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THE EFFECT OF INQUIRY-FLIPPED CLASSROOM MODEL TOWARD STUDENTS' ACHIEVEMENT ON CHEMICAL REACTION RATE

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Abstract. The aim of this research is to find out the effect of Inquiry-Flipped Classroom Models toward Students' Achievement on Chemical Reaction Rate topic. This study was conducted at SMA Negeri 3 Tangerang in Eleventh Graders. The Quasi Experimental Method with Non-equivalent Control Group design was implemented in this study. 72 students as the sample was selected by purposive sampling. Students in experimental group were learned through inquiry-flipped classroom model. Meanwhile, in control group, students were learned through guided inquiry learning model. Based on the data analysis, it can be seen that there is significant difference in the result of the average achievement of the students. The average achievement of the students in inquiry-flipped classroom model was 83,44 and the average achievement of the students in guided inquiry learning model was 74,06. It can be concluded that the students' achievement with inquiry-flipped classroom better than guided inquiry. The difference of students' achievement were significant through t-test which is $t_{obs} 3.056 > t_{table} 1.994$ ($\alpha=0.005$).

INTRODUCTION

Learning process in the 21st century undergoing a paradigm shift from teacher-centered learning into a students-centered learning with the characteristics of active learning. Learning process that involves full and active students will assists them in developing and constructing ideas of knowledge independently. According to Hollingsworth (2008), the active learning facilitates students to learn actively and involved continuously, both mentally and physically.

Based on the observation of learning chemistry in school, there are some weaknesses in the learning process. First, learning model used by the teacher is not suitable with the students needs, so the role of students in learning is not maximized. In addition, learning in the classroom are often more focused on low order thinking, such as knowledge and understanding of the concepts and facts. In general, the teacher gives homework to the students as strategies in motivating students to learn more the material that has been taught. For smart students, this activity motivated them to learn more and acquire new experiences from material that has been taught. Except for students who lack of intelligent, this activity make students who have not understand the material in the class will consider the homework as an unpleasant experience or useless assignment, so that students do not understand the material intact.

Flipped Classroom learning model can be the solution of problems, because reorganizes the time inside and outside the classroom. According to Brooks (2014), flipped classroom is a learning model that combines instructional technology and active learning, where students learn through online video outside the classroom, and inside the classroom students discuss about subject matter that they have not understand guided the teacher in exciting learning and collaborative atmosphere. Students acquire learning concepts and new terminology through video learning and and answer some guiding question on material with their new understanding. Then learning in

the classroom conducted to explore students's questions which appears from independent learning that they have done at home through the video and conduct discussion activities related to problem solving in small groups using the students knowledge capabilities and classroom practices. This activity uses textbooks and slide presentation which is prepared by the teacher. In flipped classroom learning model, designed activities expect the students to think about the implications of previous concept (Love, 2015). The flipped classroom allows students to watch the video according to their preferred time and need, and they can study at their own pace; this type of activity also increases students' collaborative learning in distance education outside the class. Thus, by flipping the class, the students will not spend so much time listening to long lectures in the classroom, but will have more time to solve problems individually or collaboratively through distance learning with peers. (Zainuddin and Halili, 2016). This is certainly in line with the objectives of the 21st Century Skills that the students should have the technology skills to be used in their life. Flores (2016) generally describes that flipped classroom learning model is a combination of online learning and face to face where the interaction between teacher and students happens inside and outside the classroom. The interaction between students and teacher outside the classroom through an independent assignment for students that delivered from teacher by utilizing advances technology, such as video of learning, e-book and few instruction tasks or exercises based on inquiry that will be accessed online by the students.

Flipped classroom learning model need media contains material created by the teacher before face to face in the classroom. The activity of students in the classroom can be filled with tasks that require problem solving, experimenting, exploration, invention, implementation, and communication related to the material being studied in class. Flipped classroom learning model provide a short video and other multimedia that created by the teacher that can substitute learning process in the classroom and practice assignment at home.

The implementation of flipped classroom learning model give students many opportunities to develop the ability to think critically and independently, as well as improving students learning process through collaborative interaction with peers. In this model, teacher gives flexibility and freedom to the students so that they can learn from the activities that specifically designed to improve problem solving skills. Zainuddin and Halili (2016) stated that flipped classroom learning model based on the theory of cognitive domain Bloom's taxonomy revision. In implementing flipped classroom, remembering and understanding are the lower order thinking that practiced outside the classroom. While in the classroom students learn with focus on higher order thinking such as applying, analyzing, evaluating, and creating. The following picture illustrates the level of students learning in flipped classroom learning model to Bloom's taxonomy revision.

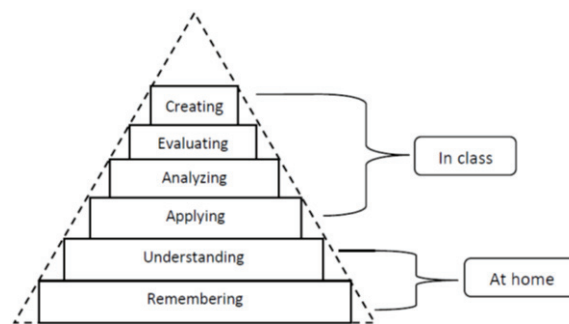


FIGURE 1. Bloom's taxonomy revision on flipped classroom

The flipped classroom learning model focus on how to support students in achieving cognitive domain at the higher order thinking. Learning by applying flipped classroom model allows students to spend more time to accomplish the tasks at higher cognitive level through discussions in the classroom. Meanwhile, tasks with lower cognitive level such as knowledge and understanding solved independently outside the classroom (Nederveld and Berge, 2015). Students's activity in the classroom is spent on application and higher order thinking than listening to lectures and other lower order thinking tasks, as shown in the Table 1.

TABLE 1. Comparison between traditional classroom and flipped classroom in achieving higher order thinking Bloom's taxonomy (Nederveld and Berge, 2015)

Cognitive Level	Traditional Classroom Activity	Flipped classroom Activity
Remembering	Face-to-face lecture	Pre-recorded lecture, reading material, and watching video lectures Independently
Understanding	Question and answer session	Reflection, peer-to-peer discussion and collaboration
Analyzing	Homework	Classroom activities such as a group discussion
Applying, Evaluating, Creating	Homework or nothing	Student projects, presentations, peerevaluation, instructor evaluation and teacher evaluation

Marshall and DeCapua in Love (2015) stated that on flipped classroom learning, remembering and understanding cognitive level is moved outside the classroom, so that learning in the classroom focus on higher cognitive level of the taxonomy, such as applying, analyzing, evaluating, and creating. Students in Flipped Classroom learning have better performance and higher morale, as well as deeper understanding. McCarthy (2016) outlines some of the potential benefits and difficulties of Flipped Classroom in the following table.

TABLE 2. Potential benefits and pitfalls of the flipped classroom

Potential benefits	Potential pitfalls
Students are able to learn at their own pace rather than move too far ahead or fall behind.	Students may have limited access to online resources at home in terms of required hardware, software and Internet.
Students are introduced to self-directed, independent learning techniques, as well as collaborative, group-oriented learning.	Students may lack the discipline to complete the required work and subsequently come to class unprepared.
Teachers can gain insight into student performance, as well as learning difficulties and varying learning styles.	There may be an increase to staff workload, as class resources take more time to prepare.
Teachers can customise and update course content more easily and can provide learning materials to students on a 24/7 basis.	There may be costs associated with preparing course materials, such as video recording and editing hardware and software.
Classroom time can be used more effectively and creatively with a focus on peer interaction and engagement.	The quality of teacher-created videos may be lacking, if the teacher is unfamiliar with video editing and exporting.
The use of new technologies aligns with the concept of '21st century learning', and may appeal to contemporary student cohorts.	Some students may resist new or novel teaching methods.

Flipped Classroom learning model can be implemented or integrated with models or active learning strategies such as inquiry, problem based learning, and collaboration learning (Love, 2015). Inquiry is an active learning approach that directs students to find ideas and information through their own efforts. Inquiry approach contradictory from the view that students as a subject of study have basic ability to develop optimally according to their ability. The teacher's role put themselves as facilitator of learning. Thus, students are doing activities independently or in groups to solve problem with teacher guidance.

Inquiry learning according to Victor and Kellough (in Jacobsen,2009) is a process in answering questions and problems based on a logical test of facts and observations. Inquiry learning starting with giving students the problems associated with the content that will be focused on the class activities. While inquiry according to Arends (2013) is a teaching method that emphasizes the students to explore and develop the skills, attitude of asking questions and draw conclusions. Therefore, Inquiry–flipped classroom learning model is expected to make interesting active learning and maintain continuous involvement of students with the knowledge discovery process, improve the understanding of the concept and finally improve students' achievement.

RESEARCH METHODOLOGY

This research was conducted in SMA Negeri 3 Tangerang Selatan in the odd semester of academic year 2016/2017. Target population includes all students and affordable population in this research is the students of class

XI MIA consisting of 240 students scattered into six classes. Sample selection technique in research by using purposive sampling technique, that is choosing two classes from the affordable population intentionally (Sugiyono, 2013). One class as control group and one class as experiment group. The method used in this research is quasi experiment method with nonequivalent control group research design. Both of groups were given a pretest to determine the initial ability of students and determine the level of equality. In experiment group, the students given an explanation of inquiry-flipped classroom learning model through videos that must be learned at home before the next meeting. At 2nd meeting a pretest is given to find out the level of students' understanding after studying at home through videos and to find out students who have not learned through video. Then do the inquiry study about reaction rate material. And ended by giving a practicum video that should be learned at home before lab work in the laboratory at the 3rd meeting. The practicum inquiry in next meeting about the factors of the chemical reaction rate is the effect of concentration and surface area. This practicum activity was carried out to apply the reaction rate material in the learning video and observed the students' learning outcomes on psychomotor aspects. The 4th meeting is the same as the 3rd meeting, which begins by giving pretest to know the level of student understanding after studying at home through video. At the meeting, inquiry activity in the laboratory about the factors of chemical reaction rate that is the influence of temperature and catalyst. This practicum activity was carried out to apply the reaction rate material in the learning video and observed the students' learning outcomes on psychomotor aspects. After completion of the practicum, proceed by completing the Practical Activity Sheet provided by the teacher. At the end of the activity, students are given the task of reading and summarizing the law of rate equations and reaction order. At 5th meeting, the students do the inquiry study about law material of rate equation and reaction order. At 6th meeting, there is a learning evaluation in the form of posttest to know the students' learning outcomes on the cognitive aspect. At the end of the lesson, the teacher evaluates the reaction rate learning from the second meeting up to the fifth meeting.

RESULTS AND DISCUSSION

The result of pretest and post test of both groups contained in the table below.

TABLE 3. Data of experimental group and control

Statistic	Experimental Group		Control Group	Number of ions
	Pre-test	Post-test		
Number of Students (n)	36	36	36	36
Mean	72	83.44	72.67	74.06
Maximum Value	88	100	92	92
Minimum Value	56	56	56	40

Achievement can also be seen from the percentage of grade completeness adjusted to minimum mastery criterion (KKM). Successes or completeness of each group can be compared from the post-test in the following table:

TABLE 4. Comparison of experimental and control group completeness

Description	Experimental Group	Control Group
Minimum	56	40
Maximum	100	92
KKM	75	75
Completeness Percentage	83%	56%

The table above explains that average of the control group posttest is smaller than the experimental group. On the control group, students achievement to reach minimum mastery criterion is only 56%, while the majority of students in experimental group had reached the value above minimum mastery criterion (KKM) i.e. 83%.

Hypothesis test result of two independent samples using t-test at significance level 0.05 indicates the value of t_{obs} 3.056 and t_{table} 1.994. Its mean that there are significant differences between the average of experimental group achievement using inquiry-flipped classroom learning model compared to the average of control group achievement using guided inquiry learning model. The experimental group showed higher achievement. It happened because inquiry-flipped classroom learning model provides different learning experiences for the students. Teacher gives guidance to the students to conduct independent learning activities outside the classroom through instructional videos designed and limited to the knowledge and understanding of the concepts and facts on each section of material before the students are learning in the classroom. Later in the classroom activities, teacher provides learning

inquiry that facilitates students to be more active in exploring the question, engage in discussion related to problem-solving in small groups, presentation, as well as practice in the laboratory. So that students in the experimental group are more active in the classroom because they have gained the knowledge and understanding of the concepts and facts before learning in the classroom. Teacher merely acts as facilitators to motivate, guide, and provide feedback on the student's performance. When students experience difficulties in learning, they can discuss the subject between them or ask questions directly to the teacher so that students understand the subject material. In the classroom, the teacher can make time allocation for students who require improvement assistance on the stuff that they are unable to learn by themselves. This leads to optimal learning time in the experimental group. Nederveld and Berge (2015) stated that in flipped classroom learning model, the activities are spent on higher level implementation than listening to lectures and other lower order thinking tasks of Bloom's taxonomy. As stated by Flores (2016) in his research that the face to face activity with students in the classroom can be filled with tasks that require problem solving, conjecture, experiment, explore, create, implement, and communicate related to the material being studied in the classroom. In addition, students are more motivated to learn by using this model. It is as expressed by the following students:

"I'm very lazy for reading textbooks. Each teacher provide an assignment to read and summarize the textbook at home, I never did it. I am thankful, when the teacher provide a different way of learning for me by giving instructional video. This video helped me to learn at home."(Students no.3, the result of feedback inquiry-flipped classroom)

Even students feel more focused with the use of learning videos that have been learn before classroom activity rather than if the material is newly explained in the classroom. It is because classroom consists of many students that sometimes makes the classroom is not conducive for a learning place. In addition, the inquiry -flipped classroom learning model also makes students more confident during the exam. Here is the exposure of the students:

"When I learned in the class, I feel unfocused because sometimes my friends make a fuss. So I get left behind in the chemistry class. I intend to go to the staff room for asking further information about the material conveyed in the classroom, but I feel shy and hesitate. So I let myself left behind in understanding the material and eventually during the exam takes place I get the impact of my incomprehension. By this new learning method with video assistance, I can manage my learning time outside the classroom and reduce the pressure in the class. As I able to catch up chemistry class. During the Reaction Rate exam, I feel more confident and relaxed in filling out the answer sheet."(Students no.5, the result of feedback inquiry-flipped classroom)

Based on the data, inquiry-flipped classroom model that have been conducted is proven to increase student's motivation and make them more confident in learning and doing the exam. In contrast to experimental group, the control group students conduct learning activities in the classroom by using guided inquiry model with over focus on the lower dimension on Bloom's taxonomy, i.e. knowledge and understanding. After learning in the classroom, students is given a homework assignment in the form of problem-solving. Homework is given as one of the teacher's strategies in motivating students to relearn the material that has been taught. For smart students, this activity motivated them to relearn and acquire new experiences from material that has been taught. However, not the case for students who lack of intelligent. This activity make the students who have not understand the material in classroom will regard homework as a burden and useless. Because when the students work on the problems that are given there is no assistance by the teacher. Marshall and DeCapua (in Love, 2015) revealed that most of the students who are given instructional which commonly used in the classroom, tend to focus on lower levels of Bloom's Taxonomy (understanding and remembering).

CONCLUSION

Based on the result, it can be concluded that there is a positive effect of inquiry-flipped classroom learning model implementation toward the achievement of chemical reaction rate in the class XI SMA Negeri 3 Tangerang Selatan. It means that students who learn through inquiry-flipped classroom learning model have a better understanding than students who did not use this learning model. It can be seen from the result of t-test and the overall score of student tests. Additionally, there is a positive effect on the implementation of this inquiry-flipped

classroom learning model that increase student's motivation in learning and make them more confident during the class and on the exam.

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