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The Effects of the ECIRR Learning Model on Mathematical Reasoning Ability in the Curriculum Perspective 2013: Integration on Student Learning Motivation

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Abstract: This study aims to determine the impact of the ECIRR (Elicit, Confront, Identify, Resolve, Reinforce) learning model on students' mathematical reasoning abilities in terms of student motivation. The research method used was a quasi-experimental method with a post-test only control design research design. The population of this study was all students in five classes XII Private School. The samples were taken at class XII AP-2 and XII MM-1 as the experimental class, and class XII AP-1 and XII MM-2 as the control class. The data analysis technique used is hypothesis testing using ANOVA 2 paths. Based on the research results obtained that (a) There is an influence of the ECIRR (Elicit, Confront, Identify, Resolve, Reinforce) learning model on mathematical reasoning abilities. (b) There is an influence of student learning motivation on mathematical reasoning abilities. (c) There is no interaction between the treatment of learning models and categories of students' learning motivation towards mathematical reasoning abilities. Thus, as a whole it can be concluded that the ECIRR (Elicit, Confront, Identify, Resolve, Reinforce) learning model influences the ability of mathematical reasoning and can increase students' learning motivation.

Keywords: *ECIRR, mathematical reasoning ability, student learning motivation.*

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Introduction

Mathematics has an important role as a basis for logic and reasoning, as well as quantitative solutions that can be used for other lessons. In accordance with one of the goals of mathematics learning according to the Ministry of Education Regulation No.22 of 2006 is to use reasoning on patterns and traits, carry out mathematical manipulations in making generalizations, compiling evidence or explaining mathematical ideas and statements (Sari, 2014). Mathematical reasoning abilities need to be the focus of attention in mathematics learning because through reasoning students can use their reasoning to think in learning mathematics.

Mathematical reasoning ability is one of the important abilities to be trained because this ability is one of the goals in learning (Sumartini, 2018) and is the ability to think that sees the phenomenal that arises then arranged to draw conclusions (Riyanto & Siroj, 2014). But in reality, the low reasoning ability of students is still a problem that occurs at this time. One of the factors that influence the lack of improvement in students' mathematical reasoning is the learning model used by educators. Monotonous learning and not attracting the attention of students will make students tend to be lazy and will reduce the level of student learning motivation (Abdurrahman et al., 2019). The selection of the right learning model will help students understand the mathematics learning material (Diani et al., 2019). One learning model that can be used is a cooperative learning model (Lestari et al., 2019). Cooperative learning is a learning process where students are active, positive and learn to work together in groups (Putri et al., 2016). According to the results of

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research, some experts show that the influence of the use of cooperative models makes students 'mathematical learning achievement better than students' mathematical learning achievements using conventional learning methods (Kusuma, 2017).

The characteristics of the curriculum 2013 use a scientific approach and recommend learning that actualizes the full potential of students and arouses motivation (Ahid et al., 2020). Learning models that are relevant to the demands of the curriculum 2013 one of which is ECIRR *(Elicit, Confront, Identify, Resolve, Reinforce)*. One of the cooperative models that can be used to improve students' mathematical reasoning abilities and learning motivation is the learning model ECIRR *(Elicit, Confront, Identify, Resolve, Reinforce)*. In addition to the learning model (Sumarni et al., 2019), motivation is also one of the causes of success or failure of learning (Sriwidiarti, 2016). If the motivation is strong enough he will decide to do learning activities (Yasin et al., 2020). Conversely, if the motivation is not strong enough he will decide not to carry out learning activities (Diani, et al., 2019) because motivation arises from within or from outside himself (Badrun & Hartono, 2013; Farhan & Retnawati, 2014; Supriadi et al., 2018).

Figure 1. The results of Motivation (external and internal) (Vision Exercise Physiology, 2018).

Various studies on the ECIRR learning model on the mastery of student concepts have been carried out (Effendi, Muhardjito, & H, 2017) various studies in improving mathematical reasoning abilities have also been carried out (Indriani, 2018; Nopitasari, 2017; Setiawan, 2016; Sumartini, 2018; Zahara, 2014) as well as previous research that reviews student motivation (Anita, 2015; Arifin Handoyo & Arifin, 2016; Badrun & Hartono, 2013; Badu Kusuma & Utami, 2017; Ghofuri, Sanusi, & Krisdiana, 2014; Maduretno, Sarwanto, & Sunarno, 2016; Meriyana, Tandiayuk, & Paloloang, 2016; Setiawan, 2016; Wardani, 2015). However, there is no research that applies the ECIRR learning model to mathematical reasoning abilities in terms of learning motivation.

Based on the previous research, researchers are interested in conducting research with the renewal that is seeing the effect of the ECIRR learning model on mathematical reasoning abilities in terms of learning motivation. Thus, the purpose of this study is to determine the impact of the ECIRR learning model on mathematical reasoning ability in terms of student learning motivation.

Methodology

Research Design

This research was a quasi-experimental study using a 2 x 2 factorial design. The treatment was given to two groups of students, the experimental group and the control group. The experimental group is a group of students who learn by using the ECIRR learning model, the control group is a group of students who learn by cognitive conflict models with direct current electricity teaching material. The study uses learning tools with the ECIRR model, essay test items to measure initial knowledge, and multiple choice items to measure students' mastery of concepts. The research data were analyzed with two-way ANOVA after the prerequisite tests were carried out: normality test and homogeneity variance test. This type of research used in this study is a quasi-experimental study with a posttest only control design. The research design is described as in Table 1.

Table 1. Research design

Treatment (A_i)	**Motivation to learn (B_j)**		
	High (B_1)	**Normally (B_2)**	**Low (B_3)**
ECIRR Learning Model (A_1)	A_1B_1	A_1B_2	A_1B_3
Conventional Learning (A_2)	A_2B_1	A_2B_2	A_2B_3

Research Sample

The population of this study was all students in five classes XII Private School of Bandar Lampung in the odd semester of the 2018/2019 academic year. Samples were taken using the cluster sampling method and obtained class XII AP-2 and XII MM-1 as the experimental class, and class XII AP-1 and XII MM-2 as the control class.

Figure 2. The condition of the class room (up: experiment class, bottom: control class)

Data collection techniques using tests, interviews and questionnaires. Research instruments include tests of mathematical reasoning ability and learning motivation questionnaires. The data analysis technique used to test the research hypothesis is the ANOVA test, before conducting a hypothesis test, a prerequisite test is performed, namely the normality test using the Liliefors test and the homogeneity test using the Bartlett's test.

Implementation of the test at the beginning of the research activity with essay items used to measure students' initial knowledge (Huda et al., 2020). A description of the students' initial knowledge data is presented in Table 1. The initial knowledge data obtained by students in the ECIRR class and cognitive conflict were used to classify students into two levels of groups. The two groups are groups of students with a high initial level of knowledge (high PA) with a score above the average and a group of students with a low initial level of knowledge (low PA) with a score below the average. Implementation of the multiple choice item test at the end of the research activity used an essay used to measure students' mastery of concept concepts.

Data description of students' mastery of physics concepts between groups is presented in Figure 1. From the results of the analysis with the two way ANOVA, it is concluded that there are differences in the mastery of students' physics

concepts between groups of students learning through the ECIRR learning model and cognitive conflict models, there are differences in the mastery of students' physics concepts between groups of students who have high and low initial knowledge, and there is an influence of interaction of learning models (ECIRR learning models and cognitive conflict models) and initial knowledge of students' mastery of physical concepts.

Findings / Results

Based on the results of data processing the results of tests of mathematical reasoning ability of students with descriptive analysis and data from the two groups are in a balanced state. Then, the recapitulation results obtained from the observation are as follows:

Table 2. Description of Observation Data Mathematical Reasoning Ability Tests

Class	X_{max}	X_{min}	Measuring Central Tendency			Size of Group Variance	
			$\bar{X}$	Me	Mo	R	S
Experiment	94	58	75.800	76	76	36	9,208
Control	90	50	70.067	72	74	40	9,861

Based on Table 2 the experimental class obtained the highest value (X_{max}) = 94 and lowest value (X_{min}) = 58. The average in the experimental class is 75.8, with the middle value (median) 76, values that often appear (mode) 76, range of values *(R)* 36, and standard deviation 9,208. Then, in the control class the highest value (X_{max}) 90 and lowest value (X_{min}) 50. The average in the experimental class is 70.067, with the middle value (median) 72, values that often appear (mode) 74, and range of values *(R)* 40, and standard deviation 9,861.

In addition to testing the mathematical reasoning ability test, questionnaire data related to learning motivation were also shared with students. The questionnaire data that was analyzed obtained the number of learning motivations included in the 3 criteria that can be seen in Table 3.

Table 3. Description of Observation Questionnaire Data

Class	$\bar{X}$	S	Learning Motivation Criteria		
			High	Normally	Low
Experiment	86,567	11,805	6	20	4
Control	84,333	11,586	4	20	6

Based on Table 3.the experimental class obtained an average value of 86,567 and a standard deviation of 11,805. Therefore, it can be categorized that there are 6 students with high learning motivation, 20 students who are categorized as moderate learning motivation, and 4 students who are categorized as low learning motivation. While the control class obtained an average value of 84,333 and a standard deviation of 11,586. Thus, it can be categorized that there are 4 students with high learning motivation, 20 students who are categorized as moderate learning motivation, and 6 students who are categorized as low learning motivation.

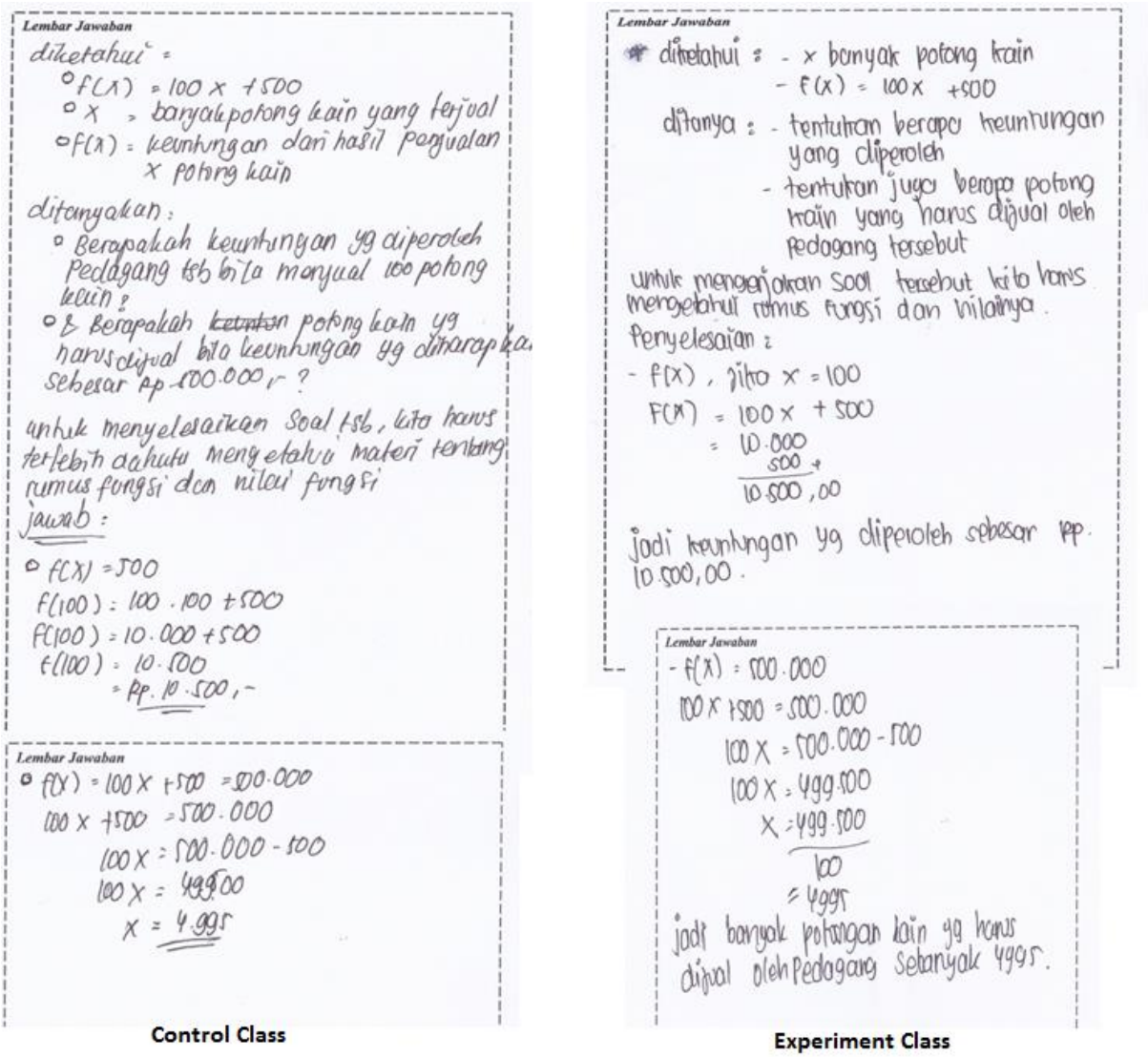

Figure 3. Student work snippets / papers

After all the test data has been collected, it will be used as a hypothesis test using 2-way ANOVA, but before the hypothesis test is carried out, the prerequisite test will be conducted first using the normality and homogeneity test. The normality test results can be seen in Figure 4.

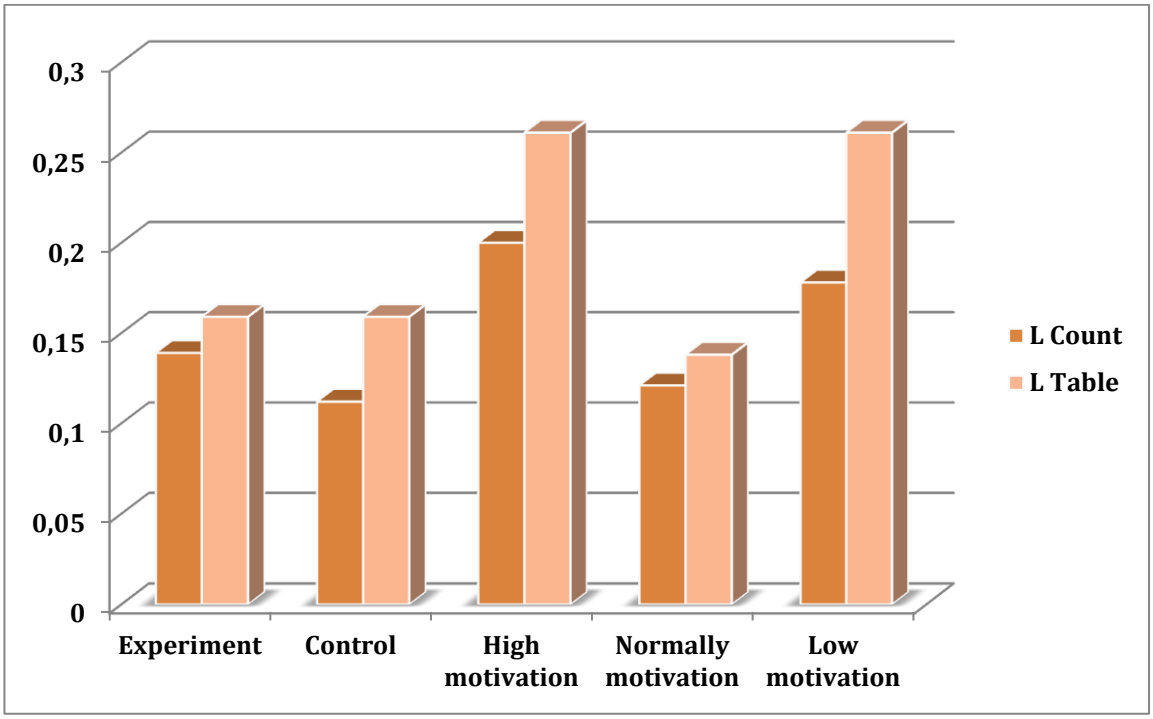

Figure 4. The results of Recapitulation of Normality Test Results

Based on Figure 4, the experimental class obtained $L_{count} = 0.139$ with $L_{table} = 0.159$, the control class is obtained $L_{count} = 0.112$ with $L_{table} = 0.159$.while the motivation to learn for students classified as high motivation is obtained L_{count} 0.200 with a sample of 10 respondents and L_{table} 0.261, for students belonging to the motivation (Munifah et al., 2019) being obtained L_{count} 0.121 with a sample of 40 respondents and L_{table} 0.138 and for students belonging to low motivation is obtained L_{count} 0.178 with a sample of 10 respondents and L_{table} 0.261. Based on all the normality test results it can be concluded that all groups have $L_{table} \leq L_{table}$ which mean H_0 accepted which means the data comes from a normally distributed population (Huda et al., 2019).

Furthermore, homogeneity tests were performed using test on test data and questionnaires using a significance level of 5%. The test can be said to be homogeneous if ${X^2}_{count} < {X^2}_{table}$.The results of the calculation test between the experimental class and the control class get a value ${X^2}_{count}$ = 0.136 with ${X^2}_{table}$ = 3.481, while for the categories of learning motivation that are high (Hartinah et al., 2019), medium and low score ${X^2}_{count}$ = 1.196 with ${X^2}_{table}$ = 5.991. Thus, it can be concluded that the sample came from a homogeneous population (Munifah et al., 2019). After knowing all the data of each group is normally distributed and comes from the same variance, then the hypothesis test can then be performed using 2 way ANOVA (Habibi et al., 2019). The recapitulation of ANOVA 2 roads can be seen in Table 4.

Table 4. Recapitulation of the results of the 2 road ANOVA

Source	JK	dK	RK	F_{count}	F_{table}
Learning (A)	370.671	1	370.671	7.153	4.020
Motivation (B)	274	2	1372.5	26.485	3.168
Interaction (AB)	88.2	2	44.100	0.851	3.168
Error	2798.4	54	51.822	-	-
Total	6002.271	59	-	-	-

This explanation indicates that the need for further testing is a double comparison test using the Schaffer method. The aim of this further test is to see the more significant influence of the independent variables, namely the ECIRR learning model (Munifah et al., 2019) and learning motivation on the dependent variable, namely the students' mathematical reasoning ability (Sagala et al., 2019).

Table 5. Calculation of the double column comparison test

No	H_0	F_{count}	F_{table}	Test Decision
1	$\mu_1 vs \mu_2$	32.457	6.336	H_0 rejected
2	$\mu_1 vs \mu_3$	38.593	6.336	H_0 rejected
3	$\mu_2 vs \mu_3$	4.670	6.336	H_0 accepted

Following are the conclusions of the double comparison test between columns in Table 5:

a) Intermediate calculation results $\mu_1 vs \mu_2$ obtained $F_{count} > F_{table}$ which mean H_0 is rejected. Thus, there is a significant influence between high learning motivation and moderate learning motivation on mathematical reasoning abilities. Based on Table 5, it can be seen that the mean marginal motivation is high, amounting to 86 greater than the average marginal motivation being, at 71.5. This research can be concluded that students who are included in the category of high learning motivation are better than students who are included in the category of moderate learning motivation towards mathematical reasoning ability.

b) Intermediate calculation results $\mu_1 vs \mu_3$ obtained $F_{count} > F_{table}$ which mean H_0 is rejected. Thus, there is a significant influence between high learning motivation and low learning motivation on mathematical reasoning abilities. The mean marginal of high motivation, by 86 is greater than the marginal rate of low motivation, by 66. Therefore, it can be concluded that students who are included in the category of high learning motivation are better than students who are included in the category of low learning motivation towards mathematical reasoning abilities.

c) Intermediate calculation results $\mu_2 vs \mu_3$ obtained$F_{count} > F_{table}$ which mean H_0 is accepted. Thus, that there is no significant effect between moderate learning motivation and low learning motivation on mathematical reasoning abilities.

Discussion

Students will be motivated in learning if learning makes students more active and attracts students' attention (Astamega, 2018). According to Sumartini (2018), mathematical reasoning of students can be stimulated by various cooperative learning models that can make students active in the learning process (Sumartini, 2018). This is in line with the results of research conducted by the author that the activeness of students who were given the implementation of the ECIRR model makes students have better mathematical reasoning abilities compared to students who were treated with conventional methods (Prastowo et al., 2019).

The ECIRR model is a model of the learning process actively involving students to create an understanding of oneself. This ECIRR learning has the advantage that the teacher can know the initial knowledge possessed by the student is correct or there is still a mistake because in this lesson students can identify their knowledge (Rahmawati, Lestari, & Umam, 2019), can accustom students to discuss and express opinions using clear and logical language for answers that they think are correct so they can respect one another (Silaban et al., 2017). Also based on the results of previous research by Apriyani (2017), revealed that the use of the ECIRR model in mathematics learning can improve students' mathematical reflective thinking skills (Apriyani, 2017). This is also in line with the conclusions obtained from the results of research by Efendi that the use of learning in the ECIRR class can improve the ability of students to understand (Ramadhani, Huda, & Umam, 2019) the concept of students better than the class conflict (Effendi et al., 2017). Reviewing students 'learning motivation, Kusuma et al. (2014) explained in his research that the ECIRR learning model can improve students' motivation (Ramadhani et al., 2019) and learning outcomes (Kusuma et al., 2014).

Conclusion

Based on the results of research and discussion it can be concluded that (a) There is an influence of the ECIRR learning model on mathematical reasoning abilities. Students who are treated with learning using the ECIRR learning model have better mathematical reasoning abilities compared to students who are treated with conventional learning; (b) There is an influence of student learning motivation on mathematical reasoning abilities. The mathematical reasoning ability of students who have high learning motivation is better than students who have moderate or low learning motivation. Students who have learning motivation who are getting mathematical reasoning skills as well as students who have low learning motivation; (c) There is no interaction between the treatment of learning models and categories of student motivation for mathematical reasoning abilities.

Based on the conclusions of this study, some suggestions can be made so that the teacher can apply the ECIRR learning model and for further researchers to examine the effect of the ECIRR learning model on other subjects to improve

students' mathematical reasoning abilities, or be expected to be able to see how other mathematical abilities possessed students by applying the use of the ECIRR learning model.

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