The Applicaton of Flipped Classroom Learning Model of High School Students on Electrolyte and Non-Electrolyte Solutions

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Abstract: The purpose of this study was to determine the differences in the application of the Flipped Classroom learning model and the conventional learning model to student learning outcomes on electrolyte and non electrolyte solutions. The sampling technique is random sampling. The sample of this research is class X. The learning outcomes obtained by the average value of the experimental class are 70.19 and the control class is 64.81. Testing the data from the first research, namely the test using the effect size by Cohen's d, it was found that in the experimental class the Flipped Classroom learning model applied to affect student learning outcomes greater than 97.7% or the effect was very large, while in the control class the conventional learning model applied to affect the results. Student learning as much as 94.5% or a big effect. The second uses a two-party t-test statistical analysis with prerequisite tests, normality tests, and homogeneity. The results of hypothesis testing are obtained – $t_{table} < t_{calculation} > + t_{table}$, was -2007 < 2.9069 > +2.007 with a significant level ($\alpha = 0.05$) and degrees of freedom = 51. The conclusion of the research is that there are differences in student learning outcomes.

Keywords: Flipped Classroom, Student Learning Outcomes, Electrolyte and Non-Electrolyte Solutions

INTRODUCTION

Teaching and learning are two things that are closely related and cannot be separated in educational activities. Education is said to be a way of interacting between teachers and students that helps each learn more. The teaching and learning activities in this case are directed towards achieving specific goals that have been pre-determined before teaching takes place.The teacher is consciously planning his teaching activities systematically in order to benefit the students. (Pane & Dasopang, 2017)

Learning and teaching activities are activities that cannot be separated. The process of learning and teaching activities is influenced by factors that determine the success of student learning. In learning activities there are factors that can

inhibit so that it affects the low learning outcomes. Inhibiting factors can come from educators, teaching methods used or come from students. The problem that often occurs is that the class is less active or the students are only passive. The teacher is the first and main source of learning in learning. Students come to class with no understanding whatsoever of the material to be studied. So, the teacher starts learning by explaining the concepts that exist in the material. Students come to class only accept what is explained by the teacher.

One of the learning materials is science learning. Learning science is something that should be finished by understudies, not something done to understudies. Science learning expects understudies to advance effectively, which is suggested in physical or mental exercises, not only including hands-on activities but also minds-on. The main goal of learning science is students who have scientific literacy skills so that they not only understand the content and process skills but also in context students are able to complete or make the right decisions based on their knowledge (Fahmawati, 2018)

Based on the results of an interview with Mrs. Nurbaeti Alimuddin, S.Pd as a teacher at Public Senior High School 1 in Paleleh. In the subject of chemistry itself the Low learning outcome is influenced by the inability of students to understand the meaning of the questions given. According to Mrs. Nurbaeti this is because the learning process is limited by time so that students do not practice questions to deepen the material. For example, for materials that have a lot of theory, for example, electrolyte and non-electrolyte solutions require more time to explain them, so the teacher has limitations in providing enrichment. To be able to overcome these problems, teachers need to design a learning model that is able to give students more time in the learning process. One of the models that the author offers is the Flipped Classroom learning model.

Flipped classroom In essence, it is "flipped." What was previously done in class is now completed at home, and what was previously assigned as homework is now completed in class (Bergmann & Sams, 2012). Using Flipped Classroom can result in less time for the lecture portion. Thus, there will be an increase in the time to make activities in the classroom that can deepen concepts and increase student knowledge retention (Roehl *et al*., 2013).

The ability to learn differently and independently is made feasible by the use of technology and the "flipped classroom" method. To address all of the requirements of students, diversity is necessary. Students are introduced to freedom of learning (self-learning) through the gradual release of responsibility, which permits metacognition during the learning process. Students can differentiate themselves through independent study and select from a selection of exercises to help them learn the topic in the method that is most convenient for them. (Marlowe, 2012).

The flipped classroom learning model is an educational approach that can give teachers a means to reduce the amount of direct instruction in classroom activities and increase student-teacher interaction. This approach uses technology to provide students with additional learning resources, specifically by employing instructional videos (Johnson, 2013). One of the challenges that today's students are facing is the overuse of modern technology such as tablets, mobile phones, and cyberspace. By putting recent factors on the agenda, the flipped training method has been able to lead the world to the optimal learning challenge, not as a leisure technology, but as a means of teaching aids. Thus, flipped education has been able to use a motivating factor (the use of new technology) in the service of academic progress (Samavi *et al.*, 2020)

The teacher's role in flipped classrooms should be to support learning reflection and discussion as well as to offer objective criticism and guidance. In order to participate actively in learning in the flipped classroom and benefit from professional assistance, students need to have a high level of self-learning that promotes dialogue and discussion and enhances problem-solving abilities. Instead than being instructors, teachers now serve as mentors and assistants. The emphasis on the flipped classroom has caused a change in the use of technology in education from classroom instruction to independent study at home. Students interact with their friends and teachers at school through self-practice (Hwang *et al*., 2015)

Learn using learning videos students can repeat learning videos so they can better master the material. Students can further develop procedural skills, be inspired, and receive assistance from teachers and other students with challenging assignments by providing them more influence over the learning process when they are in class and debating, exchanging knowledge, and solving problems. Students may be better able to comprehend the subject matter and be able to solve difficulties by having more control over their learning way that it can improve the results of student learning (Damayanti & Sutama, 2016). Learning outcomes, according to Muniwastia *et al.*, (2018) is a change of an individual's way of behaving, for instance from not knowing to knowing and not understanding to understanding. One of the big obstacles in implementing this method is the lack of student motivation to study the material independently outside the classroom. They assume that learning teaching materials is when they are in class by directly listening to explanations or lectures from the teacher (Farida *et al*., 2019)

Based on the results of research from Djajalaksana *et al*., (2014), who saw the application of the Flipped Classroom model for statistics and probability courses in the information systems study program has shown positive results and can be considered for the future. The outcomes showed that this strategy furnished critical beneficial outcome with *p-value* 0.0352 at *alpha* 0.05 between pre-test and

post-test scores. Understudies likewise gave positive criticisms on the execution of this technique as a greater number of them comprehended the materials better after the action. Research conducted by Paristiowati, Cahyana, *et al*., (2017) with the title Flipped Classroom: alternative learning model to improve student learning outcomes in K-10. The study's data showed that the use of the flipped classroom paradigm enhanced students' learning outcomes for the redox reaction material. The analysis of the requirements test revealed that the data had uniform variances and were normally distributed. The results of the hypothesis test were significantly different (0.05). The experimental group's pretest - posttest measurements had an average value of 12.50. The experimental group's average difference between pretest and posttest scores is greater than that of the control group.

According to prior study, the use of the flipped classroom learning model had a favorable impact on students' learning outcomes and was able to enhance such outcomes as shown by the significant difference between the mean scores of the pre and post exam on material chemistry for buffer solutions Khumairah *et al*., (2020). Based on research conducted by Rahmawati *et al*., (2020) who identify the effects learning model flipped classroom integrated cooperative learning to motivation students on the subject matter reaction reduction and oxidation of showed positive results.

The Flipped Classroom learning model can help students in the learning process. Students and teachers have plenty of time for enrichment. It is hoped that it will further improve understanding and have a positive effect on student learning outcomes.

This research is important to do as a form of reference a more effective learning model so that it can optimize outcomes for high school students. The purpose of this study was to determine the differences in the application of the Flipped Classroom learning model and the conventional learning model to the learning outcomes of class X high school students in electrolyte and nonelectrolyte solutions.

METHOD

The method section is written with a length of 15 – 20% of the length of the article, containing the research design, data collection techniques and data sources and methods of data analysis. If the study of the article is in the form of philosophy and learning theory, then this sub-method/experiment does not need to be described.

The type of research used in this research is Quasy Experiment or quasi-experimental using two classes, namely the experimental class which is given treatment with the Flipped Classroom learning model, and the control class using

the Conventional learning model. The research design used was a non-randomized pretest-posttest control group design. The complete research design can be seen in Table 1.

Table 1. Research Design Non-Randomized Pretest-Posttest Control Group

Group	Pre-test	Treatment	Post-test
A (Ex. Experiment)	Y	X1	Y
B (Control Class)	Y	X2	Y

The population in this study were students of class X Public Senior High School 1 in Paleleh, which consisted of 5 parallel classes, namely class X natural science 1, X natural science 2, X social science 1, X social science 2, and X social sciences 3. their respective majors but study the same subjects. The samples in this study were students of class X natural science 1 as the experimental class and X social science 3 as the control class.

The sampling technique in this study was completed with a simple random sampling technique. simple random sampling technique is an approach to taking examples from all individuals from the populace at arbitrary regardless of the layers/levels that exist in the populace (Sundayana, 2016). The type of data in this study is in the form of quantitative data and the data source of this research is student learning outcomes data.

The research instrument used in this research is the questions used for pre-test and post-test in the form of multiple choice. Consists of 20 questions that have previously been tested for instruments.

The data analysis technique used in this research is descriptive and inferential statistical analysis techniques. Descriptive statistical analysis in this experiment used Cohen's Effect Size. Effect Impact size is a proportion of the extent of the impact of a variable on different factors, the greatness of contrasts and connections, which are liberated from the impact of test size, the magnitude of differences and relationships, which are free from the influence of sample size (Santoso, 2010). effect size can allude to the crude distinction between bunch means, or outright effect size, as well as normalized proportions of impact, which are determined to change the impact to an effectively figured out scale. Outright effect size is helpful when the factors under study have inherent meaning (Sullivan & Feinn, 2012). And for inferential statistical analysis applied after the data obtained are normally distributed and homogeneous. The criteria for testing normality at degrees of freedom db = k-3 with = 0.05, namel χ^2count $\leq$ χ^2table then the data is normally distributed. While the data criteria are homogeneous with a significant level (α) = 0.05. The test criteria are that the data is said to be homogeneous if Fcount < Ftable (Riduwan, 2010). Inferential statistical analysis

was used to analyze student learning outcomes data by using a two-sample independent t-test (unpaired). The test criteria are if – t table ≤ t count ≤ + t table then H_0 is accepted and Ha is rejected at = 0.05 with db = n1 + n2 – 2 (Sugiyono, 2010).

RESULTS AND DISCUSSION

Based on the research conducted, the student learning outcomes in the experimental class and control class can be seen in Table 2.

Table 2. Comparison of student learning outcomes in experimental and control classes

Description	Experiment Class		Control Class	
	Pre-test	Post-test	Pre-test	Post-test
Lowest value	20	45	10	45
The highest score	50	90	75	90
Average score	34.81	70,19	36.54	64.81
Standard deviation	-	12.21	-	12.19

The results of descriptive statistical analysis in this study used Effect Size. A variable's effect on other variables is quantified by its effect size. In the research, the results of calculations using Cohen's d formula were obtained in the experimental class, the value d = 3.935 or rounded to 3.9 and the results of calculations using Cohen's d formulas in the control class obtained the value of d = 1.648 or can be rounded to 1.6. These two results are then interpreted with the interpretation table from Cohen's obtained that in the experimental class the Flipped Classroom learning model applied to affect student learning outcomes greater than 97.7% or a very large effect, while in the control class the conventional learning model applied to affect student learning outcomes. as much as 94.5% or a large effect.

The normality test was used to determine whether the data obtained were normally distributed or not. The results of the experimental class calculations obtained data χ^2_{count} = 4.72 and χ^2_{table} = 7.81. These results meet the criteria for normal distribution of data $\chi^2_{count} < \chi^2_{table}$, namely 4.72 < 7.81. The results of the calculation of the control class obtained χ^2_{count} = 5.88 and χ^2_{table} = 7.81 These results meet the criteria for normal distribution of data $\chi^2_{count} < \chi^2_{table}$, namely 5.88 < 7.81.

The homogeneity test aims to determine the The variance between two samples is the same, this test uses the F test. Based on the results obtained, the largest variance is 148.97 and the smallest variance is 148.48, so that the F_{count} value is 1.00 and the F_{table} obtained based on the test criteria, the db of the numerator = n – 1, db of the denominator = n – 1 with = 0.05, which is 1.92. The results obtained

are F_{count} < F table, (1.00 < 1.92), Furthermore, the data can be said to be homogenous because there is no difference in variance between the two classes.

With the use of the Flipped Classroom learning model and traditional learning models, this exam will compare (differentiate) the results of student learning. The test criteria are if $- t_{table} \leq t_{count} \leq + t_{table}$ then H_0 is accepted and Ha is rejected at = 0.05 with degrees of freedom, db = 51. Based on the results obtained $- t_{table} < t_{count} > + t_{table}$, (–2.007 < 2.9069 > +2.007), then H_0 is rejected and H_a is accepted, therefore it can be stated that there are differences in student learning results using the Flipped Classroom learning model and conventional learning models on electrolyte and non electrolyte solutions.

This study aims to determine the differences in the application of the Flipped Classroom learning model and the conventional learning model to student learning outcomes in class X Public Senior High School 1 in Paleleh on electrolyte and non-electrolyte solutions. The type of research conducted is Quasi Experiment. In this study, two classes were used, namely the control class and the experimental class. Where the control class is given a conventional learning model and the experimental class is given a Flipped Classroom learning model. The research design used in this study was a non-randomized pretest-posttest control group design (pre-test-post-test control group without randomization).

The implementation of the research in the experimental class and control class used the same learning time, namely 2 meetings (6 lesson hours). and 1 meeting (3 hours of lessons) for the post-test. In both classes, they studied the same material, namely the material of electrolyte and non-electrolyte solutions. The difference lies in the learning model applied, namely the Flipped Classroom learning model in the experimental class and the conventional learning model in the control class.

Before conducting the experiment, the validity of the questions that will be used for the pre-test and post-test is carried out first. Validation aims to determine the validity of the question. Aspects that were assessed were material, construction and language with the final conclusion that they were suitable for use with improvements. The second validation was tested on 28 students. The questions tested are 30 questions. After obtaining the results, the AnatesV4 application was used to measure validity, level of difficulty, discriminatory power, and reliability so that 25 valid questions and 5 invalid questions were obtained.

Before carrying out the teaching and learning process, first conduct an initial test (pre-test) in the experimental class and control class to determine the students' initial abilities. The results obtained in class X natural sciencesd 1 the average value of the Pre-test was 36.54 while in class X social sciences 1 was 34.81. Then the treatment was given to each class according to the learning model, namely the Flipped Classroom learning model in class X social sciences 3

as an experimental class and conventional learning models in class X natural sciences 1 as a control class. The last is giving a final test (Post-test) using the same questions as the Pre-test. The results obtained are the experimental class obtained an average value of 70.19 while the control class obtained an average value of 64.81.

Learning is carried out following the lesson plan that was made previously. In the experimental class starting from pre-class activities, students are divided into 6 groups, each consisting of 4-5 people. The researcher gave a flash drive to each group that contained a learning video. Then explain a little about the stages of flipped classroom learning. The next activity is class activities, starting with an introduction for 10 minutes, then continuing with core activities for 115 minutes. This core activity focuses more on solving the questions that the researcher has prepared beforehand. And ended with closing activities for 10 minutes. In the control class, students were divided into 6 groups consisting of 4-5 people. The activity began with an introduction for 15 minutes, then continued on to the core activity for 110 minutes. It is used to explain the material about electrolyte and non-electrolyte solutions, then the students use the time they have with their group friends to work on the questions that the researchers have prepared beforehand. And ended with closing activities for 10 minutes.

Based on the learning outcomes that have been obtained from the two classes, the researchers conducted a descriptive statistical analysis by using the Effect Size test. d in the control class obtained a value of d = 1.648 or can be rounded up to 1.6. These two results are then interpreted with the interpretation table from Cohen's. It is found that in the experimental class the Flipped Classroom learning model applied to affect student learning outcomes greater than 97.7% or a very large effect, while in the control class the conventional learning model applied to affect student learning outcomes. as much as 94.5% or a large effect.

Data on student learning outcomes were also analyzed using inferential statistics using a two-party t-test. Both the experimental class and the control class have data that are normally distributed, where for the experimental class the value of $\chi^2_{count} < \chi^2_{table}$ (4.72 < 7.81) and for the control class the value of $\chi^2_{count} < \chi^2_{table}$ (5.88 < 7.81). Because the data is normally distributed, the homogeneity test is then carried out. Aiming to determine the two samples have the same variance, this test uses the F test. Based on the results obtained, the largest variance is 148.97 and the smallest variance is 148.48, so that the F_{count} value is 1.00 and F_{table} is obtained based on the criteria The test is on the db of the numerator = n – 1, db of the denominator = n – 1 with = 0.05, which is 1.92. The results obtained are F count <

Furthermore, because the data is homogeneous, it can be continued on the t-test. The t-test analysis was obtained $– t_{table} < t_{count} > + t_{table}$, (–2.007 < 2.9069 > +2.007) with a significance level ($\alpha = 0.05$) with degrees of freedom = 51. Based

on these data, it is clear that t_{count} is in the rejection region. H0, then H0 is rejected and Ha is accepted, so it can be concluded that there are differences in student learning outcomes using the Flipped Classroom learning model with conventional learning models on Electrolyte and Non-Electrolyte Solutions. This difference is because the Flipped Classroom learning model has a lot of time for students and teachers to enrich the material. long enough time is used for discussion between students and group friends, students with other groups, and students with teachers (Nugroho, 2015).

The research using the Flipped Classroom learning model, the teacher has involved students to develop existing strategies in learning so that the quality of students increases through enthusiasm in refuting and agreeing to questions, working on questions, answering and asking questions. According to previous research, the reason for the success of the Flipped Classroom learning model is that students can re-watch or pause the given learning video or even watch it repeatedly so that they can better understand the material. This is impossible if learning is carried out as usual (Waer & Mawardi, 2021). Since some students use the Flipped Classroom learning model to repeat and pause instructional videos so they can better understand them, students can also learn alone. It can be completed at the students' own pace. Students must however take the initiative and be accountable for their own learning (Danker, 2015)

According to Chandra and Nugroho Chandra & Nugroho, (2017) The Flipped Classroom method as a supporter of Design Photography courses (specifically the discussion of commercial photography) shows an increase in learning outcomes and students like the video tutorial because they can watch it repeatedly so that they better understand the material and students come to class with their knowledge. This shows an increase in learning outcomes. In view of past examinations, it is reasoned that there was a massive distinction between the normal pretest and post-test scores showing that the use of the Flipped Classroom learning model decidedly affected understudy learning results and had the option to further develop understudy science learning results on buffer solution material (Khumairah *et al*., 2020). This change in outlook includes utilizing website innovation to further develop learning in the homeroom, so educators invest more energy cooperating with understudies in the study hall as opposed to giving equipment. This is typically carried out utilizing instructor made recordings that understudies watch before class begins or using recordings that are unreservedly accessible on the website (Olakanmi, 2017). Video is one of the mass learning tools consisting of still and moving sound images, both in real conditions, an animation that is useful for helping the learning process. Through videos, learning problems such as time constraints can be overcome, because learning using videos can be done anywhere and anytime (Sihaloho, 2017).

In a study conducted by Mukdasai *et al*., (2021) entitled Development of E-Learning Chemistry Learning for SMA/MA Project Based Learning on Colloid Materials with the Flipped Classroom Approach in Class XI Senior High Schools, concluded The e-learning material for colloid development utilizing the Model application created in this study has content and construct validity levels of 0.838 and 0.801, respectively, with very high and high categories, according to the data analysis that has been done. We can therefore draw the conclusion that electronic learning content for the development of e-learning chemistry learning in senior high school project-based learning on colloid material using the Model application can be said to be valid and useful so that it can boost student motivation in the learning process. As a result, senior high schools can already use or make use of the research's output.

According to Paristiowati, Fitriani, *et al*., (2017) the Flipped Classroom learning model brings a new, more fun air in learning science in the homeroom. This can expand the association among instructors and understudies and between understudies, so that learning turns out to be more escalated and better. The flipped classroom model benefits students because students have a lot of time to learn, not only in class but outside the classroom. In addition, students can learn to share information with each other, if there are students who do not understand then they can solidify a concept together. Thus, learning materials that have not been mastered by students can be understood well through the help of teachers or friends (Khumairah *et al*., 2020).

The model enjoys a few benefits for understudies, as far as guaranteeing that understudies are ready. For example, making the course fun and useful, giving instructor direction and cooperation, and propelling understudies by making a competitive environment inside the study hall. Also, one might say that the innovation which is incorporated into the flipped homerooms upholds individual realization, which helps increase the progress of understudies. Because of these benefits, it is normal that the homeroom commitment level of the understudies will definitely be impacted by the use of this model (Ayçiçek & Yelken, 2018).

CONCLUSION

According to the data from the research analysis, there are discrepancies in the learning results for students using the Flipped Classroom model and traditional learning models for the topic of electrolyte and non-electrolyte solutions. This can be seen from the average post-test value of each class, namely the experimental class = 69.24 and the control class = 59.50. And the results of the t-test analysis were obtained – $t_{table} < t_{count} > + t_{table}$, (–2.007 < 2.9069 > +2.007) with a significance level ($\alpha = 0.05$) with degrees of freedom = 51.

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