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PAPER**The effectiveness of flipped classroom learning model in secondary physics classroom setting**

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The effectiveness of flipped classroom learning model in secondary physics classroom setting

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Abstract. The research aimed to describe the effectiveness of flipped classroom learning model on secondary physics classroom setting during Fall semester of 2017. The research object was Secondary 3 Physics group of Singapore School Kelapa Gading. This research was initiated by giving a pre-test, followed by treatment setting of the flipped classroom learning model. By the end of the learning process, the pupils were given a post-test and questionnaire to figure out pupils' response to the flipped classroom learning model. Based on the data analysis, 89% of pupils had passed the minimum criteria of standardization. The increment level in the students' mark was analysed by normalized n-gain formula, obtaining a normalized n-gain score of 0.4 which fulfil medium category range. Obtains from the questionnaire distributed to the students that 93% of students become more motivated to study physics and 89% of students were very happy to carry on hands-on activity based on the flipped classroom learning model. Those three aspects were used to generate a conclusion that applying flipped classroom learning model in Secondary Physics Classroom setting is effectively applicable.

1. Introduction

Physics as a very basic of various science makes it not limited to one particular topic. Physics as a science that studies various natural phenomena along with all the interactions that occur on it make it can't be separated from everyday life. Those various phenomena are led to various innovations in multi sector of life.

In this recent digital era, information and communication technology (ICT) develops rapidly. There are a lot of new innovations produced every day, where some of the innovations are related to education field of study. The innovations are presented with the aim to create a generation that has the skills needed in today's digital era that has the character of a thinker who has the skills to think critically, innovate, create, communicate, solve problems, and use technology and have a responsibility [1].

One of the new innovations in the education field is related to the learning model conducted in the classroom. Currently, the flipped classroom learning model is favoured by many teachers. As a new learning model, it makes many teachers want to try to apply the flipped classroom learning model.

The idea of a flipped classroom learning model arises from the problems faced by students who have to leave the class frequently for some reason. When students have to leave the class, automatically the student will miss various explanations given by the teacher during the learning process in class. On the other hand, teachers with various time constraints are very difficult to provide additional lessons outside



the class to the students. From these conditions, ideas arise to make learning videos easily accessible to students [2].

2. Literature Review

2.1. Definition of flipped classroom

At the heart of the flipped classroom is moving the "delivery" of material outside of formal class time (through the use of extensive notes, video-recorded lectures and other appropriate means) and using the formal class time for students to undertake collaborative and interactive activities relevant to that material [3].

Flipped classroom learning model is an approach to education that emphasizes active learning. The flipped classroom learning model was developed by Jonathan Bergmann and Aaron Sams in 2007 [4]. Simply put, the concept of a flipped classroom is to replace activities that are usually done at home for work in school and vice versa [2]. The flipped classroom is a learning model consisting of two parts: interactive learning in groups in the classroom, and direct computer-based individual instruction outside the classroom [6].

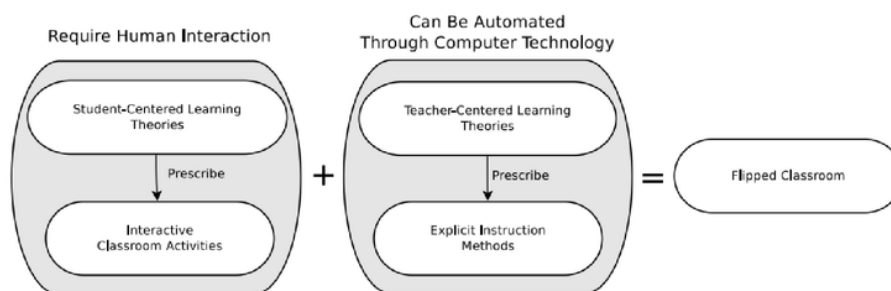


Figure 1. Diagram of flipped classroom [5].

2.2. Learning strategy of flipped classroom

The flipped classroom learning model is characterized by the materials provided to the students as homework before starting school activities. The material given can be learning videos, hand outs, or other learning materials. Students are assigned to study the materials that will be discussed in schools through various media that teachers have provided. With this, students are expected to already have enough knowledge to do activities in the classroom.

One of the advantages of using video learning media is that students can easily repeat or pause learning videos. When students feel left behind by the explanations given by teachers in the traditional classroom, students are unable to repeat the teacher's explanation at a moment's notice. However, by using video learning the students can repeat the learning video to feel understood about the material discussed in the video [2].

Classroom learning activities begin with motivations aimed at improving students' interest in learning. Then, followed by question and answer relating to the material that has been studied by the students through the medium of learning that has been given by the teacher. Here the teacher can know how much the level of understanding of students after watching the learning video given or studying other learning materials.

After the question and answer activities are completed, the activities are continued with investigation activities that can be in the form of problem-solving, lab work, or other activities aimed at improving students' understanding as well as the application of the material already learned. Here the teacher's function is changed dramatically, where the teacher is no longer a source of student information, but the

teacher acts as a student facilitator in conducting activities. Where in the traditional classroom teachers should explain the material first before starting to conduct investigation activities either in the form of problem-solving or laboratory activities? [6]

Table 1. Comparison of class time in traditional versus flipped classroom [2, 4].

Traditional Classroom		Flipped Classroom	
Activity	Time	Activity	Time
Warm-up activity	5 min.	Warm-up activity	5 min.
Go over previous night's homework	20 min.	Q&A time on video	10 min.
Lecture new content	30 – 45 min.	Guided and independent practice/or lab activity	75 min.
Guided and independent practice and/or lab activity	20 – 35 min		

2.3. Students' view of flipped classroom

Active learning was described as requiring students “to do meaningful learning activities and think about what they are doing” [7]. Baeten et al. [8] find that student-centred learning approaches are more likely (among other factors) to lead to a deep approach to learning [9] by students.

A recent survey of research into the flipped classroom learning model with results being relatively consistent in that general student opinion of the flipped classroom tends to be positive with a significant minority being opposed [5].

A research find that 80% of survey respondents in a first-year physics course preference the flipped structure to a traditional approach [10]. Where in the business course, a largely positive response from students in a flipped introductory business course was found, although 32% of survey respondents advocate a return to a traditional lecture format [11].

In the other hand, students in a flipped classroom introductory statistics class were less satisfied with classroom structure than those in the traditional class, but that they become more open to co-operation and innovation as the semester progressed [12].

Another research find that student response to the flipped classroom structure of Actuarial Techniques was largely positive, indicating it to be an approach worth pursuing in future years [3]. While around a 50/50 split of respondents thought the proposed structure would be beneficial at the start of the semester, by the end of the semester over 75% of total respondents viewed the flipped classroom as being beneficial to their learning experience compared to a didactic lecture structure. The 25% of students who viewed the flipped classroom as not being beneficial to learning is relatively consistent with the 32% in Schullery et al. [11] and the 20% in Bates and Galloway [13].

Based on the literature, students' view of the flipped classroom is very varied. Mostly the students give a good response to the flipped classroom learning model, but on the other hand, there are some students that less satisfied with the result of flipped classroom learning model. It means that the flipped classroom learning model is still debatable in students' perspective.

3. Method

The research model used is the quasi-experiment. The quasi-experiment is an experimental study that controls the research situation using non-random methods. The research design used is one group pre-test and post-test design. The subject used in this research will get treatment in the form of application

of flipped classroom learning model. Subject used in this study is students of Secondary 3 SIS Kelapa Gading who choose Physics.

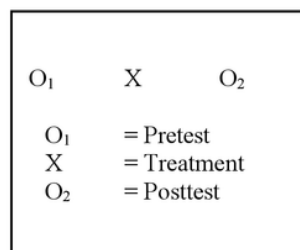


Figure 2. One group pretest-posttest design.

Before doing research, it begins by doing an observation of learning activities undertaken. It aims to know the characteristics of students who are used as research subjects. After that, preparing the learning tools that required. The learning media are designed to be suitable for the characteristics of the students themselves. This is important because, in the flipped classroom learning model, students will learn more independently through the media that have been prepared. Use of appropriate media is expected to increase student motivation to learn.

The research begins by giving a pre-test that aims to determine the initial ability of students. The pre-test is only given once at the first meeting. The pre-test was given in type of multiple choice related to the topic to be studied. Then proceed with the treatment that is in the form of application of flipped classroom learning model.

Learning activities in the class begin with a question and answer session related to the materials that have been learned by students through the given media by the teacher. Students are given the opportunity to clarify the knowledge gained by asking questions or providing answers to questions raised by other students. In this session, the teacher acts as a facilitator while ensuring the concepts built by the students are appropriate.

After the question and answer session, learning activities continued with exploration activities. Exploration activities conducted in the form of experiments (either directly or virtual computer-based) and solving a problem/phenomenon (based on the worksheet). The teacher actively guides students in conducting exploration activities. At the end of the exploration activities, the teacher provides a review of the learning activities that have been done. Before ending the learning activities, teachers always remind students to learn the next topic through the media provided (Video, PDF, PPT).

At the last meeting, post-test is given in aims to know the results of learning activities undertaken. The post-test was given in the form of multiple-choice questions and open-ended question. After that, students fill out the student response questionnaire sheet of the application of the flipped classroom learning model.

Data analysis of research result includes analysis of lesson plan implementation, analysis of pre-test and post-test result and student response questionnaire analysis.

Analysis of the implementation of the lesson plan using the following formula:

$$P(\%) = \frac{\text{Score}}{\text{Total Score}} \times 100\% \quad (1)$$

with the criterion of assessment score interpretation as follows:

Table 2. Interpretation Criteria.

Percentage	Criteria
25% - 43.7%	Bad
43.8% - 62.5%	Enough
62.6% - 81.25%	Good
81.26% - 100%	Very God

Analysis of pre-test and post-test data involves determining the completeness and the improvement of students' comprehension skills by calculating normalized n-gain values.

Based on the post-test result, it can be determined the percentage of students who have met the minimum criteria set. The minimum criterion specified is 50% of the total post-test value. The percentage can be calculated by the following formula:

$$P(\%) = \frac{\text{Score}}{\text{Total Score}} \times 100\% \quad (2)$$

Based on the pre-test and post-test results, a normalized n-gain score calculated aims to define the improvement of knowledge after being given treatment to the students. The normalized n-gain score is calculated by the following formula:

$$< g > = \frac{\text{Posttest score} - \text{Pretest Score}}{100 - \text{Pretest Score}} \quad (3)$$

with the following score categories :

Table 3. Gain score interpretation.

Gain Score	Category
$(< g >) \leq 0.3$	Low
$0.3 < (< g >) < 0.7$	Moderate
$(< g >) \geq 0.7$	High

In addition, based on the results of the questionnaires that distributed to students, it will be analysed in order to determine the students' responses to the application of the flipped classroom learning model. Analysis of student response questionnaire data used the following formula:

$$P(\%) = \frac{\text{Score}}{\text{Total Score}} \times 100\% \quad (4)$$

with the following criteria :

Table 4. Interpretation criteria.

Percentage	Criteria
25% - 43.7%	Bad
43.8% - 62.5%	Enough
62.6% - 81.25%	Good
81.26% - 100%	Very God

4. Analysis

4.1. Analysis of lesson plan implementation

Based on the observation data of lesson plan implementation which conducted by an observer obtained data as follows :

Table 5. Learning implementation aspects.

Aspects	Percentage	Interpretation
Activities Before Learning and Teaching Process	80.4 %	Good
Level of Understanding of Learning Materials	76 %	Good
Implementation of Teaching Strategy	82.4 %	Good
Use of Learning Resources	83.4 %	Very Good
Learning Instrument	81.8 %	Good
Class Management	80.4 %	Good
Implementation of Student Assessment and Evaluation	85 %	Very Good
Interrelationship with students	83.4 %	Very Good

Based on all of the observed aspects, Use of Learning Resource, Implementation of Students Assessment and Evaluation, and Interrelationship with Students included to Very Good criteria while the other aspects are included in Good criteria. It shows that the learning activities conducted by using the flipped classroom learning model on the Secondary 3 students performed well.

4.2. Analysis of pre-test and post-test result

Based on the data of pre-test and post-test results obtained as follows:

Table 6. Pre-test and post-test results.

Pre-test		Post-test	
Minimum Score	28	Minimum Score	36
Maximum Score	78	Maximum Score	92
Average Score	54	Average Score	72

Based on posttest result obtained that 89% of students had passed the minimum criteria of standardization. Furthermore, to find out the increment of students understanding of the concept by calculating the normalized n-gain score. The normalized n-gain score that obtained is 0.4. That normalized n-gain score is fulfilled in the moderate category.

4.3. Analysis of questionnaire

Based on the analysis of questionnaire that distributed to the students, obtained that 93% of students become more motivated to study physics and 89% of students were very happy to carry on hands-on activity based on the flipped classroom learning model.

The use of appropriate media makes students more motivated to learn physics. This is shown by 93% of students who become increasingly motivated to study physics by using the flipped classroom learning model. In addition, the appropriate media allows students to understand the concept of physics well so that makes students more easily during the exploration activities.

5. Conclusion

Based on the data analysis, 89% of students had passed the minimum criteria of standardization. The increment level in the students' mark analysed by normalized n-gain formula, obtaining a normalized n-gain score of 0.4 which fulfil medium category range. Obtains from the questionnaire distributed to the students that 93% of students become more motivated to study physics and 89% of students were the to carry on hands-on activity based on the flipped classroom learning model. Those three aspects were used to generate a conclusion that applying flipped classroom learning model in Secondary Physics Classroom setting is effectively applicable.

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