

## **Effect of a flipped mastery classroom strategy assisted by social media on learning outcomes of electrical engineering education students**

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**ABSTRACT:** Information and communications technology (ICT) in education has altered learning to be more flexible, interactive and productive. The purpose of this study was to investigate the effectiveness of the flipped mastery classroom model assisted by social media on the learning outcomes of a course for electrical engineering students in the Faculty of Engineering at the State University of Malang, Indonesia. Learning outcomes were measured by the learning and teaching test (LTT). A pre-test post-test quasi-experimental design was employed. A total of 61 engineering education students participated in the study divided into an experimental and control group. The experimental group (N = 31) was taught through the flipped classroom method, while the control group (N = 30) was taught using traditional teaching methods. The researchers employed an independent sample *t*-test to analyse the data obtained. Findings indicated a significant difference in learning achievement between the two groups, with students performing better through the flipped mastery classroom.

### INTRODUCTION

The Learning and Teaching course (UMKK603) is compulsory for students majoring in electrical engineering education in the Faculty of Engineering, Universitas Negeri Malang, Indonesia. It counts as four credits and is delivered in 16 meetings of 200 minutes each. The Learning and Teaching course is to equip students with the knowledge and skills to become an effective teacher. Course topics are:

- concepts of learning and teaching;
- learning and teaching theories and their implications;
- selection of learning approaches and learning models;
- learning motivation;
- learning and teaching problems;
- basic concepts of learning assesment;
- planning and implementing effective lessons.

With the rapid advancement in educational technology, many researchers have suggested the use of technology across all disciplines, including teacher education to produce positive results in teaching and learning. Researchers and practitioners have explored alternative strategies and teaching methods to engage and motivate students in learning. The principles of prescriptive learning and their application in real learning situations is a strategy that can facilitate students to achieve desired outcomes [1].

The flipped classroom is one alternative strategy. The flipped mastery classroom was introduced by Bergmann and Sams in 2008 based on the theory of mastery learning [2][3]. It is similar to the Indonesian philosophy of learning coined by Ki Hadjar Dewantoro [4]. In the flipped classroom, technology is applied to improve the accessibility of learning and learning outcomes. The flipped classroom is a learning strategy oriented to learners, where the learning activities and achievements of learners are the focus. Flipped classroom is defined as a learning model in which learners access on-line video lectures uploaded by the instructor prior to the classroom sessions. Class time is used for participative learning activities [5], instructor-guided problem-solving and discussion. Flipped classroom learning allows learners to learn at their own pace.

According to Horn, this results in a paradigm shift from a teacher-centred to student-centred approach [6]. Viewing lectures on-line may not seem to differ much from the traditional homework reading assignment, but there is one critical difference: classroom time is no longer spent taking in raw content, a largely passive process. Instead, while at school, students practise solving problems, discuss issues or work on specific projects. The classroom becomes

an interactive environment that engages students more directly in their education. Students are more ready to apply knowledge from the class in the form of problem-solving, discussion or creating projects [7-9].

### Experience with Flipped Classrooms

Research evidence on the use of the flipped classroom in the teaching and learning of various disciplines has yielded positive results. One example is the effect of flipped classrooms on learners with different achievement levels in learning mathematics [10]. The learning achievement and motivation were measured by the mathematics achievement test (MAT) and course interest survey (CIS), respectively. A pre-test post-test quasi-experimental design was employed. The participants were 82 high-school students and were divided into experimental and control groups.

The experimental group (N = 41) was taught trigonometry with the flipped classroom method, while the control group (N = 41) was taught utilising traditional teaching methods. The researchers employed an independent sample *t*-test, analysis of covariance (ANCOVA), and multivariate analysis of variance (MANOVA). Findings indicated a significant difference in the learning achievement and motivation between the two groups, with students performing better using the flipped classroom [10].

Researchers have also investigated whether a flipped classroom design would improve student performance and perceptions of the learning experience compared to a traditional lecture course design in a required pharmacotherapy course for second-year pharmacy students [11]. Students viewed short on-line videos about the foundational concepts and answered self-assessment questions prior to face-to-face sessions involving patient case discussions. Mean scores of the post-test of experimental group students improved from the pre-test.

A postcourse survey showed 88 percent of experiment students were satisfied with the flipped classroom. Students reported that they appreciated the flexibility of video viewing and knowledge application during case discussions and it improved student test performance and perceptions of the learning experience during the first year of implementation [11].

In the area of history and science, the findings of Mohanty and Parida strengthened the positive impact of flipped mode of instruction on children's learning outcomes [12]. The result showed that the experimental group of eight graders performed better than the traditional group [12]. A systematic review investigated the use of flipped classrooms in Turkey based on 38 studies [13]. The findings were grouped into five categories:

- First: this was a comparison of student achievement in flipped classrooms compared to traditional lecture-based classrooms. The studies reported that students were more successful in flipped classrooms, and there was an increase in the achievement scores (academic performance, academic achievement, learning gains, performance increase or examination-based scores) of students taught by flipped classrooms compared to students' scores in traditional lecture-based classrooms.
- Second: regarding students' perceptions/opinions or views about flipped classrooms, the review revealed that the flipped learning environment was more flexible, fostered peer interaction and co-operation and students came to class better prepared. They preferred flipped classroom over traditional methods and developed a better comprehension of the learning content.
- Third: in terms of the disadvantages and limitations, students found the lecture videos boring, and they experienced technical problems related to the computers and Internet connection. They also had problems due to their unfamiliarity with the method.
- Fourth: concerning the effect of flipped classroom on students' motivation, the findings revealed that students' motivations were higher in flipped classrooms by comparison with students in traditional lecture-based classrooms.
- Fifth: on the subject of students' attitudes, the findings demonstrated that students had positive attitudes towards flipped learning as they reported they had more fun and felt less anxious. They had higher achievement and they assessed the classroom as a less stressful learning environment [13].

From the above, research evidence is abundant across various disciplines, but is limited for engineering teacher education in Indonesia. To fill this gap, the present study was an examination of the effectiveness of the flipped mastery classroom model on the course, Learning and Teaching, in the Electrical Engineering Department at the Universitas Negeri Malang, Indonesia. The research question was formulated as: is there any significant difference in the learner's achievement scores between the experimental and control groups?

The null hypothesis can thus be formulated as:

H<sub>0</sub>: there is no difference in learning outcomes between groups of students taught using the flipped mastery classroom and the conventional model.

## METHOD

Applied in the study was a pre-test post-test quasi-experimental design [14]. Sixty-one second year electrical engineering students, aged 20 to 21 participated in the study. The experimental group had 31 students, and the control group 30. The experimental group undertook lessons on the concept of learning and teaching with the flipped classroom, while the control group used the conventional method. Both groups were given pre- and post-tests.

The learning and teaching test (LTT) was administered to measure the student's performance. The content of the pre-test and post-test was the same, but the order of the test items was interchanged to avoid the same set response effect. The test items comprised 50 multiple-choice questions and three essays on the concept of learning and teaching. Sixty minutes was allotted for the LTT. Content validity of the instrument was determined quantitatively by a panel of five experts. To improve the quality of the instrument, it was also administered to students who took the course in the previous year.

The duration of this study was six weeks. Two weeks before the intervention, both the experimental and control group underwent a pre-test. The author selected four teaching modules for this study: the concepts of learning and teaching; learning and teaching theories and their implications; selection of learning approaches and models; and learning motivation. In the control group, the instruction was provided in the classroom. Students were asked to attend the classroom-based lectures and complete their homework on their own, before the next class. Sixty minutes of the total class duration (100 minutes) were devoted to the lecture and question-answer session. The remaining time was utilised for discussion.

In the experimental group, pre-recorded video lessons were uploaded to WhatsApp one week before the class. The average duration of each lesson was 15 to 20 minutes. Students were asked to watch the video lesson before coming to the class. During classroom time, students were involved in activities based on the video lessons. Students were divided into groups to discuss problems. At the end of the intervention, both groups were given post-tests to collect scores for learning achievement and motivation.

Frequencies and percentages were used for descriptive statistics. Concerning the learning achievement, an independent sample *t*-test was conducted to determine the effects of the flipped classroom on learners. All analyses were conducted through the statistical package for the social sciences (SPSS22). The statistical significance level was set at  $p = 0.05$ .

## RESULTS

Statistical analysis results through SPSS22 for Windows indicated that the average pre-test score of the experimental group was 31.80 with a standard deviation of 7.098 and the average pre-test score of the control group was 32.52 with a standard deviation of 9.701.

After the flipped classroom treatment, the average post-test score for the experimental group was 68.97 with a standard deviation of 6.676, and the average post-test score for the control group was 41.78 with a standard deviation of 8.573. The data are presented in Table 1. The pre- post- gain for the experimental group was 37.17, while the gain for the control group was 9.26.

Table 1: Pre-test and post-test scores.

	Pre-test	Post-test	Gain	Pre-test SD	Post-test SD
Experimental group	31.80	68.97	37.17	7.098	6.676
Control group	32.52	41.78	9.26	9.701	8.573

Before employing the *t*-test, Levene's homogeneity test was conducted. The results of the test confirmed that the significance value  $p$  of the pre-test and post-test was 0.102 and 0.134, which was greater than 0.05. Therefore, it was concluded the participants had homogenous ability.

### Hypothesis Testing

Hypothesis testing was performed using a *t*-test with SPSS22 for Windows. Based on the results of the paired post-test pre-test on the experimental and control group, the average coefficient values of each experimental and control group before and after treatment were as follows:

- 1) the average gain for experimental group was 37.17 with a *t*-value of 19.961 and a  $p$ -value of 0.000;
- 2) the average gain for the control group was 9.26 with a *t*-value of 3.389, and a  $p$ -value of 0.003.

The experimental group  $p$ -value of 0.000 was  $< 0.05$  and the control group  $p = 0.003 < 0.05$ . Accordingly, there was a significant difference between the experimental and the control groups.

An independent samples *t*-test was carried out to find the difference between before and after treatment for each group. The independent sample test on the experimental and control pre- and post-tests had a value of 0.000 at df 50 (degrees of freedom). The *t* value was 0.000 compared with the *t* value for df 48 with a probability of 0.05 which was 2.021. Since 9.142 > 2.021, it can be concluded that the null hypothesis, which states there is no difference in learning outcomes between groups of students taught using flipped mastery classroom and conventional model, is rejected. In other words, there is a significant difference in learning outcomes between the experimental group taught by the strategy of flipped mastery classroom and the control group taught with conventional methods.

Displayed in Table 2 are the *p*-values (2-tailed) as  $0.000 < 0.05$ . Therefore, the difference is significant at  $p = 0.05$ . The difference in mean value was 28.253 meaning that the experimental group had a higher average than the control group. The strategy of the flipped mastery classroom applied to the experimental group was more effective than the conventional strategy applied to the control group in terms of student cognitive learning outcomes. Summarised in Table 2 are the hypothesis testing results.

Table 2: Hypothesis testing results.

		Levene's test for equality of variances		<i>t</i> -test for equality of means				
		F	Sig.	<i>t</i>	df	Sig. (2-tailed)	Mean difference	Std error difference
Post-test Pre-test	Equal variances assumed	3.05	0.085	9.361	50	0.000	28.253	3.087
	Equal variances not assumed			9.142	48	0.000	28.253	3.148

The hypothesis testing confirms that different learning strategies produce different results on students' learning outcomes. The *p*-value of the experimental group was  $0.000 < 0.005$  and the control group was  $0.003 < 0.05$ . Hence, the flipped mastery classroom applied to the experimental group significantly positively influenced students' cognitive learning outcomes compared to conventional learning applied to the control group.

## DISCUSSION

A learning strategy involves taking a particular approach to accomplish learning objectives in the context of an educational environment. The research results reported here are in accordance with such a theory in which a certain approach was used to create different learning outcomes [1]. This research confirmed that the cognitive learning outcomes of students were better during the Learning and Teaching course, in which the flipped mastery classroom was employed, as compared with those of students taught in the conventional way. The flipped mastery classroom, alternatively, offers a positive influence on students' cognitive learning outcomes in the Learning and Teaching course instead of the conventional learning approach.

These research results strengthen Mohanty and Parida's findings, which determined that flipped classroom mastery offers a positive and significant influence on students' learning outcomes [12]. In the further analysis it is argued that it also enhances college students' learning. Flipped mastery learning provides a flexible time for students to learn. In this learning strategy, students are allowed to repeatedly review learning topics and material which are provided on-line. This repeated learning process in the flipped mastery strategy will further enforce students' understanding of the course materials and topics. The students' engagement was noticed during face-to-face learning in the classroom [6][7].

Course material in the classroom should not only deal with the basic concepts [8], but also with higher level conceptual applications of the issues faced by students in real life [9]. Therefore, students' understanding and ability to apply knowledge is enhanced [5][12][15].

The application of the flipped mastery classroom strategy assisted by social media is also in line with the learning stages proposed by Ki Hadjar Dewantoro: the TRINGO strategy (*Ngerti, Ngrasa, Nglakoni*), as reported by Mohanty and Parida [12]. A good learning process moves from knowing facts, concepts, principles and laws to a phase where the theory is applied to solve problems or to make a product.

The stage begins through the learning activities to understand and to comprehend what is learned (*Ngerti/understanding*), to the process of having and perceiving (*Ngrasa/internalisation*) the material learned. Learning materials, in this context, are no longer interpreted as the teacher's properties or on-line properties, but have been transformed and perceived by the students through the process of material internalisation. In the end, all the internalised materials are used to solve the problems faced or to invent a product based on the needs of students (*Nglakoni/do, solve the problem*) [12]. In this case, problem-solving is presented in the Learning and Teaching course and in completing the assignments given by the lecturer.

The learning scenario is as follows:

- First: students review the learning materials individually on-line repeatedly. Then, the learning materials are processed by the student through independent learning, pairwork or group-work or in the classical way.
- Second: the learning materials are assimilated by the student through assignments; therefore the materials are personally incorporated into the student's mindset. In other words, knowledge has been internalised within a student's mindset and thinking.
- Third: this is the stage in which students apply or implement the knowledge they obtained to solve problems face-to-face in the classroom. The knowledge obtained will be internalised within a student's mindset and thinking. Then, there is the implementation process of creating a written summary, presentation, designing a poster or even designing learning media, which will be presented as learning outcomes during the Learning and Teaching course.

## CONCLUSIONS

The conclusion reached from this study is that the cognitive learning outcomes of the students studying electrical engineering education in the Faculty of Engineering at Universitas Negeri Malang, in which a flipped mastery classroom was applied, obtained higher average scores as compared to a control group with conventional learning. It confirms that student learning activities with the flipped classroom were more flexible, constructive, participatory and student-centred. The utilisation of social media (WhatsApp) helps students to communicate, consult and share information effectively during learning.

It is suggested that a flipped mastery classroom should be extensively applied, because it offers students an easy way to learn independently. It also enables students to access learning materials on-line through social media and enables students to discuss material through group or peer-to-peer work. It is important for lecturers to take into account communications with students and the delivery of additional materials regarding students' questions, which may be delivered outside the classroom.

The duration of this study was limited to six weeks and this is one of its limitations. Future studies should cover more use of the flipped classroom strategy. Another limitation of this study was that students were not able to ask their questions immediately while watching the lesson videos. Future studies may provide an on-line discussion forum for giving opportunity and motivating the students to ponder questions, so as to develop critical thinking and engagement. Interactive video lessons are also recommended for further studies in the flipped classroom to make learning more meaningful.

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