



## CORE AND PROBLEM BASED-LEARNING: THE IMPACT ON CRITICAL THINKING ABILITY BASED ON SELF REGULATION

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### ABSTRACT

The low ability to think critically can affect the student's learning process. In overcoming the problem of critical thinking, teachers must first observe students' self-regulation. This quasi-experimental study aims to determine the effect of the CORE and PBL models on students' critical thinking skills based on self-regulation and interactions. The population is all 8th grade students of SMP N 1 Tungal Ulu. Random sampling technique was used to choose class VIII B as experimental class 1 with 34 students, VIII D as experiment class 2 with 32 students, and VIII E as control class with 33 students. Data were collected using test questions. Statistical test using two-way ANOVA with SPSS software version 21 with a confidence level of 0.05. The results of the study based on hypothesis testing in the three classes obtained that  $F_{count}$  was 18.693 while the value of  $F_{table}$  was 4.00, meaning that  $F_{count}$  was greater than  $F_{table}$ . These results indicate that  $H_1$  is accepted (there are differences in critical thinking). It was concluded that CORE and PBL learning had an effect on improving students' critical thinking skills compared to traditional learning. However, there is no interaction between learning treatment and critical thinking skills.

## CORE DAN PROBLEM BASED LEARNING: PENGARUHNYA TERHADAP KEMAMPUAN BERPIKIR KRITIS BERDASARKAN SELF REGULATION

### ABSTRAK

#### Kata Kunci:

Kemampuan berpikir kritis

Model CORE

Model *problem based learning*

*Self regulatioan*

Rendahnya kemampuan berpikir kritis dapat mempengaruhi proses belajar siswa. Dalam mengatasi masalah berpikir kritis, guru harus terlebih dahulu mengamati regulasi diri siswa. Penelitian *quasi experimental* ini bertujuan untuk mengetahui pengaruh model CORE dan PBL terhadap kemampuan berpikir kritis siswa berdasarkan *self regulation* dan interaksinya. Rancangan penelitian *non-equivalent pre-test and post test control group design*. Populasi meliputi seluruh siswa kelas VIII SMP N 1 Tungal Ulu. Teknik *random sampling* digunakan untuk memilih kelas VIII B sebagai kelas eksperimen 1 sebanyak 34 siswa, kelas VIII D sebagai kelas eksperimen 2 sebanyak 32 siswa, dan kelas VIII E sebagai kelas kontrol sebanyak 33 siswa. Data dikumpulkan dengan menggunakan instrumen tes berupa soal. Uji statistik menggunakan ANOVA dua jalur dengan SPSS software versi 21 dengan taraf kepercayaan 0,05. Hasil penelitian berdasarkan uji hipotesis antara ketiga kelas diperoleh  $F_{hitung}$  adalah 18,693 sedangkan nilai  $F_{tabel}$  adalah 4,00 artinya bahwa  $F_{hitung}$  lebih besar dari  $F_{tabel}$ . Hasil ini menunjukkan bahwa  $H_1$

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diterima (terdapat perbedaan berpikir kritis). Disimpulkan bahwa pembelajaran CORE dan PBL berpengaruh dalam meningkatkan kemampuan berpikir kritis siswa dibandingkan dengan pembelajaran tradisional. Namun, tidak terdapat interaksi antara perlakuan pembelajaran dengan kemampuan berpikir kritis.

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## 1. INTRODUCTION

Lately, learning activities have faced many problems, especially due to the Covid-19 pandemic. Learning cannot run optimally because we have to stay at home and implement physical distancing so that online-based/distance learning become the solution [1]. Distance learning is implemented in various units of education level and in every subject [2]. For learning outcomes, online learning is certainly not as effective as direct learning at school. Mastery of learning models, learning tools, learning materials, and good communication is required in delivering online learning [3], [4]. Teachers need to have the competence to choose approaches and teaching methods that support the success of student learning in online learning, because learning approaches and methods have a significant effect on students' interest and motivation to participate in learning activities [5]. However, in the 2022/2023 school year, direct learning resumes with all the same subjects including mathematics.

Mathematics is a compulsory subject that is available from Elementary School, Junior High School, High School to higher education. The process of learning mathematics is a student's effort to gain knowledge about mathematics [6], [7]. In the process of learning mathematics, students are given the opportunity to construct their own knowledge. Because mathematics is very important as a basis for logic or quantitative reasoning and solutions that can be used for other subjects [8]. In addition, through learning mathematics, students can play an important role in representing, communicating, and predicting events in learning mathematics [9]. For many people, mathematics is considered the most difficult subject to learn [10]. However, mathematics is actually one of the ways to solve problems in everyday life, so everyone needs to learn it [11].

In the observations made by the researchers at the public junior high schools in Tungal Ulu Regency, especially in grade 8, students showed that their critical thinking skills were still low. The researcher also found that in the process of learning mathematics, the teacher directly gave mathematical formulas to students without involving students in the process of finding the formula. So that students do not understand how to use mathematical formulas and cannot even solve a problem. This thinking is strengthened based on the admission of school students that they have difficulty in completing assignments and tests related to the concepts of everyday life, which results in poor learning outcomes. The learning process in the classroom does not involve a discussion or question and answer process with the teacher. The learning process is still dominated by the teacher, this is also shown by the results of the pre-test on initial observations. The results show the average score of students' critical thinking skills is 45 which is included in the low category. Based on previous research, the CORE learning model can improve students' critical thinking abilities and mathematical dispositions [12].

The failure to achieve learning objectives can be caused by several factors, in addition to inner factors from within students, there are external factors that are very influential, namely the teacher and the learning model used [6]. Teachers are required to be able to choose a learning model that can stimulate the enthusiasm of each student to

be actively involved in learning [13], [14]. This is a challenge for mathematics teachers to change bad predicates about mathematics by presenting fun learning so that it can increase the enthusiasm of students to be more motivated to learn mathematics [15].

With this fact, the teacher must clearly take action by choosing the right learning model so that students can actively participate in the classroom, because the teacher's decisions affect the development of students' abilities [16]. In addition, the current demand for education continues to increase, because the quality of learning objectives continues to improve. Learning activities are one of the factors that influence student learning outcomes. Therefore, to improve the quality of learning, we need to focus on student activities during the learning process [17].

The selection of learning models can encourage students to be more active in learning. One alternative learning model that can be an option is the CORE model. CORE stands for four words that have a unified function in the learning process, namely, Connecting (connecting old information with new information or between concepts), Organizing (organizing the information obtained), Reflecting (rethinking the information that has been obtained), and Extending (expand knowledge) [17]. The CORE learning model is a discussion-based learning where two or more people participate to share ideas, experiences, and increase knowledge. The discussion method is part of the cooperative learning model [18]. The purpose of the CORE learning model is to increase students' success in mathematics, reasoning abilities, and self-regulation [19]. It has been researched that the Self-Regulated Learning of students who use the CORE learning model in learning mathematics is better than students who use the Discovery Learning learning model [20].

Besides CORE, another alternative learning model that can also develop students' thinking skills is the Problem Based Learning (PBL) model. PBL is a set of teaching models that use problems as a focus to develop problem-solving skills, materials, and self-regulation [21]. PBL provides learning that stimulates student activity, with the following steps: 1) Problem orientation, 2) Organizing students for learning, 3) Guiding individual/group experiences, 4) Developing and presenting work, 5) Analyzing and evaluating problem solving processes [22]. So, student activities in the mathematics learning process in the PBL model are driven by curiosity and understanding of the concept of learning mathematics [23], according to the results of previous studies which revealed that PBL can significantly affect student learning outcomes [24], and this condition illustrates that performance assessment in Problem Based Learning is very influential on the achievement and improvement of students' mathematical problem solving abilities [25]. Not only improving students' mathematical problem solving abilities, but PBL can also improve students' mathematical critical thinking skills [26].

Critical thinking skills encourage students to make decisions from various points of view carefully, thoroughly, and logically. With the ability to think critically, students can consider the opinions of others and be able to express their own opinions [23]. That is why it is important to incorporate critical thinking skills into the education curriculum in every country [27].

To address the problem of critical thinking, the teacher must first observe students' self-regulation. Good self-regulation can increase learning independence and assist students in managing appropriate learning patterns for themselves in order to increase their learning motivation to achieve a good achievement [28]. A previous study has found that increased self-regulation occurs because students become more accustomed to assessing and criticizing their own learning processes and achievements, thereby increasing learning independence [28]. In addition, self-regulation is also a mental ability

and emotional control during cognitive and physical development, as well as emotional control and good socialization skills, leading a person to self-regulate well [29], because self-regulation includes affective, cognitive, and psychomotor aspects [28].

Research on the CORE learning model on critical thinking skills has been carried out several times including: the effect of the CORE model on mathematics learning outcomes in terms of critical thinking skills [30], CORE learning through an open-ended approach to improve mathematical critical thinking skills [31], and the effect of CORE learning model on critical thinking skills [32], [33]. Besides, there are studies that discuss the impact of the problem-based learning model on critical thinking skills [34]. However, among these studies there is no research that discusses the effect of the CORE and PBL models on critical thinking skills based on self-regulation. The difference between learning with CORE and learning with PBL will give different findings in the field. Thus, this study aims to analyze the effect of the CORE and PBL models on students' critical thinking skills based on self-regulation and their interactions.

## 2. METHOD

The method used in this research is Quasi-Experimental Design, with a nonequivalent pre-test and post-test control group design. In this design there is an experimental group and a control group, then each group is given treatment and a post-test [35]. The research design is a research design that includes how to collect data and analyze data that is used as a guide in conducting research.

Because it uses an experimental quantitative method with a 3 x 3 factorial design, in this study there are several codes used. For example, students in a class with the implementation of the Core model with a review of High, Moderate, Low Self Regulation, coded as CT, CS, and CR. For more details, this code is described in Table 1.

**Table 1.** Coding in Experimental Quantitative Method with a 3 x 3 Factorial Design

| Model<br>Self Regulation | Core Class (C) | PBL Class (P) | Control Class (K) |
|--------------------------|----------------|---------------|-------------------|
| High (T)                 | CT             | PT            | KT                |
| Moderate (S)             | CS             | PS            | KS                |
| Low (R)                  | CR             | PR            | KR                |

This study involved 99 8th grade students at SMPN 1 Tungal Ulu. The distribution: 34 students in experimental class 1 (Core class), 32 students in experimental class 2 (PBL class), and 33 students in control class (traditional learning). To see the homogeneity and normality of the distribution, homogeneity and normality tests were carried out.

This quasi-experimental research was carried out with a procedure that went through the stages of the research workflow starting from identifying problems, formulating problems, and studying literature. In the end, the research tools were obtained in the form of lesson plans and research instruments in the form of essay tests that included critical thinking indicators, namely elementary clarification, basic support, advances clarification, strategies and tactics. This research instrument was validated by experts (educational experts), and improvements were made according to the validation results. The instrument was also tested on 64 students who were not samples, then statistical tests were carried out in the form of validity, test reliability, discriminating power, and difficulty index. After getting the test results with good quality, the instrument is ready for use.

Before giving the pre-test, the researcher gave a self-regulation questionnaire to divide students based on high, moderate, and low levels of self-regulation. After giving the questionnaire and pre-test, the research was continued by giving treatment in the form of a learning model in each class. At the end of the meeting, a post-test was conducted on each sample class to obtain final data. Furthermore, the normality test and homogeneity and normality tests were carried out on the research variables as prerequisite tests, and hypothesis testing using two-way ANOVA to obtain research conclusions. Figure 1 is a research design made by the researcher

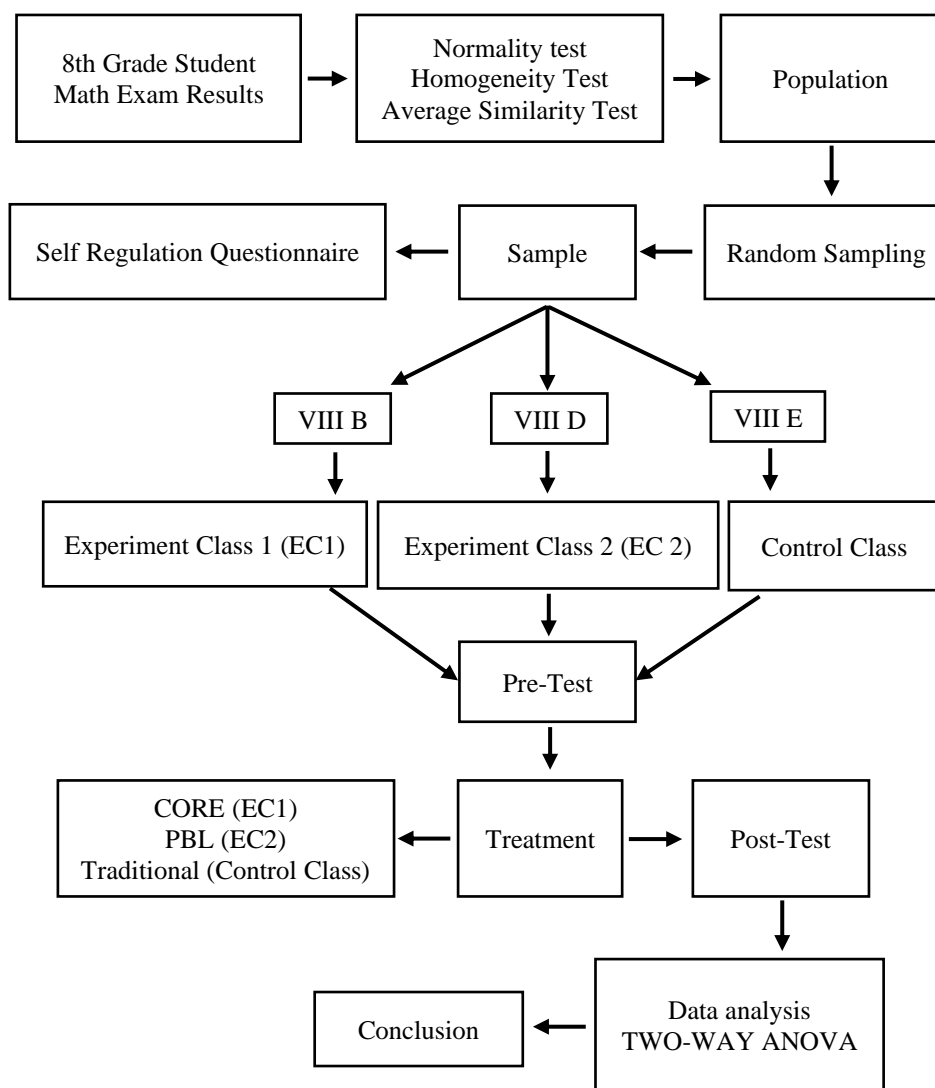


Figure 1. Research Design

### 3. RESULTS AND DISCUSSION

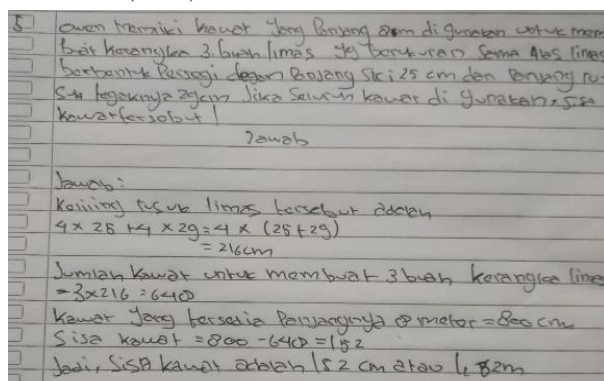
The teaching topic of this research is flat-side geometry. Table 2 shows examples of student post-test results who obtained the highest scores in the experimental and control classes.

Table 2. Students' Work

| Sample Question  |
|--|
| 5. Owen has a wire 8 m long used to frame 3 pyramids of the same size. The base of a pyramid is a square with a side length of 25 cm and a height of 29 cm. If all wires are used, draw and count the remaining wires! |

Students' Work's Sample (taken randomly)

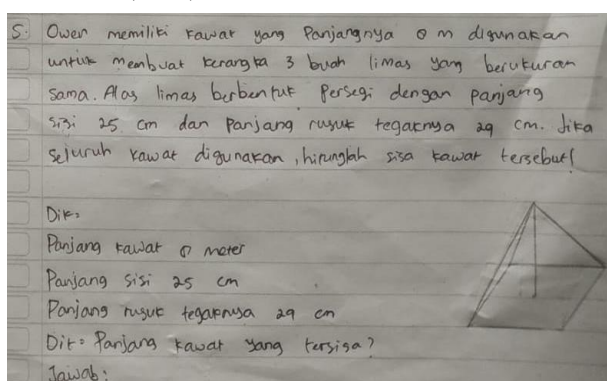
Core Class (EC 1)



In the picture:  
 (does not provide pyramid illustration)  
 The perimeter of the side of the pyramid is:  
 $4 \times 25 + 4 \times 29 = 4 \times (25 + 29)$   
 $= 216 \text{ cm}$   
 Wire needed to make 3 pyramids =  $3 \times 216$   
 $= 648$   
 The available wire is 8 meters long = 800 cm  
 Remaining wire =  $800 - 648$   
 $= 152$   
 So, the remaining wire is 152 cm or 1,52 m

Students' Work's Sample (taken randomly)

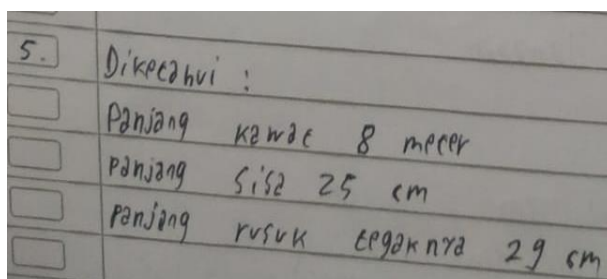
PBL Class (EC 2)



In the picture:  
 (provide pyramid illustration)  
 It is known:  
 Wire length: 8 meters  
 Side length: 25cm  
 Height: 29 cm  
 The remaining wire length?  
 (PBL student has not finished the calculations)

Students' Work's Sample (taken randomly)

Control Clas



In the picture :  
 (does not provide pyramid illustration)  
 Wire length: 8 meters  
 Side length: 25cm  
 Height: 29cm  
 (The control class student hasn't finished the calculations either)

Based on Table 2, it can be seen that the student from the Core class gave more complete and more precise answers than the students from the PBL class and the control class. Based on the overall results, the highest score in EC 1 class is 100, while the lowest score is 20. For EC 2 class, the highest score is 100 and the lowest is 30, while for the control class the highest score is 85 while the lowest score is 30. The description in Table 3 below presents the calculation data of the final test results from all samples.

Table 3. Critical Thinking Skills of the Students

| No | Statistic Category       | Class       |            |                       |
|----|--------------------------|-------------|------------|-----------------------|
|    |                          | EC 1 (CORE) | EC 2 (PBL) | Control (Traditional) |
| 1  | The Number of Sample (N) | 34          | 32         | 33                    |
| 2  | Mean                     | 67,21       | 67,66      | 56,36                 |
| 3  | Standard Error Mean      | 3,608       | 3,550      | 3,113                 |

|   |                    |         |         |         |
|---|--------------------|---------|---------|---------|
| 4 | Median             | 70      | 70      | 55      |
| 5 | Standard Deviation | 21,041  | 20,080  | 17,996  |
| 6 | Varians            | 442,714 | 403.201 | 323,864 |
| 7 | Max                | 100     | 100     | 85      |
| 8 | Min                | 20      | 30      | 30      |
| 9 | Range              | 80      | 70      | 55      |
|   | Total              | 780     | 780     | 685     |

Table 4 describes the results of hypothesis testing with a significance level of 95% or 0.05 which will be compared with the significant value in the table. If sig. > 0.05 then  $H_0$  is accepted, and otherwise, if sig. < 0,05 then  $H_1$  is accepted. The results of the analysis of hypothesis testing with Two-Way Anova are shown in Table 4.

**Table 4.** Two-Way Anova Result

| <b>Tests of Between-Subjects Effects</b>    |          |      |
|---|----------|------|
| Dependent Variable: Critical thinking score |          |      |
| Source                                      | F        | Sig. |
| Corrected Model                             | 72.438   | .000 |
| Intercept                                   | 6689.658 | .000 |
| Model                                       | 13.263   | .000 |
| Self  | 266.418  | .000 |
| Model * Self                                | .824     | .514 |

Based on table 4, it can be seen that the value of sig. for the model variables (experimental and control) is 0.000, the value is smaller than the significance level of 0.05 so  $0.000 < 0.05$ , it can be concluded that  $H_0$  is rejected and  $H_1$  is accepted. These results are consistent with the results of previous research which revealed that PBL is a teaching model that uses problems as a focus to develop problem-solving skills, materials, and self-regulation so that it can support students' critical thinking skills to be better [21]. The same condition has been expressed by other studies, that student learning outcomes using the PBL method are higher than student learning outcomes taught by the demonstration learning method [36]. Not only PBL, but CORE also makes a good contribution to students' reasoning abilities in drawing logical conclusions, providing explanations with models, facts, properties, and relationships, predicting answers and solution processes, using patterns and relationships to analyze mathematical situations, compiling and testing conjectures. to increase [37]. Through PBL and Core learning, students become responsible in mathematics, have confidence in solving math problems, have the initiative in mathematics learning, do not depend on others in mathematics, and are able to solve math problems.

There are several factors from teachers or students that must be considered in using the PBL and CORE learning models. Factors that come from the teacher are that they must be able to manage the class in a conducive manner, ensure that students are ready to learn, divide students with different abilities into one group, allocate learning time well, and of course plan learning to the fullest and funniest way. The student factor is that students must get used to looking for information both from books and from friends in a group. Students who are able to think highly must be willing to help students with low abilities in one group, students must also be brave to express their opinions [6]. If these factors are not met and teachers who use the PBL learning model do not minimize their shortcomings, then the PBL learning model cannot improve students' critical thinking skills [38], [39].

One of the thinking skills developed in the world of education today is critical thinking [40]. Critical thinking can support students to analyze arguments and generate insight into each meaning and interpretation, develop cohesive and logical reasoning patterns, understand the assumptions and biases that underlie each position. In this study, it was found that there is an effect of critical thinking ability on self-regulation. The ability of students to think critically is based on the motivation to control themselves and continue to strive to achieve their goals. Other studies have also proven that critical thinking skills can be improved through Core and PBL [41].

Furthermore, based on the results of the study, there was no relationship between learning treatment in terms of critical thinking skills towards self-regulation (sig. = 0,514). Due to these results, it is suspected that students have not used their abilities optimally, besides that there are several factors that may influence. Based on previous research, the student's ability factor should have a very strong impact on the achieved self-regulation [38]. Another study also found that self-regulation has a positive and significant effect on students' critical thinking skills [39]. Critical thinking in terms of self-regulation shows: (1) subjects with high self-regulation fulfill three critical thinking stages, namely the clarification stage, the assessment stage, and the strategic stage; (2) subjects with self-regulation are fulfilling two stages of critical thinking, namely the assessment stage and the inference stage; and (3) subjects with low self-regulation only fulfilled one critical thinking stage, namely the assessment stage.

To see the increase in critical thinking skills from the results of the pre-test and post-test, in this study the N-Gain test was used. The N-Gain test has an interpretation level that refers to the N-Gain score. For high interpretations with an N-Gain score  $\geq 0,70$ , moderate interpretations with a score between  $0,30 \leq \text{N-Gain} < 0,70$  and for low interpretations with an N-Gain score  $< 0,30$ . So that the N-Gain score is obtained in Table 5.

**Table 5.** N-Gain Test Results

| No | Class   | N-Gain Value | Interspretation |
|----|---------|--------------|-----------------|
| 1  | EC 1    | 0,40         | Moderate        |
| 2  | EC 2    | 0,33         | Moderate        |
| 3  | Control | 0,32         | Moderate        |

Based on the results of the study, between the experimental class (with CORE and PBL learning models) and the control class (with traditional learning), it can be clearly seen that the learning outcomes of mathematics using the Core and PBL learning models are better. This traditional learning method only uses lectures, questions and answers, assignments, and summarizing. This traditional learning is still teacher-centered and this learning model makes students more passive because the activities during the learning process are dominated by the teacher. In other words, the Core and PBL learning models are good to be applied in mathematics learning for students who have high, moderate, and low critical thinking skills. Because through learning with the Core and PBL models, students are trained to develop information and analyze. The average value of the pre-test and post-test results for the sample class is presented in Table 6.

**Table 6.** Average Score of Pre-test and Post-test

| Group   | Pre-test | Treatmen    | Post-test |
|---------|----------|-------------|-----------|
| EC 1    | 44,26    | CORE        | 67,20     |
| EC 2    | 43,28    | PBL         | 61,85     |
| Control | 35,60    | Traditional | 56,36     |



With the results of the pre-test and post-test, the hypothesis was tested. In the hypothesis test, between the EC 1 class, EC 2 class, and the Control class, it was revealed that  $F_{\text{count}} = 18.693$  while the  $F_{\text{table}}$  value at  $dka = 1$  and  $dk = 72$  for a significance level of  $0.05 = 4.00$ , this means that  $F_{\text{count}}$  is greater than  $F_{\text{table}}$  ( $F_h = 18.693 > F_t = 4.00$ ). These results indicate that the null hypothesis ( $H_0$ ) is rejected and the alternative hypothesis ( $H_1$ ) is accepted. The alternative hypothesis states that there is a significant difference in mathematics learning outcomes between students in the EC 1 class, EC 2 class and the control class [40]-[44]. This significant difference occurs because through PBL and Core learning, students become responsible in mathematics, have confidence in solving math problems, have the initiative in mathematics learning, do not depend on others in mathematics, and are able to solve math problems. So that the critical thinking ability of students in class EC 1 (with CORE model) and EC 2 (with PBL model), is higher than students in control class (with traditional learning).

#### 4. CONCLUSION

Based on the results of the study, it was found that there was a significant influence from the selection of learning models on critical thinking skills in terms of self-regulation. This research was conducted in the 8th grade of SMP Negeri 1 Tungkal Ulu. CORE and PBL learning are proven to be more influential in improving students' critical thinking skills compared to traditional learning. Furthermore, it is suggested to teachers or further researchers to pay attention to the selection of learning models according to the teaching topic, because the CORE and PBL models have the disadvantage that they take longer time than traditional learning. Therefore, teachers who use the CORE and PBL learning models must be careful in designing lessons because the steps in these two models are quite complicated and time consuming.

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