on students' ability to learn continuously through their environment (Herawati, 2021). The lecture process is composed of a number of components that are related to each other. The interaction between lecturers and students during the lecture process plays an important role in achieving lecture objectives. Lecture methods are learning activities that must be carried out by lecturers and students so that lecture objectives can be achieved effectively and efficiently (Khoerunnisa, 2020).

Linear Algebra lectures at the Faculty of Computer Science, Dharma University AUB Surakarta have not succeeded in increasing understanding of the concept of Linear Algebra. The factor that causes low understanding of the concept of Linear Algebra is lectures centered

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on lecturers, so it is necessary to improve the lecture process by using lecture methods that can increase understanding of the concept of Linear Algebra, namely by implementing the TAPPS (Thinking Aloud Pair Problem Solving) learning model. This learning model trains student cooperation and responsibility with the roles of PS (Problem Solver) and L (Listener) (Maula, 2013). Based on the background of the problem, the author formulates: "Is there an increase in understanding of the concept of Linear Algebra after lectures using the TAPPS learning model?". The aim of this research is: "To describe increasing understanding of Linear Algebra concepts through the TAPPS learning model".

THEORITICAL REVIEW

Research conducted by (Aulia, 2022)concluded that the TAPPS learning model is better than the direct learning model for mathematical problemsolving abilities. Research conducted by (Pujiarti, 2022)concluded that the Thinking Aloud Pair Problem Solving (TAPPS) Cooperative learning model with LKS had a positive effect on solving mathematical problems. Research (Setianungrum, 2020) concludes that the use of the Thinking Aloud Pair Problem Solving (TAPPS) learning model can improve student learning achievement. From the three previous studies, researchers improved by utilizing technology in education.

In theory, conceptual understanding is an understanding built from factual knowledge to understand the relationship between concepts, principles and generalizations (Radiusman, 2020). This research focuses on the following indicators of concept understanding: 1) Presenting concepts in various forms of mathematical representation; 2) Using, utilizing, and selecting certain procedures or operations; 3) Apply problem solving concepts or algorithms.

TAPPS was first introduced by Claparede, then used by Bloom and Broder to research problem solving in students. Art Whimbey and Jack Lochhead have developed this method in teaching mathematics and physics. Students are divided into several team, each team consists of two parties. One party becomes PS (Problem Solver) and the other party becomes L (Listener). Each team member has their own duties and follows certain rules (Nusywari, 2022).

The TAPPS procedure includes students being asked to form pairs and explain the roles of PS and L. PS's first task is to read the problem, followed by expressing what comes to mind to solve the problem. L's main task is to understand every step and PS's mistakes. An L not only knows the steps taken by PS but also understands the reasons used to choose those steps. L should try not to solve PS problems. After a problem has been solved, the two students exchange assignments so that all students have the opportunity to become PS and L

(Rahayuningsih, 2013). The Thinking Framework in this research is presented in the following picture:

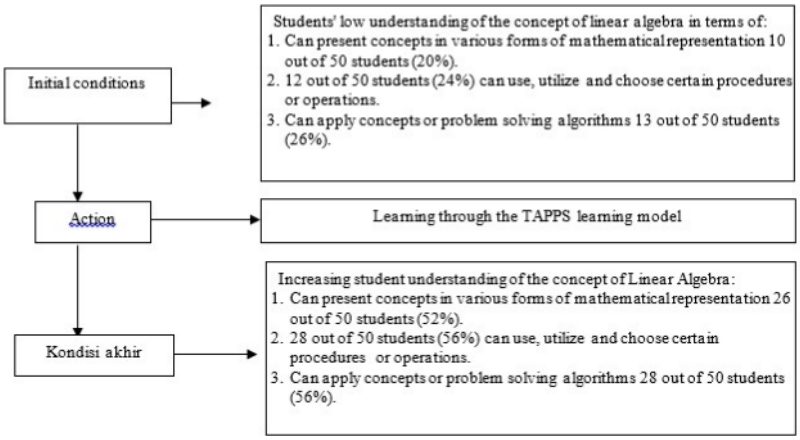

Figure 1. Thinking Framework Diagram

METHOD

This type of research is Classroom Action Research (PTK) in an effort to increase understanding of linear algebra concepts through the TAPPS type cooperative learning model. Classroom action research is an examination of learning activities in the form of action (Arikunto, 2021). The subjects of this research were chosen based on purpose sampling (Sugiyono, 2018), The aim of this research is to increase understanding of the concept of Linear Algebra among students as a whole, such as (Nashrullah, 2023) the sample aims to be used in a certain orientation in research. In this research, Semester II Class A students for the 2023/2024 Academic Year, Faculty of Computer Science, Dharma University, AUB Surakarta were the research subjects. The research design is presented in the form of the following image:

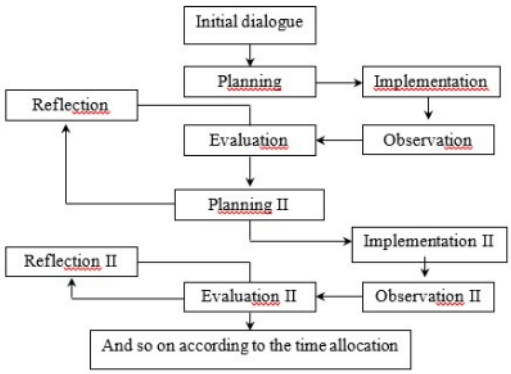

Figure 2. PTK, modification of Kemmis and Mc. Tanggart (Mualimin, 2014)

RESULT AND DISSCUSSION

Data regarding understanding of linear algebra concepts from before class action to round III class action can be presented in the following table:

Table 1. Data resulting from increasing understanding of linear algebra concepts through the TAPPS

Action	can present concepts in various forms of mathematical representation	can use, utilize, and choose certain procedures or operations	can apply concepts or problem solving algorithms
Before action	10 students (26,3%)	13 students (34,2%)	7 students (18,4%)
Round I	17 students (44,7%)	18 students (47,3%)	14 students (36,8%)
Round II	21 students (55,2%)	22 students (57,8%)	19 students (50,0%)
Round III	28 students (73,6%)	25 students (65,7%)	23 students (60,5%)

Problem 1: Is there an increase in understanding of linear algebra concepts through the TAPPS model?

This research refers to understanding the concept of linear algebra through the TAPPS model. The indicators for understanding concepts in this research are that students can present concepts in various forms of mathematical representation, students can use, utilize and choose certain procedures or operations, and students can apply concepts or problem solving algorithms.

1. **Students can present concepts in various forms of mathematical representation.**

   Students' ability to present concepts in various forms of mathematical representation from before the action to round III experienced a significant increase. Before the action, students can present concepts in various forms of mathematical representation as many as 10 students (20%), round I as many as 16 students (32%), round II as many as 19 students (38%), and round III as many as 26 students (52%).

   Students' ability to present concepts in various forms of mathematical representation from before round to round III experienced a significant increase. This is because the TAPPS model trains students to work in groups independently so that each group member has a responsibility, apart from that students are trained to communicate and be active in lectures so that indirectly they can present concepts in various forms of mathematical representation, This is in line with (Maula, 2014), Apart from that (Setianingrum, 2015) also stated that the TAPPS learning model can improve students' mathematical understanding, and because of

the provision of rewards in the form of additional points from lecturers, students become motivated to be more active in learning.

2. **Students can use, utilize, and choose certain procedures or operations.**

Students' ability to use, utilize and choose certain procedures or operations from before the procedure to round III experienced a significant increase. Before the action, 12 students (24%) could use, utilize and choose certain procedures or operations, 18 students (36%) in round I, 22 students (44%) in round II, and 28 students in round III (56%).

Students' ability to use, utilize, and choose certain procedures or operations before round to round III experienced a significant increase. This is because the use of the TAPPS model can train students to be active in lectures so that in their group work, they exchange ideas on which procedures to use to solve questions given by the lecturer, this is in accordance with (Aninda Junita, 2015). Apart from that (Togatorop, 2023) also states that the TAPPS model can improve students' communicative abilities

3. **Students can apply problem-solving concepts or algorithms.**

The ability of students to apply concepts or problem solving algorithms means that students can remember the material studied, determine known characteristics, and students can apply these concepts in solving problems. Students' ability to apply concepts or problem-solving algorithms from before the action to round III experienced a significant increase. Before the action, 13 students (26%) could apply the concept or problem solving algorithm, 15 students (30%) in round I, 23 students (46%) in round II, and 28 students (56%) in round III.

Students' ability to apply concepts or problem-solving algorithms from before round to round III has increased significantly. This is because in using the TAPPS model there is always a presentation and evaluation at the end of the meeting with students delivering conclusions and reviews of the material that has been presented at the meeting. This trains students to be able to apply problem-solving concepts or algorithms, in accordance with (Artika, 2019). Apart from that (Rahmadhanningsih, 2016) also stated that the TAPPS learning method can influence students' problem solving abilities

The three indicators of conceptual understanding above are in line with the opinion of (Ali, 2021) which states that cooperative learning is a lecture model that prioritizes cooperation between students to achieve lecture goals. The cooperative model has the following characteristics: 1) Students work in groups cooperatively to complete their learning material; 2) Groups are formed from students who have high, medium and low abilities; 3) Whenever

possible, group members come from different races, cultures, ethnicities, genders; 4) Rewards are more group oriented than individual.

The existence of individual responsibility encourages each group member to strive to achieve completeness in the material presented by the lecturer so that the group's goals are achieved so that it is hoped that the group can understand the concept of the material being taught.

CONCLUSION

Based on the results of classroom action research carried out in collaboration between the research team and model lecturers, it can be concluded that there is an increase in understanding of linear algebra concepts through the TAPPS model. The conclusion above provides the implication that using the TAPPS model can improve understanding of linear algebra concepts. This shows that using the TAPPS model is one solution to increase students' understanding of linear algebra concepts.

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