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by Muhammad Nabili

The Implementation of Flipped Classroom Assisted by Learning Management System for Numerical Method Courses

Mitra Pramita, R. Ati Sukmawati, Delsika Pramata Sari
Departement of Computer Science Education
Universitas Lambung Mangkurat
Banjarmasin, Indonesia
mitrapramita92@ulm.ac.id

Abstract—This study aims to describe the implementation of reversing classes assisted by the learning management system (LMS) for numerical method subjects. The research method used was a combination method (mix method). The mix method model used in the study is a concurrent triangulation model. The subjects of this study were 58 students of the Computer Science Education Study Program FKIP Lambung Mangkurat University who took numerical method courses, 29 from class A and 29 from class B. The research data collection used was tested instruments, observations, and questionnaires. The results show that the flipped classroom implementation in the numerical method can increase the activity of students. It also improves the mastery/ competency of students in solving problems, and it is known that class B who learns to use teaching materials in the form of text and video is more active and able to understand the material well than class A students who learn using text only. The average value of each class B pre-test and the formative test is better than class A, but the students in class A and class B are still less accustomed to independent learning by working on the practice questions that have been given.

Keywords—flipped classroom; cooperative learning model; numerical methods

I. INTRODUCTION

The rapid development of information and communication technology (ICT) makes very significant changes to all parts of human life such as the way humans work, socialize, and learn. In entering the 21st-century civilization, technology has a very close relationship in all aspects including the field of education that makes both students and instructors required to have skills in learning and teaching. By having these skills, students are expected to be able to solve new problems in facing a more challenging life in the future [1].

Regarding the development of ICT in the field of education, it has resulted in the increasingly merging concept of "space and time" which has been a determining factor for the speed and success of human control over science and technology [2]. For example, people no longer need to go to places like libraries and bookstores to get information. They solely use smart devices like smartphones, tablets, and laptops to get any information they need.

The development of ICTs encourages renewal efforts in the world of education, especially the utilization of ICT developments in the learning process that can help with the implementation of teacher-centered learning the process to learner-centered learning (Student-Centered Learning).

Efforts to improve the quality of learning cannot be separated from the factors that influence it. Success in the learning process can be seen from student learning outcomes. Learning outcomes are abilities that students achieve after going through the teaching and learning process. Learning outcomes are abilities possessed by students after he receives his learning experience [3]. They are the result of interactions between internal factors (derived from the students themselves, such as intelligence, interests, and talents), and external factors (derived from the environment, such as: instructors, learning materials/materials, media, learning strategies used, means physical, family, community, including cultural value systems that affect schools, homes and communities [4]. It aims to achieve maximum learning goals, to produce qualified students.

Related to improving the quality of learning, the researchers conducted preliminary observations and found a number of problems; (1) students tend to be passive in the learning process takes place; and (2) the learning approach that has been used so far, namely face-to-face learning using traditional learning models, is considered to be less effective in providing experience to achieve these competencies. Traditional learning models raise several problems, including learning activities that are more teacher-centered, students tend to be passive, less independent, and lack initiative in learning, and learning time is wasted to convey and discuss instructional materials to provide less learning experience to apply the concept of methods numeric.

Based on the results of the team teaching discussion in the subject of numerical methods, one of the main causes is the low desire of students to learn independently before the learning begins, or the curiosity of something is low. This indication is seen when the learning process takes place. In learning activities, it appears that not all students are active in learning. They tend to be passive, just listen, and record what the teacher explains.

Based on the phenomena that exist in this numerical method course, it is necessary to make efforts to improve the quality of learning so that each student is active and more independent in the learning process. One effort that can be done is to make improvements through efforts to apply a variety of learning approaches that are in line with the development of science and technology.

The Student-Centered Learning (SCL) approach encourages students to be actively involved in building knowledge, attitudes, and behaviors [5]. One way to use ICT that can be used to support the SCL approach is by applying the Flipped Classroom strategy. The concept of Flipped Classroom is to reverse the work that students should do in the classroom (study material) into work at home, and work that should be done at home (individual/group assignments) becomes the work in the classroom [6].

Flipped classroom strategy is a method of using ICT as its main support. One of the technologies that can be used in the Flipped Classroom strategy is the Learning Management System (LMS). LMS can be a virtual class that helps interaction between instructors and students outside the real class. Teachers will upload teaching materials to the LMS; then students can read and study the teaching material.

In this study, the flipped classroom strategy is integrated with one of the learning models with the SCL approach, namely cooperative learning. Cooperative learning encourages students to interact actively and positively in groups [7]. Problems that may arise related to the application of flipped classroom strategies and cooperative learning models include: how are the describe in applying the flipped classroom strategy in the numerical method course. The purpose of this study is to describe the implementation of a flipped classroom assisted by a learning management system (LMS) for numerical method subjects.

II. METHOD

The research method used was a combination method (mix method). Mix method is a research method that combines or associates qualitative forms and quantitative forms [8].

Mix method has two models, namely mix method concurrent triangulation and concurrent embedded models. The mix method model used in the study is a concurrent triangulation model. The concurrent triangulation model is a combination of quantitative and qualitative methods that are mixed in a balanced manner, used together in the same time to obtain data to answer the same problem formulation, both the formulation of quantitative and qualitative problems [9].

A. Research Subject

The subjects of this study were 58 students from the 2015 and 2016 classes of the Department of Computer Science Education FKIP Lambung Mangkurat University who took numerical method courses, 29 students from class A and 29 students from class B.

B. Data Collection

The data of this study was collected using a test instrument. This test instrument was in the form of an essay test of two questions to measure the learning outcomes of students. In the pre-test and formative test, each question meeting was adjusted to the material to be studied. The time allotment to do this formative pre-test and test was 30 minutes.

Furthermore, the implementation of the learning requires observers of at least two educated people with at least S2 to record everything found during the learning process. This observation aimed to observe and record responses or obstacles faced by students during the learning process.

The instrument of questionnaires was given, and several questions were provided online using Google Form services. The purpose of questionnaire questionnaires was to find out feedback from students regarding the learning process using the Flipped Classroom strategy.

III. RESULTS AND DISCUSSION

Since this study was a mixed method study, there were two studies that had been conducted namely qualitative and quantitative studies. The quality was carried out during the development of the implementation of the Flipped Classroom strategy and the cooperative learning model assisted by the Learning Management System (LMS). The quantitative study data was obtained by analyzing student learning outcomes and analyzing student questionnaires towards learning using google classroom.

A. SCL and ICT based Learning Design

The strategy used for the implementation of SCL and ICT based learning was Flipped Classroom. The concept of Flipped Classroom is to reverse the work that students should do in the classroom (study material) into work at home, and the work that should be done at home (individual/group assignments) becomes the work in the classroom [6].

In traditional learning, students take classes and listen to the delivery of teaching materials in class; they will be given individual/group work at home. At Flipped Classroom, the teacher will first prepare and upload the teaching materials on the Learning Management System (LMS), then the students will learn teaching materials before the lecture day. Then, in the classroom, the teacher will ask the students to the group to be given a case/problem.

The design phase included the determination of the learning model, preparation of the Learning Implementation Plan (RPP), preparation of teaching materials, uploading of teaching materials, and preparation of evaluation instruments.

The application of the Flipped Classroom strategy needed to be integrated with the learning models that support the concept of Student-Centered Learning (SCL). Therefore, it was very important to determine the learning model. Based on the results of team discussions, the learning model used was Cooperative Learning. Cooperative learning is a form of learning where students learn and work in small groups collaboratively and its members consist of four to six people

with heterogeneous group structures [3]. In this cooperative learning model, the teacher act as a facilitator who functions as a bridge to higher understanding.

The principles of the cooperative learning model are 1) positive interdependence; 2) individual responsibility; 3) face to face; 4) communication between members, and 5) group process evaluation [10]. The benefits of the Cooperative Learning include increasing student learning activities and academic achievement, helping students develop oral communication skills, developing students 'social skills, increasing students' self-confidence, and helping to improve positive relationships between students [11]. According to [12], Cooperative Learning has six steps as can be seen in Table 1.

TABLE I.   COOPERATIVE LEARNING STEPS

Steps	Indicator	Teacher Activities
1	Delivering goals and motivating students	Teachers convey learning objectives and communicate basic competencies to be achieved and motivate students.
2	Presenting Information	Teacher presents information in the form of apperception and a review of the material that has been uploaded on LMS.
3	Organizing students into study groups	Teacher coordinates students to a group and provides cases/problems to be solved by each group.
4	Guiding study groups	Teacher motivates and facilitates student work in study groups.
5	Evaluating	Teacher evaluates the learning outcomes by presenting group learning outcomes in solving cases/problems that have been given.
6	Giving awards	Teacher gives awards for learning outcomes of the group.

The lesson plan was based on the concept of Flipped Classroom and the steps of the cooperative learning model. Teaching materials are arranged based on Semester Learning Plans (RPS) for each subject that can be text or video. Teaching materials have an important role in the strategy of Flipped Classroom.

The preparation of teaching materials must be designed so that students can learn the material independently; therefore, besides the material, there are also examples of questions and exercises that must be done by students at home. In addition to the teaching materials to be uploaded, another thing that was prepared was a worksheet in the form of cases/problems that will be resolved in groups when in class. Meanwhile, the pretest test and formative test questions were done by students individually on the learning process in the classroom.

The important thing in implementing the flipped classroom strategy was Information and Communication Technology (ICT). One technology to use in the Flipped Classroom strategy is a Google Classroom Learning Management System (LMS). Google Classroom is a web service developed by Google that aims to administer, document, track, and deliver learning content. To use Google Classroom services, users must have a Google account and do the following steps.

1) Class Making

An instructor or instructor makes virtual classes on Google Classrooms. Then the instructor provided a code of access for the participants to join.

2) Topic Making

After the class was finished, the next step was to make the topic. Topics were designed according to the number of meetings that would be held. Each topic represented a meeting in a real class.

3) Uploading Teaching Materials

One of the Google Classroom features is as a medium for storing the compiled instructional. Teacher uploaded teaching materials 2-3 days before the lecture schedule, then he/she informs the participants of the course so that they could be learned.

Uploading instructional materials tailored to the topic that has been made. Google Classroom supports a number of teaching material formats such as text-based formats and video-based formats. In addition to the material, the instructor can also upload assignments and quizzes. The teaching materials uploaded for numerical methods consist of videos and text.

4) Evaluation Design

The design of the evaluation was carried out to prepare instruments or methods as a reference for the reflection of the learning process carried out. Evaluation of the implementation of learning was done in three ways, namely the implementation of pre-test and formative tests, observation of the learning process, and filling out the questionnaire.

The pre-test was carried out at the beginning of learning. The implementation of the Pre-Test aimed to determine the extent to which students are active in studying the material. The questions contained in the Pre-Test were arranged in accordance with the material and designed so that it could be completed in about thirty minutes.

Observation of the learning process was carried out during the learning process. Observations were made by the other instructors in the team. This observation aimed to observe and record responses or obstacles faced by students during the learning process.

Questionnaires were given after the learning process took place. The questionnaires are provided online using Google Form services. The purpose of the questionnaire was to find out feedback from students regarding the learning process using the Flipped Classroom strategy.

B. Implementation of SCL and ICT based learning

The implementation of SCL and ICT based learning was carried out in the numerical method courses in the Department of Computer Science Education. The learning implementation in the course of the Numerical Methods was carried out four times in two different classes namely Class A (Teaching material in the form of text) and Class B (Teaching Materials in the form of text and video).

The implementation stage of the learning using the cooperative learning model is as follows. First, the teacher

asked the students to answer the Pre-Test before the learning process begins. Second, the teacher conveyed the purpose, apperception and motivation about the material to be studied. Third, the teacher reinforced the material uploaded in the LMS, the teacher then divided students into several groups and asked students to understand and discuss material and solve problems given to MFIs. Then, the teacher guided the discussion and asked the group representatives to present the results of the discussion. Fifth, the teacher gave awards to each group that had presented the results of the discussion. After the learning process, the students were given formative tests.

C. Reflection on SCL and ICT based learning

The reflection phase was carried out to discuss the results of the observations during the implementation of learning in the course of numerical methods. The findings of the learning process of numerical methods in the first meeting of class A (teaching materials in the form of text) are as follows:

- Many students studied but could not understand the material given on Google Classroom.

- Students were still having difficulties in the learning process because some students did not carry counting tools such as calculators or laptops.

- Students were still not proficient when using and applying the formula to Ms Excel or calculator.

- Students were still not used to using cooperative learning models so that the learning process took a long time.

- Division of tasks in solving group problems was still dominated by several people so that only a few students were active.

The findings of the course learning process Numerical methods the second meeting in class A (teaching materials in the form of text) are as follows:

- Students began to get used to using cooperative learning models so that group collaboration got more intense; each student was active in solving problems given.

- All students carried assistive devices to calculate such as calculators or laptops during the learning process.

- There were still some students who were less proficient when using Ms Excel and calculators thus took a long time to solve the problems given.

The findings of the learning process in the Numerical Method the first meeting in class B are as follows:
- Some students did not access the videos uploaded because of limited internet connection.

- Students who did not study the material through video were still having difficulty understanding the material and using calculating tools such as Ms.Excel and calculators.

- Students who studied material through videos could better understand the material in depth and were adept at applying the formula using Ms Excel.

- Students were still not used to using cooperative learning models so that the learning process took a long time.

The findings of the course learning process for the Numerical Method of the second meeting in class B are as follows:

- The students began to get used to using cooperative learning models so that group collaboration got more intense; each student was active in solving problems given.

- The division of tasks for each group member was carried out evenly so that they had their own responsibilities.

- When given a problem, each group member controlled the work of friends in the group so that the answers generated were aligned and confirmed.

- Group members who had understood and learned before learning in class could guide and give good explanations to other members who did not understand the material.

The results of the pre-test and formative tests of students in class A and class B can be seen in Table 2.

TABLE II. PRE-TEST AND FORMATIVE TEST RESULTS ON CLASSES A AND B

Class	Average Score of Pre-Test 1	Average Score of Formative Test 1	Average Score of Pre-Test 2	Average Score of Formative Test 2
A (teaching material in the form of text)	42.41	85.17	25.52	68.28
B (teaching material in the form of text and video)	49.31	89.31	39.66	86.21

Table 2 shows that the average score of each class B pre-test and formative test result are better than class A, meaning that in the learning process using teaching materials in the form of text and video is better than just using text in learning. This result is in line with the research carried out by [13] examined 67 peers-reviewed papers from 2003-2013 that focus on (what they refer to as) video based learning and conclude that use of video in teaching can improve learning outcomes as well as learning satisfaction. The impact on learning outcomes through video (lecture capture systems) could be significant and deserves to be investigated further [14].

The questionnaire results of students in class A and class B can be seen in Table 3.

TABLE III. RESULTS OF THE PERCENTAGE OF QUESTIONNAIRE IN CLASSES A AND B

Indicator	Percentage of Class A	Percentage of Class B
Google classroom facilitates the learning process	73.7%	74.1 %
Agree that the material uploaded on google classroom helps in the learning process	52.6%	88.9%
Sometimes access google classroom before taking lectures	57.9%	55.6%
View material uploaded on google classroom	78.9%	85.2%
Read material uploaded on google classroom	63.2%	59.3%
Work on problem training on material uploaded on google classroom	47.4%	40.7%
The ideal time to study the material that is needed before the lecture is 2-3 days	52.6%	55.6%
Obstacle to accessing material on google classroom is an internet connection	73.7 %	85.2%

Table 3 shows that overall Google Classroom facilitates the learning process, agreeing that the material uploaded on Google classroom helps in the learning process, and sometimes accessing Google classroom before attending lectures.

On the percentage indicator, the material uploaded on Google Classroom in class A is 78.9% and class B is 85.2%. The percentage of reading material uploaded on Google Classroom in class A is 63.2% and class B is 59.3%. Then, the percentage of indicators working on the questions on the material uploaded on Google Classroom decreased by only 47.4% and 40.7%, meaning that less than 50% of the students who worked on the exercises in the material provided. That is, most students only see and read material uploaded on Google Classroom without understanding and working on the exercises contained in the material provided on Google Classroom.

IV. CONCLUSION

Based on the results of this study, it can be concluded that students who learn with the implementation of the flipped classroom strategy on the numerical method course can increase the activeness of students in groups using cooperative learning models and improve the mastery/competence of students in solving problems. In addition, class B students who learn using the materials in the form of text and video are more active and can understand the material better than students of class A who learn using text only.

The results of the pre-test and formative tests of class A and class B students showed that the average value of each pre-test and formative test of class B who learned to use teaching materials in the form of text and video was better than class A who learned to use text only. Then, the results of the questionnaire indicate that most students only saw and read the material uploaded on google classroom without understanding and working on the exercises contained in the material provided. So, it can be concluded that the main obstacle in applying the flipped classroom strategy is that students in classes A and class B are still less accustomed to independent learning by working on the practice questions that have been given.

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