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The effect of flipped classroom and project based learning model on student's critical thinking ability

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The effect of flipped classroom and project based learning model on student's critical thinking ability

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Abstract. The challenge of industrial revolution 4.0 in education demand innovative and student-centered learning, which is based on information and communication technology, and be ready to compete with another scope. The research purpose is to know the effect of the flipped classroom and the project-based learning model on student's critical thinking ability. The research sample is 38 students. The learning material is about The Substance Changes. The data collection used observation, questionnaire, and test. The result showed that the combination of Flipped Classroom and Project Based Learning Model gives the effect on student's critical thinking ability with the significant value <0.05. The critical thinking aspects like elementary clarification, basic support, inference, and advance clarification showed that the average of gain is 0.39(medium category). The Flipped Classroom and Project Based Learning Model were integrated with the website so the student could easily access the learning material. The models contributed an interesting, effective, the student-centered learning process. Besides, they also improve the student's ability and enthusiasm to solve the problem of daily life.

1. Introduction

The industrial revolution 4.0 is signed by the utilizing of Information and Communication Technology (ICT) that gives an impact on an educational program. For this moment, the learning model has to innovative and based on digital. This solution uses student-centered learning (SCL) so the students could construct an inquiry for their concept. Wright [1] stated that student-centered learning can establish students to improve their learning outcomes. The students are trained to develop their self-abilities such as the study ability, time management ability, the ability to express themselves orally and writing, etc. So, the importance of improving the quality of learning process is regulated in Regulation of the Minister of Research-Technology and The Higher Education number 44 on 2015 about The National Standard for Higher Education vide 11(1) "The characteristics of the learning process as it is intended that have interactive properties, holistic, integrative, scientific, contextual, thematic, effective, collaborative and student-centered.

Even though the student-centered learning is not yet fully applied, the learning process of the practice activity uses a hard file like a module from the lecturer. Based on data, only 30% the lecturer applied the learning based on ICT. The use of ICT in teaching learning process usually in form of Moodle, simulation, distance learning, utilizing the media social (WhatsApp, telegram, line and another), video and etc. The learning approach was only focused on the knowledge, skill and attitude aspect but not yet

to improve the critical thinking ability, creativity, collaboration, and innovation. Of course, this is a contrast to the learning concept of the 21st century that demand the student to use the critical thinking, communication, collaboration, creativity, IT literacy, cross-culture understanding, problem-solving, and self-directed learning [2].

The average score of Substance Change was still less satisfy, 52% of students had "B", 35% of students had "C", 13% of students had "D". The students had difficulties when in practice activity, so the practice activity was not on time. It's needed more innovation from the learning process in the classroom, both in term of the learning model and its integration in the use of technology.

The learning model is exactly to solve more problems is Project Based Learning Model (PjBL). This model used the student-centered which was aimed to discuss in the team, interdisciplinary skills, critical thinking, interpersonal communication, project management [3]. The project-based learning model is not only the abstract theory, listening and reading. But able to apply concepts to real-world [4]. PjBL can direct the student to have creative thinking, and solve the problem in real life. According to Miftari [5] that PjBL is able to direct the learning proses that an interdisciplinary, the student-centered learning, increasing creativity, critical thinking, and managing skills. Implementation of the learning process could be more dynamic and the student could learn and understand the high contents of The Bloom Taxonomy "create". Bender [6] explained that PjBL is a learning method of the 21st century and this method trains the student to face the issues related to real life, define the solution and act collaboration. In practice, according to Wena [7] that PjBL is started at 1) start the essential question, 2) design a plan for the project, 3) create a schedule, 4) monitor the student and the progress of the project, 5) asses the learning outcome, and 6) evaluate the experiences.

While the flipped classroom (FC) is a learning model that the flips are direct learning in the classroom. In this learning, the lecturer gives the learning video by online/offline to the students that have to be watched at their home, the student read the book about the next matter. Instead, the learning process in the classroom is used for discussion groups and tasks, and the lecturer is a facilitator. The students have to learn earlier so it can be used as basic knowledge for students. The flipped classroom is student-centered learning so the direct learning process to be easy. The flipped classroom is an instructional approach that includes three components of the class: before, during and after classroom sessions [8]. The flipped classroom is a learning model that requires the students to see the material outside the classroom [9]. The flipped classroom emphasizes the element of the application of emerging technologies and requires the student to prepare to learn outside the classroom through an online video that has been prepared by the lecturer [10].

Actually, the learning process observes the object from the module, do the worksheet and practical report so the student less show the critical thinking. Based on it, this research used critical thinking as a dependent variable. This learning process uses PjBL and FC model. The project-based learning model could improve the thinking ability of the student. In project-based learning model, the student formulates the problem, determine the procedure, the tools and the materials needed, do the investigating, design and create the product, present and communicate the product and discuss with their group [11]. The aspects of the critical thinking ability are the giving elementary explanation, designing of the basic skill, creating of conclusion, creating of the advanced explanation, strategy, and tactic [12].

2. Research Methods

2.1. Population and Sample Research
The research was done in Science Education STKIP PGRI Nganjuk at 2017/2018 academic years and this population as a sample which consists of 38 students. The material is The Substance Change. The sampling data used purposive sampling. The data collection used observation, questionnaire, and test.

2.2. Research Design
The research used the quasi-experimental with one-group time series design. All sample as an experimental group without the control group. The experimental group was given a pretest and then the application of the flipped classroom and project-based learning. After that, the experimental group was

given the posttest. The analysis data used the multiple choices in pretest and posttest to measure the critical thinking of the student. The improvement of the learning outcome was calculated with N-gain formula. The effectiveness of the both of learning model could be known with the significant of N-Gain.

2.3. Analysis Data
The pre-test and post-test data used the normality and homogeneity as a prerequisite test and then the next testing used T-test. The significant level was 0.05. The research used a paired sample a t-test to compare the result of pre-test and post-test. There is an effect of the flipped classroom and the project-based learning to the critical thinking of the student as the hypothesis research.

3. Results and Discussion
The research had description data of the student's critical thinking before and after the flipped classroom and project-based learning.

Table 1. The Description Data of The Student's Critical Thinking.

Test	The number of Students	Mean	Deviation Standard	Minimum	Maximum
Pre-test	38.00	13.87	6.53	4.00	26.00
Post-test	38.00	46.79	1.47	22.00	88.00

Table 1 shows that Before the learning process, the lecturer gives the pretest which average critical thinking is 13.87, deviation standard is 6.53, the minimum score is 4 and the maximum score is 26. After the flipped classroom and project-based learning were applied, the students had 46.79 for the average of critical thinking, their deviation standard is 1.47, the minimum score is 22 and the maximum score is 88. So the average of post-test was higher than the average of the pre-test.

The next steps were the normality test and homogeneity test. The normality test used Kolmogorov-Smirnov which was obtained the significant value of pre-test 0.200 and the significant value of post-test 0.122 so their significant value was higher than 0.05 so H0 was accepted and the value of pre-test and post-test were normally distributed. The homogeneity test used Levene Statistic which significant value 0.064 which was higher than 0.05. So H0 is accepted and variety data was homogenous. After that, parametric test with a paired sample t-test. The effect of the flipped classroom and project-based learning model on the students' critical thinking were shown in table 2.

The value of t is -15.176 with sig.0.000, which the significant value is less than 0.05 so H0 is rejected. It means the average of pre-test and post-test value is different. So, it can be concluded that the learning process affects critical thinking ability.

Table 2. The Effect of The Flipped Classroom Model and Project-Based Learning on Critical Thinking of Student.

	Paired Samples Test							
		Paired Differences				t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Pre-test Post-test	-3.29211E1	13.37279	2.16935	-37.31658	-28.52553	-15.176	37	.000

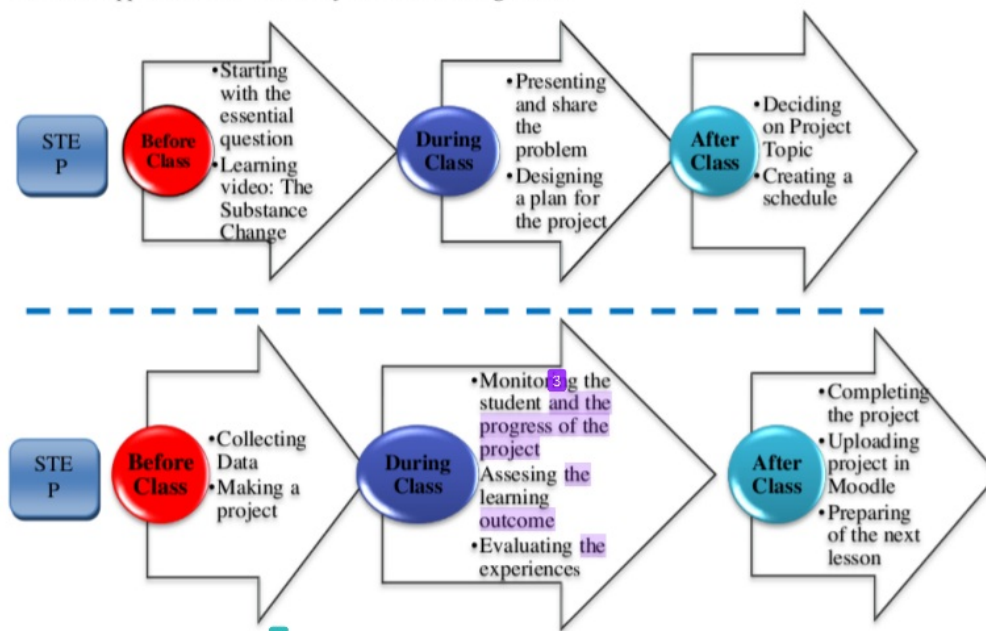*3.1. The Flipped Classroom and Project Bade Learning Model*

Figure 1. The Flipped Classroom and Project Based Learning Model

Based on figure 1, a combination between the flipped classroom and project-based learning can be applied for before, during and after class. The learning process consists of two steps. The project-based learning model involves the student to active in discussion, make a plan and solve the problem until making a judgment so the learning process is interesting and meaningful. According to Mioduser and Better [13], project-based learning improves the motivation, knowledge, skill, and the critical thinking ability of the student. While the flipped classroom makes the students have preparation better prepared for learning in the classroom and they have a foundation of the material for the lesson. The flipped classroom makes the students better-prepared face to face I the classroom. Beside it, this model makes the lecturer more expert in strategies to help their student in reaching of the higher level in Bloom's Taxonomy. In the learning process, the flipped classroom integrated with the website of

http://veraelearning.stkipnganjuk.com/. which is incorporated by the video, the matter of learning process and quiz. So, the student is easier learned everywhere and every time. If the student found the difficulties, so they could communicate with the lecturer by the website. This is supported by Andrini et.al (2017), the flipped classroom model could motivate the student to learn, improve their knowledge, and their learning process become more effective.

Table 3. The Combination Between Flipped Classroom and Project Based Learning Model

	The Syntax of Flipped Classroom	The Syntax of PjBL
Step 1	Before Class	Starting with the essential question dan learning materials from the video. The lecturer stimulates the student to analyze the video of the substantial change which is downloaded in the website of http://veraelearning.stkipnganjuk.com/. This step, the student could use their critical thinking to distinguish the example and the characteristic of the physical and chemical changes.
	During Class	The student presents and shares the problem of video which they watch. The lecturer is an evaluator and motivator. Then, Each group designs a plan for the project of their concept. They will make a tape (tape is a traditional fermented food made from cassava).
	After Class	The student decides on a project topic and creates a schedule for one week.
Step II	Before Class,	The student makes a project and collects the data for their experiment likes to prepare the instrument and matter, do the experiment and analyze the result data.
	During Class	The lecturer controls the students and their progress and assesses their learning outcome. The students present their product that is related to the physical and chemical changes. For the last step, the lecturer evaluates and suggests to the students' product and presentation.
	After Class	After completing the project, the lecturer uploads the project and then the students prepare the next lesson.

3.2. *The Effect of Flipped Classroom and Project-Based Learning Model to The Critical Thinking Ability*

After the application of the flipped classroom and project-based learning model then the researcher analyzes the critical thinking ability of the student. Based on Figure 2, critical thinking improves the medium category. The explanations of N-gain value on each aspect are (1) the elementary clarification has 0.43, (2) the basis support has 0.32, (3) the inference has 0.35, (4) the advanced clarification has 0.33 and (5) the strategy and tactics have 0.52.
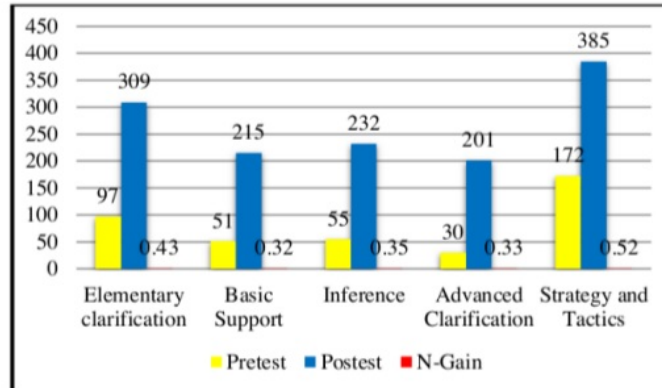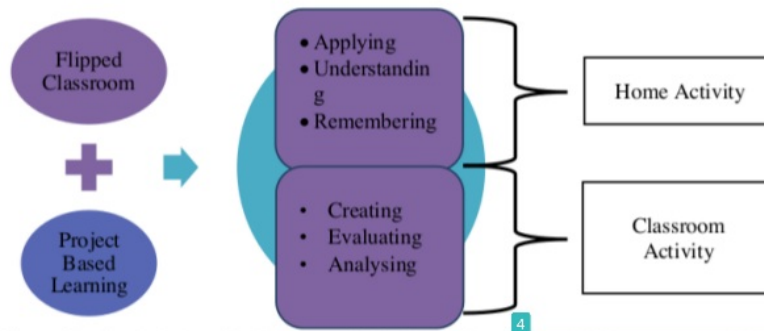
Figure 2. N-gain value for the critical thinking aspects

Figure 3. The Relationship between Critical Thinking, Flipped Classroom, and Project-Based Learning Model

The Flipped Classroom model was the flipped of the learning process from the home activity with the learning video which integrates the website to the classroom activity. The home activity improves the applying, the understanding, and the remembering ability. In the classroom activity, the learning process used project-based learning model which improve the creating, the evaluating and the analyzing ability. This competence could be a demand the industrial revolution 4.0. There is the synchronization between the educational with the technology which is related to the problem of the daily life. The research of Guerrero [14], flipped classroom and project-based learning model used the student-centered which combine the knowledge through the technology and improve the efficiency of learning, the critical thinking of the student.

The students made a project when project-based learning was applied with the flipped classroom. This was the fermented cake which is sowed the scraped of coconut. This cake made of slightly fermented rice so it had sweet and alcohol taste. The sweet taste of the fermented cassava is caused by the hydrolysis of polysaccharides to be a reduction of sugar, while the

alcohol taste because of the sugar oxidation to be alcohol or ethanol [15]. The ethanol content from the second day to the fifth day is like this diagram:
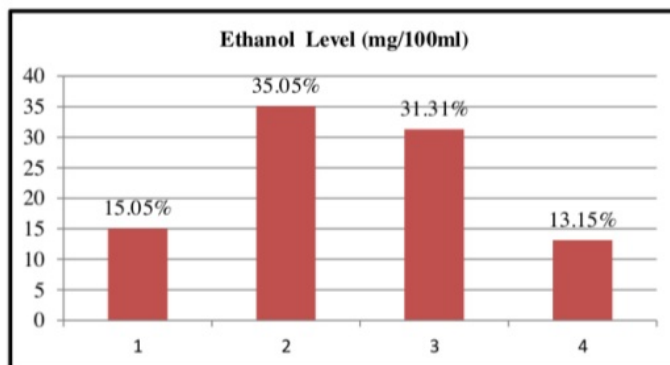

Figure 4. Ethanol level from the second day to the fifth day [15].

The content of an organic compound is carbohydrate (polysaccharides). The fermented cake is the fermentation process of the carbohydrate or protein which is helped by the microorganism (bacteria) and then change to be another matter [16]. When the students got a project, some group cut the coconut to be the small coconut and another group made the scraped coconut. They observed and explained its changes. All of the group considers that the sowing coconut is the physics changing like small coconut and the scraped coconut. The shape-changing is the physics changing like rice to be rice flour and wood to be a table [16].

Flipped classroom and project-based learning were applied together. They could be learning process which has higher Bloom Taxonomy, the student-centered and gets experience. For sending the content of material, facilities and product in project-based learning could through the flipped classroom. The cognitive aspect of project-based learning and flipped classroom could improve the effectiveness learning, the effective aspect could improve the motivation and interest to study, and the psychomotor aspect could develop more ability like the critical thinking, integrate the knowledge, the technology information and communication ability [17]. Both of this learning model could improve the interaction of student and cooperative ability, give the facilitation of teamwork, and motivate the student to solve their project.

4. Conclusion and Suggestion

The conclusion of the research is flipped classroom and project-based learning give a positive effect to the critical thinking. The flipped classroom is flipped learning of the classroom to learn at home with a video which is integrated by the website. While project-based learning is the learning process which the student-centered and gives the opportunity of teamwork between the student and the lecturer. The concept of the flipped classroom and project-based learning is the combination of learning model which improve the interaction between the students, teamwork and motivate the students to solve their project [17]. Project-based learning is the learning model which solves the problem daily activities. This model can improve critical thinking like the elementary clarification, basic support, inference, advanced clarification, strategy, and tactics. N-gain value of this research is the medium category. The lecturer is a facilitator for the learning process so the student can give more questions and discuss to solve their project [18]. In this research, the student can give more questions through the website. While the same question from the students can refer to the online discussion to find their question.

The following suggestions are proposed:

a. The students have to understand the learning concept which is applied. It is the combination between the flipped classroom and project-based learning model. The lecturer has to explain their syntax.

b. There is heterogeneous teamwork so their ability can be distributed evenly.

c. There is periodic monitoring. The students have to watch the video and study the material before class. Using social media likes WhatsApp Messenger, telegram, line and etc. Application of social media like WhatsApp Messenger can improve the interaction between the student and the lecturer so the communication is easily done any time, supporting the concept of distance learning, the discussion forum is easily formed, and it easily shares information quickly [19].

References

[1] Wright G B 2011 *Int. J. Teach. Learn. High. Educ.* **23** 92.
[2] Saavedra A R and Opfer V D 2012 *Phi Delta Kappan* **94** 8.
[3] Helle L, Tynjälä P, and Olkinuora E 2006 *High. Educ.* **51** 287.
[4] Fernandes S R G 2014 *Procedia – Soc. Behav. Sci.* **139** 219.
[5] Miftari I 2014 *Eur. J. Res. Educ.* **c** 52.
[6] Bender W N 2012 *Project based learning: Differentiating Instruction for the 21st Century* (California: Corwin)
[7] Wena M 2010 *Strategi Pembelajaran Inovatif Kontemporer Suatu Tinjauan Konseptual Operasional* (Jakarta: Bumi Aksara)
[8] Bergmann J and Sans A 2012 *Flip Your Classroom: Reach Every Student in Every Class Everyday* (Washington, DC: ISTE; and Alexandria, VA: ACSD)
[9] Chen L and Chen T L 2015 *Australas. J. Educ. Technol.* **31** 621.
[10] Sahin A, Cavlazoglu B, and Zeytuncu Y E 2015 *Educ. Technol. Soc.* **18** 142.
[11] Pratama H and Prastyaningrum I 2016 *J. Penelit. Fis. Apl.* **6** 44.
[12] Ennis R H 1985 *An Outline of Goals for a Critical Thinking Curriculum In Developing Minds: A Resource Book for Teaching Thinking* (Virginia: ASCD Publication)
[13] Mioduser D, and Betzer, N 2008 *Int. J. Technol. Design Educ.* **18** 59.
[14] Guerrero W 2017 Flipped Classroom and Problem-Based Learning in Higher Education Latin-American Context in *International Conference The Future of Education* (https://conference.pixel-online.net/FOE/files/foe/ed0007/FP/3827-ENT2480-FP-FOE7.pdf , 6 Juny 2018)
[15] Suaniti N M 2015 *Saccaromyces cerevisiae J. Virgin* **1** 16.
[16] Wibowo A M. 2013 *Madrasah* **5** 49.
[17] Shih W L and Tsai C Y 2017 *Australas. J. Educ. Technol.* **33** 15.
[18] Findlay-Thompson S and Mombourquette P 2014 *Bus. Educ. Accredit.* **6** 63.
[19] Pratama H and Kartikawati S 2017 The Effect of WhatsApp Messenger As Mobile Learning Integrated with Group Investigation Method of Learning Achievement. In *Int. J. Sci. Appl. Sci.: Conf. Ser.* **2** 164.

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