Modified cooperative learning methods in teaching computer programming laboratory course for electronics engineering students

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Abstract. Modified cooperative learning is a class-based active learning strategy, where students work on problems posed by lecturers, first individually, then in small groups, and finally as class discussions. This method allows students to express their reasoning, reflect on their thoughts, and get immediate feedback about their understanding. In this study, an investigation of the quantity and quality of student involvement was conducted in the Computer Programming Laboratory course in the electronics engineering department. Lecture material is prepared to support cooperative learning as well as class observations of students conducted by cooperative learning in the course. The pattern of student involvement was observed using the student behaviour observation form that was developed and validated. Data triangulation was done with student perception survey data. The results showed that matching timing varied depending on the topic with an average of 20 minutes for the concept presentation by the lecturer. Student involvement is very high in the form of writing and discussing groups and classes. Triangulation of student perceptions states that students feel actively involved fully in the learning process.

1. Introduction
In an effort to succeed the learning process in a course, lecturers must take the time to design, implement, and support the success of the learning strategies that will be applied next semester [1]. Research on student perceptions is a foundation that can be used to support learning strategies in an effort to increase student participation [2]. Student perceptions need to be assessed with their acknowledgement because it is very difficult to evaluate student involvement through observing behaviour and facial expressions. In addition, the learning success of a lecturer depends on the student's perspective on the actions of the lecturer. Brookfield also stated the importance of making decisions about changing learning strategies based on information obtained from student responses [3].

Cooperative learning (CL) is an active learning method where students work in small groups and help each other in the learning process. There are certain principles and requirements for CL implementation: 1) Every individual is positively interdependent and complementary; 2) The performance of each individual is evaluated on the results of individual and group successes; 3) Each group member achieves success by helping each other and sharing ideas where sense of responsibility and social intelligence increases; 4) Group Processing Evaluation: At the end of group work, students collect and discuss project productivity and whether they have achieved goals. Johnson and Johnson...
stated CL is part of the cycle of theory, research, and practice where the basis of CL is the development of cognitive, social cognitive, behavioral, and social interdependence [4]. The basis of the theory of social interdependence is that structured types of interdependence in a situation determine how individuals interact with each other, which, in turn, determines outcomes. In addition, CL has been proven to be able to improve student achievement, encourage motivation to learn, improve relations between student groups, build critical and creative thinking, as well as experts in problem solving [5].

Parastwi and Rahmanto had performed study on Cooperative Learning with Think Pair Share (TPS) method whereas at the whole class time, lecturer had to fill observation form, recorded the results of direct observation in the class, and had triangulated the data by distributing questionnaires to students after each lecture. This is difficult to be done on the regular class. Although Parastwi and Rahmanto result showed student involvement in each phase of TPS was very high in the form of writing and discussing groups and classes, however it is very difficult to be implemented in all time [6]. In CL implementation, lecturers form small groups to learn a topic and have them work together does not guarantee quality cooperation or learning. Even the goal of creating positive social interdependence, arranging shared goals and giving some instructions on how to work together might not be enough. Some questions that arise are: 1) how a lecturer knows when students speak productively or not; 2) How much talk is out of topic, when a lecturer has to give reminder to only talking on the topic; 3) How can a lecturer know the various levels of participation of each group member. Therefore, in this study we proposed modified CL methods where students work on problems posed by lecturers, first individually, then in small groups, and finally as class discussions. This method allows students to express their reasoning, reflect on their thoughts, and get immediate feedback about their understanding. The modification take place at the end of the class where each student evaluated by writing on small paper nameless related to what are the most important things the student learned today and what questions remain unanswered. The answers of the questions can be able helping lecturer to evaluate the successful or failure of a topic. The research questions that guided this study was how to implement the proposed modified CL methods in laboratory engineering course.

2. Methods

In this study the modified CL methods use TPS strategy as the main strategy, whereas the modification done at each phase activities. The phases are: 1)Think: reading job-sheets & pre-test; 2)Pair: Instructor ask students to form a group of 3 or 4 students and group work on job-sheets; 3)Share: clarify and/or extend by instructor and class discussion; 4)Evaluation: Post-test; 5)Student self-perception evaluation: student feedback. Instructor ask students writing on small paper nameless related to what are the most important things the student learned today and what questions remain unanswered.

In this study, quantitative data formed the core of the research and qualitative findings were used to compliment quantitative findings. Quantitative data, therefore, were intended to explore computer programming students’ attitudes and learning experiences before and after work on job-sheets, whereas qualitative data were utilized for the purpose of triangulation [7]. Data was pertaining from 1st year Electronics Engineering’s class of 26 students in the 2nd semester in 2019. Some of these students have had a relevant computer programming or they may be learning computer programming for the first time. At every stage of the investigation, students were informed of the purpose of the research study.

3. Results and discussion

Cooperative learning was reported to be a more successful method than the traditional method with regard to both achievements and attitudes [8]. Learning strategies that provide opportunities for students to share their thoughts with at least one other student are Think Pair Share (TPS) where students think about the answers to individual topic questions, followed by group discussions where students think together on group answers before sharing group ideas openly to classmates. As a cooperative learning strategy, TPS benefits students in terms of peer acceptance and support in terms
of academic achievement as well as increased interest in learning. Concept development in TPS had forced students think to themselves on a topic provided by the teacher, pair up with another student to discuss the problems and share their thoughts with the class. By using TPS as a cooperative approach, the instructor provides students with activities that promote interaction. However, Parastiwi and Rahmanto had difficulties in implementing for the laboratory courses, therefore the modified cooperative learning methods in teaching computer programming laboratory course as seen in figure 1.

![Figure 1](image.png)

**Figure 1.** Modified cooperative learning methods in teaching computer programming laboratory course.

The modified cooperative learning methods use think pair and share strategy as the main strategy, whereas the modification done at each phase activities. The phases are: 1) Think: reading job-sheets & pre-test; 2) Pair: Instructor ask students to form a group of 3 or 4 students and group work on job-sheets; 3) Share: clarify and/or extend by instructor and class discussion; 4) Evaluation: Post-test; 5) Student self-perception evaluation: student feedback. Instructor ask students writing on small paper nameless related to what are the most important things the student learned today and what questions remain unanswered. In the first phase student’s quick-read job-sheets supplied by instructor, doing 5 minutes pre-test and getting instructor feedback on the quiz. Whereas in the second phase the group structured could be flexible group member nor appointed by instructor, student groups work on job-sheets and answering given critical thinking questions. The instructor walking around observing group work and answering students’ questions. In the third phase, the group work paused and instructor exploring the concept invention by conducting class discussion until time collapsed. In this third phase the invention has been constructed. Evaluation were done in four phase and students feedback were conclude the course session.

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the investigation, students were informed of the purpose of the research study. The result had showed that the proposed modified CL can be done in laboratory course.

4. Conclusion
The modified cooperative learning methods in teaching computer programming laboratory course consist of five phases: 1)Think: reading job-sheets & pre-test; 2)Pair: group work on job-sheets; 3)Share: clarify and/or extend; 4)Evaluation: post-test; 5)Student self-perception evaluation: student feedback. With proper timing for each phase had showed result that matching timing varied depending on the topic with an average of 20 minutes for the concept presentation by the lecturer. Student involvement is very high in the form of writing and discussing groups and classes. Triangulation of student perceptions states that students feel actively involved fully in the learning process.

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