

Implementation of STAD Type Cooperative Learning Model Oriented on Problem Based Learning in Discrete Mathematics

Katrina Samosir*

*Program Studi Pendidikan Matematika, Universitas Negeri Medan, Indonesia
Corresponding Author: katrinasamosir@unimed.ac.id

ABSTRACT

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The objective of study are reveal to : 1) Determine that the implementation-oriented models of cooperative learning on problem based learning can improve student learning outcomes in discrete mathematics, 2) Knowing that application of cooperative learning model which is based on problem-oriented learning can improve students' understanding of concept of discrete mathematics, 3) Knowing that application of cooperative learning model which is based on problem-oriented learning can improve students' understanding of proof or solving problems on discrete mathematics. The method of research used a classroom action research and that becomes the subject of research is the sixth semester students who follow a discrete mathematics 2 course. After using this strategy in cycle 1, of the achievement test showed levels mastery learning class is 81.2% with an average value of 83.9. It shows that the implementation of the Model Application Oriented Learning Cooperative Learning Problem Based on Discrete Mathematics 2 successful. It means that the learning model to improve learning outcomes of students. Application of Cooperative Learning Model Oriented Problem based Learning can improve students' understanding of concepts and improve student's ability to prove or solving problems on Discrete Mathematics 2. Acquired 84.9% of the students understand the concepts with an average value of 85.6% on Discrete Mathematics 2. The percentage of students understand the concept at a competent level of ability (B) or very competent (A) is only 41.36%. This is due to the performance of the student group discussion is not optimal, because there are three aspect that the average score of more than two and less than three, namely (1) the focus and meaning of the question, (2) ability to respond to questions other groups, and (3) clarity in argued the question or comments of other groups. Required to mitigate increased frequency of exercise solve problems on the discussion group.

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A. INTRODUCTION

This Discrete Mathematics 2 course is given in semester VI. This course is related to the Computer Program course. The advanced course of this course is the Operations Research course. The learning method used in this course is generally the discourse learning method, teaching centered on the lecturer, in teaching and learning activities the students are less active and students listen more and the explanations given by the lecturer in Discrete Mathematics 2 are not well understood by students. The observation results show that 70.1% of students think that the Discrete Mathematics 2 course is a difficult subject to learn. The percentage of students who scored an A from 2005 to 2007 was quite low, namely 17%, followed by those who received a B, namely 39%. This shows that those who get grades A and B have not reached 60%. The problems found which are difficulties for students studying Discrete Mathematics 2 are as follows:

1. Difficulty understanding concepts (definitions and theorems),
2. Students' difficulties in mapping these characteristics with examples,
3. Students' difficulties in mapping these characteristics with non-examples,
4. It is difficult to determine when a theorem is used and when it is not used,
5. The difficulty of proving the theorem,
6. Difficulty using theorems and/or definitions to solve a problem or question,
7. Difficulty narrating a reason or argument from a given answer.

Almost about 80% of students experience problems as described above. This shows that the problems mentioned above require immediate response. To overcome these problems it is very suitable to use the Cooperative Learning Model which is oriented towards Problem Based Learning in Discrete Mathematics 2 course. Based on those problems, it appears that students have difficulty mapping the properties contained in the definition of examples and non-examples, it is difficult to use definitions and / or theorems in proving and solving problems (questions), and it is also difficult to narrate the reasons for an answer given. This shows that to overcome the above problems requires a higher level of thinking, problem solving skills, and cooperation between students.

The problem-based learning model is very suitable for overcoming the above problems, because according to Nuhadi (2003; 55) that "problem-based learning is an approach that uses real world problems as a context for students to learn critical thinking and problem solving skills, as well as to acquire essential knowledge and concepts from the subject matter". The same thing was also stated by Arends (Abbas 2003; 3) that "This model is a student learning approach to authentic (real) problems so that students can construct their own knowledge, develop high skills and inquiry, make students independent, and improve her confidence". While Ibrahim and Nur (2000; 2) say that: "Problem-based learning is a learning method that is used to stimulate higher-level thinking in problem-oriented situations."

From the above opinion it can be concluded that the problem-based learning method is a learning to make students think critically, be skilled at solving a problem, be able to use their own knowledge, be able to develop themselves, and be able to increase self-confidence. According to Ibrahim and Nur (2000; 5) that the main characteristics of learning based on this problem are:

1. Submitting a question or problem.
 Problem-based learning organizes teaching around questions or problems that are both socially important and personally meaningful to students.
2. Focusing on interdisciplinary interrelationships.
 Although problem-based learning may be centered on a particular subject, the problems to be investigated have been selected that are truly real so that in solving them students review the problem from many subjects.
3. Authentic inquiry.
 Problem-based learning requires students to carry out authentic investigations for real solutions to real problems.
4. Producing products / works and showing them off.
 Problem-based learning requires students to produce certain products in real works and demonstrations that explain or represent the forms of problem solving they find. This product can be a transcript of a debate or a report.
5. Cooperation
 Problem-based learning is characterized by students working collaboratively with one another, most often in pairs or small groups.

Based on the description above, learning is problem-based, that the activities in learning are focused on student activities accompanied by lecturer guidance by providing encouragement, guidance, and direction so that students are encouraged to ask questions and carry out investigations of the questions or problems given. In this way the learning objectives of using cooperative learning which are oriented towards problem-based learning can be achieved and can improve students' abilities, because this learning is directed at improving student work on academic tasks and educating students to be able to work together and help each other.

According to Arends (Tim Instruktur PLPG, 2008:57) there are 5 main steps in managing problem-based learning, namely:

Table 1. Five Main Steps of Problem-Based Learning

No.	Learning Processes	Teacher Activities
1.	Problem Orientation	1. Inform basic competence 2. Creating an enabling classroom environment open exchange of ideas 3. Direct students to questions or problems 4. Encourage students to express ideas openly
2.	Organizing student learning	1. Help students find concepts based on problems 2. Encouraging openness, democratic processes 3. Testing students' understanding of the concepts found

3. Help investigate independently or in groups	<ol style="list-style-type: none"> 1. Provide ease of working on students in solving problems 2. Provide scaffolding 3. Encourage cooperation in completing tasks 4. Encourage discussion dialogue with friends 5. Helping students define and organize learning tasks related to problems 6. Assist students in finding hypotheses 7. Assist students in providing solutions
4. Develop and display work results	<ol style="list-style-type: none"> 1. Guide students to work on students' worksheet 2. Guide students to present their work
5. Analyze and evaluate the results of problem solving	<ol style="list-style-type: none"> 1. Help students review the results of problem solving 2. Motivate students to be involved in problem solving 3. Evaluate academic material

Based on the results of observations made that students who have difficulty learning Discrete Mathematics 2 try to ask their classmates or consult with their classmates who are smarter and there is good cooperation in their class to solve problems that arise in lectures. This shows that the cooperative learning model is very suitable for use supported by one of the cultures of the Indonesian nation, namely the culture of gotong royong, which means a culture of helping each other to solve a problem in society.

The classroom is a good place for cooperative learning activities. In the classroom, students can be given the opportunity to work in small groups to solve or solve a problem. This is in accordance with the opinion of Benner, Rolheiser-Bennet & Stevahn (Krongthong, 1998: 32) state that Cooperative Learning is the existence of cooperation and positive interdependence among group members, to achieve goals, therefore colleagues in a group must complement one another and help each other in terms of academics and social behavior.

Cooperative learning in mathematics can help students improve students' positive attitudes towards mathematics. Individual students build confidence in their ability to solve mathematical problems, so that it will reduce or even eliminate the anxiety about mathematics that many students experience. According to Suherman (2003; 259) that "cooperative learning has also proven to be very beneficial for heterogeneous students". By highlighting interactions in groups, this learning model can make students accept other students with different abilities and backgrounds.

According to Johnson and Holubec (Krongthong, 1998;) there are 7 elements that need to be considered in cooperative learning in the classroom, namely:

1. Positive dependence on each other, arranged and planned (when making teaching plans).
2. Demonstration individually alternately for yourself and a group of friends.
3. Group members are heterogeneous.
4. There are activities in groups to build trust, commitment, and cohesion.
5. Each member of the group can serve as a responsible leader alternately.
6. Social skills are taught by practice and process.
7. The teacher continuously monitors group work, assigns tasks and intervenes when necessary.

From the description above it can be concluded that to carry out cooperative learning that needs to be considered is the positive dependence between group members, each group member has responsibility for the assigned task, each group member can exchange roles, respect differences, take advantage of fatigue, fill deficiencies, trust each other, have a shared commitment, there is a relationship among members, and the role of the teacher as a facilitator.

There are several cooperative learning models developed by experts, one of which is STAD (Student Team Achievement Division) and this model was chosen for this research. According to Slavin (Krongthong, 1998; 33) that in the STAD method students are divided into groups, each group has 4 people, some are moderate and less intelligent, there are men and women from different racial and national backgrounds, the teacher conveys lessons with lectures or discussions. While according to Slavin (1995; 76) there are 4 main steps in learning activities that use the STAD model, namely:

1. Class presentation

The teacher's presentation steps emphasize several things, namely:

Opening :

- a. Explain learning objectives
- b. Provide motivation to cooperate.

c. Repeat or retrieve prerequisite knowledge.

Development :

- a. Focus on the goals to be taught
- b. Focus on understanding not memorization
- c. Demonstrate concepts and examples.
- d. Check student understanding by asking questions.

2. Guided practice

- a. Ask students to work on questions or examples or provide answers that the teacher proposes.
- b. Appoint students randomly so that all students prepare themselves to answer.
- c. Give time for students to work on one or two questions, then provide feedback.

3. Stages of group study

- a. Students work in groups consisting of heterogeneous students (2-6 people, generally 5 people in one group).
- b. Provide material in the form of work sheets and one answer key sheet.
- c. The teacher explains the stages and functions of the STAD model / provisions and cooperative skills.
- d. Each student has the role of leading the group.

4. Stages of testing individual performance

To test individual performance, tests/quizzes/posttests are generally carried out. Each student is required to take a test. At this stage students are no longer allowed to work together. Each student tries to be responsible individually, doing his best for his contribution to the group. Everyone's efforts and success will make a very valuable contribution to the success of the group.

Based on the description above, the steps or stages taken to use this STAD model in Discrete Mathematics 2 lectures are as follows.

Stage I: Presentation of lecture material in class.

At this stage what is explained or presented is:

1. Explain the purpose of the lecture
2. Test or explain the prerequisite material.
3. Lecturers present material directly using expository and demonstration methods.

Stage II: Directing and giving group assignments.

At this stage what is done by the lecturer is:

1. Lecturers form groups whose members are heterogeneous and consist of 4 people,
2. Giving group assignments in the form of worksheets, and explaining what was done, how to do it, and how to make a report on the results of group work.

Stage III: Group Study

At this stage group members work together to complete the tasks given by the lecturer. Each student can act as a group leader to discuss the assignments given. The lecturer continuously monitors group work and intervenes when needed.

Stage IV: Testing the performance of each group member.

At this stage each student is given a test, quiz, or post test to see the performance of each group member and individual responsibilities. At this stage there is no cooperation anymore.

Stage V: Award.

Teachers reward students academically regarding results he got.

The learning process with the application of cooperative learning models that are oriented to learning based on problems in Discrete Mathematics 2 is developed as follows:

Stage I: Formation of discussion groups.

Form a discussion group whose members are heterogeneous and consist of 4 people.

Stage II: Presentation of lecture material in class.

At this stage what the lecturer will do is:

1. Explain the purpose of the lecture.
2. Test or explain the prerequisite material, namely Discrete Mathematics 1, and Sets and Logic
3. Present material directly using expository and demonstration methods.

Stage III: Directing and giving group assignments.

At this stage the lecturer gives group assignments in the form of work sheets, which consist of two parts, namely understanding concepts and solving problems. The lecturer explained what was done, how to do it, and how to make a report on the results of group work.

Stage IV: Study groups

At this stage group members work together to complete the tasks given by the lecturer. Each student can act as a group leader to discuss the assignments given. The lecturer continuously monitors group work and intervenes if necessary. During the lesson, the lecturer assists the group in carrying out investigations so that students find solutions to existing problems. Then, students present the results of problem solving in front of the class. At the end of learning, the lecturer helps students to reflect or evaluate the investigations carried out.

Stage V: Testing the performance of each group member.

At this stage the lecturer gives tests, quizzes, or post-tests to each student to see the performance of each group member and individual responsibilities. At this stage there is no cooperation between group members.

Stage VI: Award

Lecturers give awards to students academically regarding the results they get.

B. RESEARCH METHODS

This research is Classroom Action Research. The actions taken aim to increase rational stability and improve the conditions of the lectures being conducted. Besides that, it also reflects on itself and improves lecturer performance, so as to increase students' understanding of problem solving in Discrete Mathematics 2 course.

This research was conducted at the Mathematics Department of FMIPA, Medan State University. The subjects of this study were students majoring in Mathematics who attended Discrete Mathematics 2 courses consisting of two parallel classes, namely in class A there were 46 people and in class B there were 44 people. The research instrument used learning achievement tests to determine students' abilities after being given treatment and observation sheets to determine the successful implementation of the selected learning strategy and to determine the performance of student group discussions.

C. RESULT AND DISCUSSION

At the end of the first cycle, a learning achievement test is given which aims to see the success of the action (student's ability after being given an action). The results of the analysis carried out showed that both classes (class A and B) classically obtained 81.2% of students who scored more than or equal to 70 with an average score of 83.9, meaning that more than 75% of students had achieved absorption. more or equal to 70%. This shows that both classes have completed their studies.

The observation results of 2 (two) members of the research team regarding the implementation of lecturer activities (N) were 89, while the results of observations from 90 students that the value of the observation results (N) were 93. According to the assessment criteria that the assessment of the two groups regarding lecturer activities in implementing the model cooperative learning that is oriented to learning based on problems in Discrete Mathematics 2 is included in the very good category. Observation of the performance of student groups shows that the results of observations of 2 (two) members of the research team (N) are 76. According to the research criteria that the performance of student group discussions on the application of the model cooperative learning that is oriented to problem-based learning in Discrete Mathematics 2 is included in the good category.

Based on the results shown above, the application of a cooperative learning model that is oriented towards problem-based learning can improve student learning outcomes in Discrete Mathematics 2 course.

The results of the final test conducted regarding students' ability to understand the concept showed that the average percentage of students in class A was 85.5% with an average score of 80.03, while the average percentage of students in Class B was 84.2% with an average score -average 85.5. So, the average percentage of students who understand the concept in class A or B (90) people is 84.9% with an average score of 82.9. This shows that the application of the cooperative learning model that is oriented to problem-based learning is well implemented.

The results of the final tests conducted regarding students' abilities in proving or solving problems showed that the average percentage of students in class A was 52.2% with an average score of 84.9, and the average percentage of students in Class B was 75% with a score average 86.2. So, the average percentage of students who are able to solve problems related to proving or solving problems in class A or B is on average 63.6% with an average score of 85.6. This shows that the application of the cooperative learning model that is oriented to problem-based learning is well implemented. The improvement of students' learning achievement obtained by referring to the achievement of performance indicators as shown in table 2.

Table 2. The Improvement of Students' Learning Achievement

Performance Indicator	Pre	Target	Post
Percentage of students who achieve score A or B	39%	50%	59,1%
Percentage of students understand definitions and theorems	NA	50%	81,5%
Percentage of students who are able to solve problems related to problem solving and proof in Discrete Mathematics 2	NA	50%	63%

From the results of the discussion above it was found that the average percentage of students from the two classes who understood the concept at the competent (B) or very competent (A) ability level was 50.17% with an average score of 82.4, almost the same as the target set. is set at 50%, while the average percentage of students from the two classes who are able to prove or solve problems at the competent (B) or highly competent (A) ability level is only 41.3% with an average score of 90.6, meaning still less than 50%.

In general, the implementation of the cooperative learning model that is oriented towards learning based on problems in Discrete Mathematics 2 works well, meaning that the Learning Model can improve student learning outcomes. The application of cooperative learning models that are oriented towards problem-based learning can increase students' understanding of concepts. The application of cooperative learning models that are oriented towards problem-based learning can also improve students' abilities to prove or solve problems.

The findings show that the percentage of students who understand concepts at the competent (B) or highly competent (A) level is 50.1%, while the percentage of students who are able to solve problems related to problem solving and proof in Discrete Mathematics 2 is at the competent level (B) or very competent (A) only 41.36%, still less than 50%. This is due to the fact that the performance of student group discussions is not yet optimal. Therefore, henceforth, it is necessary to increase the frequency of practice solving questions in group discussions.

D. CONCLUSION

In the implementation of cooperative learning models that are oriented towards problem-based learning in Discrete Mathematics 2, there are several conclusions that can be put forward, namely:

1. The application of a cooperative learning model that is oriented towards problem-based learning can improve student learning outcomes in Discrete Mathematics 2 course.
2. The application of a cooperative learning model that is oriented towards problem-based learning is very good for increasing student understanding of concepts in Discrete Mathematics 2 course.
3. The application of a cooperative learning model that is oriented towards problem-based learning is very good for increasing student understanding of proof or problem solving in Discrete Mathematics 2 course.
4. The percentage of students who are able to solve problems related to problem solving and proof in Discrete Mathematics 2 at the competent (B) or very competent (A) ability level is still less than 50%.

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