Students’ conceptual understanding in modified flipped classroom approach: An experimental study in junior high school science learning

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Abstract. The flipped classroom approach is applied through moving the lecture outside the classroom via technology while the classroom time is used to engage students in student-centered learning activities such as inquiry and problem-solving activities, developing students to be more active during class sessions. This study aims at determining the effect of modified flipped classroom approach on students’ conceptual understanding of students at grade 8 Junior High School. An experimental study with the one group pre-test-post-test design was employed. The group consisted of 34 students, modified flipped classroom approach was used in which the students were given video lessons and worksheets before the class to be done at home. The research data were obtained via the conceptual understanding test. The results showed that based on Wilcoxon test to examine the difference of two data paired obtained Asymp. Sig. (2-tailed) value 0.000 < \( \alpha \) = 0.05, meaning that there was a significant difference between students’ pre-test and post-test scores. The post-test average score of 78.47 was higher than the pre-test average score of 35.56 with N-Gain score of 0.67, including medium category. Based on these results, modified flipped classroom approach is recommended to be implemented in science learning to improve the students’ conceptual understanding.

1. Introduction
There are some problems that often faced by science teachers at school. Based on the results of interview and observation on a science teacher at Junior High School 01 Argamakmur, North Bengkulu, it is found that abundance of the learning material in the syllabus require the teacher to manage the time as effectively as possible so that all basic competencies demanded in the syllabus can be achieved. It makes the teacher prefer to use lecture, question and answer or demonstration method in teaching and learning process. Consequently, it makes students often feel bored and decrease their interest in learning science. These situations lead the students to get low learning achievement. Referring to the test results given to students at grade 8 D at Junior High School 01 Argamakmur under the topic of Temperature and Calor, it was found that the average score of students’ conceptual understanding only reached 49.71 of 100.
Science teacher are demanded to be creative in solving problem appearing in school. To cope with students’ problem of low conceptual understanding in learning science, there is an alternative solution that can be actualized by science teacher that is by implementing flipped classroom approach. Flipped classroom firstly articulated by high school chemistry teachers, Jonathan Bergmann and Aaron Sams in 2007 [1]. The flipped classroom approach is applied through moving the lecture outside the classroom via technology and moving homework and exercises inside the classroom via learning activities. This paradigm shift involves using internet technology to improve the learning process in the classroom so that teachers spend more time interacting with students in the classroom instead of lecturing [2]. In a regular flipped classroom, lectures are delivered through video given to be played and learnt at home, along with written materials and online tasks and quizzes [3, 4].

In implementation, this flipped classroom approach will be modified with the use of video not containing learning material but containing interesting phenomena of science related with the topic that will be learnt. It is assumed that video containing learning material will make students become less interested in learning activities in the classroom because they know learning material wholly before lesson. Moreover, it is not in line with constructivist theory in learning science, in which according to Piaget, students should actively participate in absorbing information and construct their own knowledge through life experiences [5]. Video containing science phenomena will be observed by students before classroom section as an alternative to present problem. Besides watching video, students also do the task on worksheet based on video. By video, students are expected to be interested in learning science, train thinking ability about science phenomena that they often find in daily lives therefore students conceptual understanding can be improved.

The classroom learning sessions in the flipped classroom approach will be filled with the problem based learning (PBL) model. This is appropriate with the function of video as a medium to explore problems in orienting students on problem stage of problem based learning model. Problem based learning begins with involving students in authentic and meaningful problem situations such as by presenting phenomena that lead to cognitive conflict so that the phenomenon becomes the basis for student inquiry [5]. Based on the background, it is necessary to conduct research to improve the students’ conceptual understanding through the implementation of modified flipped classroom approach in science learning. Questions of this study are: does the modified flipped classroom approach improve students' conceptual understanding on the topic of substance pressure? And how does the improvement of students’ conceptual understanding on the topic of substance pressure after being taught by modified flipped classroom approach?

2. Method
This study is experimental research with one-group pre-test-post-test design. A diagram of this design is shown in table 1. This research was conducted in grade 8 D at Junior High School 01 Argamakmur, North Bengkulu for 4 weeks from February 5 to March 5, 2018. Participants in this study consisted of 34 people, 16 male students and 18 female students. Research began by giving pre-test on the topic of substance pressure in the form of valid and reliable test consisting of 30 multiple choice questions. After that, the teacher socialized the learning procedure with flipped classroom where students were required to watch video every week by accessing video that have been uploaded by the teacher through YouTube application. To facilitate communication with students outside of school hours, teachers created WhatsApp group. All information relating to learning was disseminated by the teacher through the group chat.
Table 1. The one-group pre-test-post-test design.

|          | O                        | X                        | O                        |
|----------|--------------------------|--------------------------|--------------------------|
| Pre-test | Conceptual Understanding Test | Treatment (Modified Flipped Classroom Approach) | Post-test (Conceptual Understanding Test) |

The topic of substance pressure was divided into several subtopics i.e. solid pressure, fluid pressure, Archimedes’ law of buoyant force, Pascal’s law, blood pressure, transportation of substances in plants and air pressure. This learning consisted of two stages: before and during class.

Before Class, the student watched the video lecture at any time before the lesson and answered the questions in the students’ worksheet after watching video. During class, learning activities in the classroom through problem-based learning. Problem-based learning consisted of five stages: orienting students on problem, organizing students to study, conducting an investigation through experimental or scientific experiments, developing and presenting the work, analyzing and evaluating the problem-solving process [5]. Teachers began learning by giving apperception and motivation, then the teacher opened a discussion of the observed videos and student worksheets that have been done by the students at home. Teachers gave students the opportunity to explore answers from the student worksheets they have worked on. Then, the teacher guided the students to analyze and define the problem from the video, which would be solved or searched for the solution through an investigation. After the investigation through practicum activities, the group representatives would present the results of the practicum and the student worksheets of the group that they have been working on. Through presentation and discussion activities, students would get solution of the problem and have an understanding of the material being studied. After 3 cycles of PBL, students were then given a post-test problem of 30 multiple choice questions to measure students’ conceptual understanding.

Data obtained in this research were the results of pre-test and post-test. From the results of pre-test and post-test, the average value of N-Gain was released. The average N-Gain was used to find out how great the increase of a variable, in this case was students conceptual understanding after following the learning with modified flipped classroom. The average value of N-Gain obtained was then interpreted according to the following table [6].

Figure 1. Screenshot of video sample and questions on video.
Table 2. Interpretation of mean of N-gain value.

| Value \( \langle g \rangle \) | Classification |
|-----------------------------|----------------|
| \( \langle g \rangle \geq 0.7 \) | High           |
| \( 0.7 < \langle g \rangle \leq 0.3 \) | Medium         |
| \( \langle g \rangle < 0.3 \) | Low            |

To answer the research question whether the modified flipped classroom approach can improve students’ conceptual understanding on the topic of substance pressure is tested hypothesis by comparing the results of students' pre-test and post-test. Hypothesis test using the test of mean difference of two data paired. All data obtained were analyzed using SPSS 22 program.

3. Result and discussion

3.1. Results

The effects of modified flipped classroom approach toward students’ conceptual understanding. Before given treatment, students were given a pre-test of 30 multiple choice questions. Based on the results of the analysis of students' pre-test obtained descriptive data as in the table 3.

Table 3. The results of students pre-test.

| Mean | Std. Deviation | Minimum | Maximum | Range |
|------|----------------|---------|---------|-------|
| 35.56 | 8.98           | 23      | 53      | 30    |

The average pre-test score obtained by students is 35.56 with maximum score 53 and minimum score 23. After given treatment, students were also then given post-test in the form of 30 multiple choice questions. Based on the result of student post-test obtained descriptive data as in the table 4.

Table 4. The results of students post-test.

| Mean | Std. Deviation | Minimum | Maximum | Range |
|------|----------------|---------|---------|-------|
| 78.47 | 9.88           | 60      | 100     | 40    |

The average post-test score obtained by students is 78.47 with maximum score 100 and minimum score 60. From the results of pre-test and post-test, the average value of N-Gain was released. The data N-Gain of students’ conceptual understanding are presented as in the table 5.

Table 5. The data N-Gain of students’ conceptual understanding.

| Mean | Std. Deviation | Minimum | Maximum | Range |
|------|----------------|---------|---------|-------|
| 0.67 | 0.17           | 0.20    | 1       | 0.80  |

Average value of N-Gain is 0.67. Based on the table 2, the improvement of students’ conceptual understanding belongs to medium category. Before testing the hypothesis, first tested the normality of pre-test and post-test data.
Table 6. Tests of normality.

|                      | Shapiro-Wilk Statistic | df | Sig. |
|----------------------|-------------------------|----|------|
| Students conceptual understanding (pre-test) | 0.862 | 34 | 0.001 |
| Students conceptual understanding (post-test) | 0.946 | 34 | 0.091 |
| N-Gain | 0.982 | 34 | 0.841 |

Based on the data of normality test above, sig. value for pre-test = 0.001 < α = 0.05; meaning that the result of pre-test data is not in normal distribution while sig. value for post-test = 0.091 > α = 0.05; meaning that the result data of post-test is distributed normally. To test the hypothesis whether there is a difference of mean score of students conceptual understanding before and after given treatment then used non-parametric test because data of pre-test is not in normal distribution. Non-parametric test used is Wilcoxon test. Wilcoxon test is a statistical method used to test the difference of two data paired. Based on Wilcoxon test results obtained:

Table 7. Results of Wilcoxon test.

|                  | N  | Mean Rank | Sum of Ranks | Z    | Asymp. Sig. (2-tailed) |
|------------------|----|-----------|--------------|------|------------------------|
| Post-test–Pre-test |    |           |              |      |                        |
| Negative Ranks   | 0a | 0.00      | 0.00         | -5.094 | 0.000                  |
| Positive Ranks   | 34b| 17.50     | 595.00       |      |                        |
| Ties             | 0c |           |              |      |                        |
| Total            | 34 |           |              |      |                        |

a. Post-test < Pre-test
b. Post-test > Pre-test
c. Post-test = Pre-test

Test criteria for hypothesis testing is reject Ho if sig value ≤ α, accept otherwise. Seen in the table above Asymp. Sig. (2-tailed) value = 0.000 < α = 0.05, then sig ≤ α, meaning Ho is rejected and received Hi, means it can be concluded that there is a significant difference between the average score of students conceptual understanding before and after given treatment where the treatment provided increases the average score of students conceptual understanding.

3.2. Discussion

Based on the result of this study, learning with modified flipped classroom approach in grade 8 students of Junior High School can improve students' conceptual understanding on the topic of substance pressure. The improvement of students' conceptual understanding is significant with the average value of N-Gain of 0.67, which is categorized medium. The improvement of students' conceptual understanding on the topic of substance pressure can be caused by a series of learning process that was applied with modified flipped classroom approach combined with problem-based learning model. Learning with PBL model begins by orienting students to a problem situation that becomes the focus point of learning where students will find solutions to the problems posed. Teachers can pose problems through short video that students watch at home. This video contains natural phenomena, events or interesting situations that illustrate real-life problems such as the phenomenon of the floating force in the Dead Sea where all the objects dipped in the Dead Sea will float. This phenomenon attracts students' interest and curiosity so that students are motivated to find further explanation through scientific inquiry activities in the classroom [5].
Because the first stage of problem-based learning is done at home through videos that the students watch, it enables teachers to maximize the investigation stage through experiments to collect data and scientific evidence that can answer the problem. The act of loading instructional videos online for the students allow teachers to reconsider how to maximize the face-to-face session with them. In this case, students will have more time to collaborate with feedback from their teacher [7]. In addition, the stage of student investigation with experimental activities also makes students enthusiasm to engage in the learning. This is because learning by experiment is a novelty for students so that they become interested and actively involved in learning activities. Students work together and discuss working with worksheets in groups so that worksheets can be completed more quickly and easily.

After the experimental activity, students then prepare a report of the results of the investigation that will be presented in front of the class. This verbal presentation aims to enable them to exchange their ideas with other students and get feedback on their performance. In this phase, the teacher directs the class discussion. The discussion aims to get the best explanations and solutions from the problem so that all students get a complete understanding. Discussion activities are an effective way to develop students’ conceptual understanding in science [8, 9]. When students engage in classroom discussions, they are given the opportunity to guess, argue, and challenge. By speaking, a student will excuse reason to support his/her conceptual understanding and try to justify his/her views. In the meantime, the other students will oppose, express doubts, and find alternative answers so that clearer conceptual understanding will emerge [10].

Flipped classroom gives students the opportunity to learn in their own way and be more flexible in managing their time for studying and make students have responsibility with their learning process. The availability of learning videos that can be repeated constantly wherever they are and appropriate with their needs can improve their understanding with learning content. Learning sessions in the classroom are where time is more maximized for active learning such as inquiry activities, problem solving, discussion can make students more interactive [4]. Several studies have proven that with the application of flipped classroom in science learning, it can improve student academic achievement [11-13].

4. Conclusion
The results showed that based on Wilcoxon test to examine the difference of two data paired obtained Asymp. Sig. (2-tailed) value 0.000 < α = 0.05, meaning that there was a significant difference between students’ pre-test and post-test scores. The post-test average score of 78.47 was higher than the pre-test average score of 35.56 with N-Gain score of 0.67, including medium category. Based on these results, modified flipped classroom approach is recommended to be implemented in science learning to improve the students’ conceptual understanding.

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