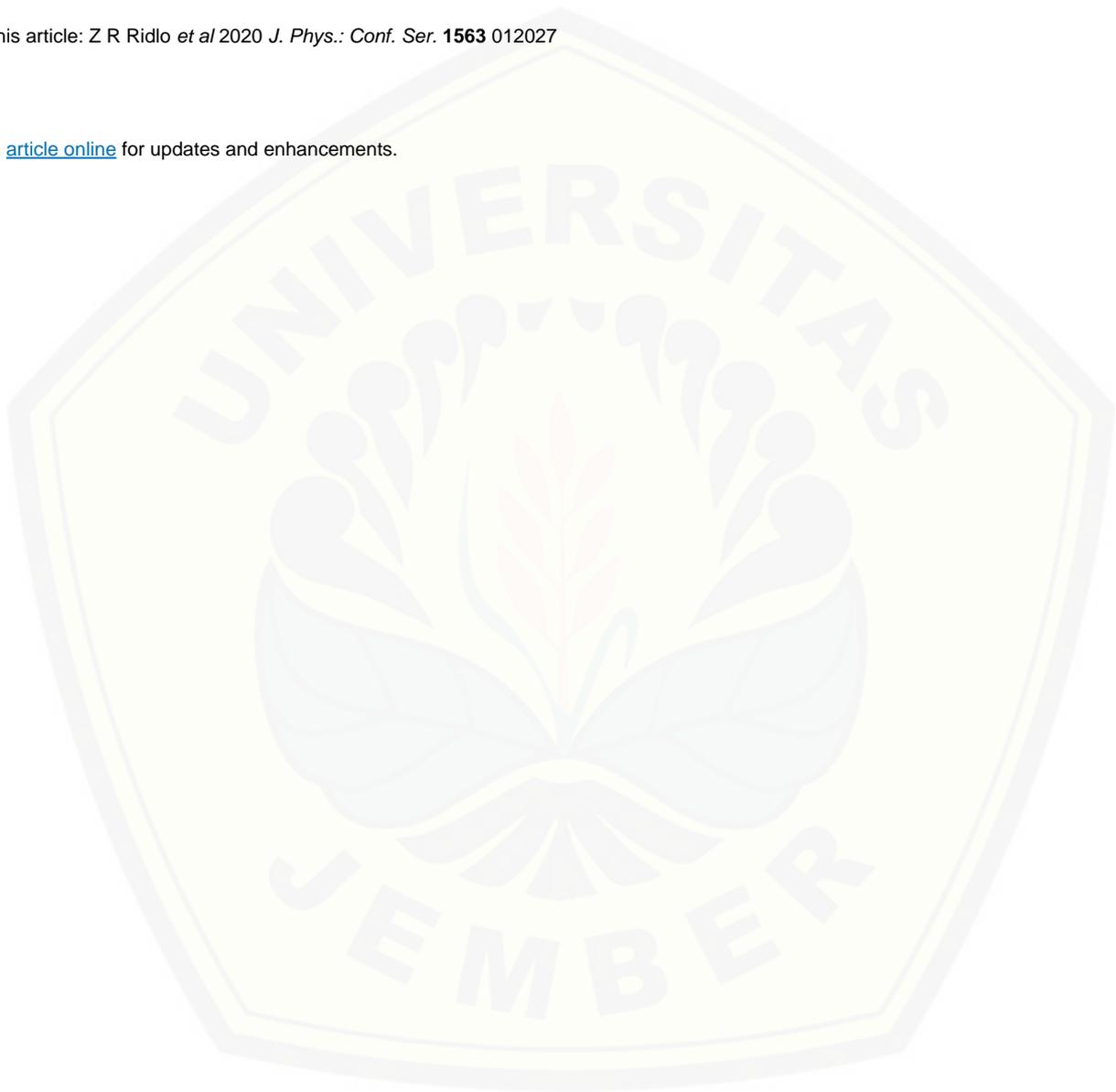


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Student profile multiple representations skills under the implementation of OBSIM (observation and simulation) model of teaching in improving creative thinking skills

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Abstract. The research aims to explore multiple representations under the implementation of the OBSIM model of teaching in the alternating-current circuit course. This research compares the modern class (experimental class) and traditional class with the traditional teaching style. Experiment class applies the OBSIM model of teaching, and Traditional Classroom teaches in traditional style with a direct explanation. Computer simulation also integrated into this research by using Matlab Software as part of multiple representations, namely programming representation. This research used triangulation methods. The quantitative methods were applied to analyze student achievement tests according to Creative thinking criteria. The Qualitative method was applied using observation of student activity. Student achievement test followed by a pretest, and post-test quasi-experimental research. The data analysis form pretest and posttest analysis indicates a significant value of 0.012 ($p \leq 0.05$). Thus, it is a significant value, and the average of student activity in experimental class better than control class. The findings conclude that two classes have differences in terms of student multiple representations and creative thinking skills after implementation of OBSIM model of teaching.

1. Introduction

Education as a long-term investment for the future to prepare students to be able to keep abreast of the times. Some thinking skills that must be possessed by someone in the industrial revolution era 4.0 include creative and innovative thinking skills and critical thinking skills [1]. Besides, the Education Content Standards also stated that one of the competencies developed in K-13 is critical and creative thinking skills. Creative thinking skills are a thought process that creates broad and diverse new ideas [2]. The characteristics of creative thinking include fluency thinking skills, flexibility thinking skills, original thinking skills, and detailed thinking skills (elaboration) [1]. Whereas, critical thinking skills



are a group of skills that include criteria, analysis, inference, and argumentation [3]. Besides, according to Dwijayanti & Yulianti [4], critical thinking is an activity of analyzing ideas more specifically, differentiating, choosing, identifying, studying, and developing them into more perfect ideas or ideas. Indicators of critical thinking are divided into six, including interpretation, analysis, evaluation, inference, explanation, and self-regulation [5].

The role of the teacher in the world of education is important to create a comfortable learning atmosphere for students. Good learning supports the realization of a good education as well [6]. Besides, prospective teachers must be equipped with sufficient teaching skills to be able to carry out professional learning in the class [7] and the ability to create a pleasant learning atmosphere [8]. The teacher, as a facilitator in learning, should be able to make learning more meaningful for students. Learning will be meaningful when students are actively involved in finding concepts from existing phenomena from the environment with the guidance of the teacher [9]. Also, the selection of appropriate and effective learning models is one way that teachers can guide students in understanding the concepts of learning [10–12]. Therefore, to create meaningful learning, a method or model of learning is needed that allows students to be active in learning.

Natural Sciences or science is one of the subjects not only in the form of a collection of knowledge but is related to how to find out about nature systematically so that it is also a process of discovery [13]. Science teachers ideally have the ability to scientific argumentation and can deliver science materials in various forms of representation (multiple representations) [14]. The multiple representations can help students overcome difficulties in working on essay questions [15]. Besides, students can be more effective and efficient in learning when they participate in reviewing the subject matter with multiple representations [16]. Multiple representations are a way to express a concept through a variety of ways and forms [17]. The ability to represent students is very important to be known or identified. Multiple representations show that student learning outcomes and student activities are better [18,19]. However, in reality, the problems by students in learning science are that teachers use mathematical representations more often than other representations [14]. Multiple representations can explore the reasons a person has in the form of diagram descriptions, graphs, and mathematics [19] and help students in problem-solving [20]. Besides, according to [21], one of the problems that often arise in learning science is the lack of active students in learning so that we need a supporter to trigger students' creative thinking skills, one of which is the method used by the teacher when teaching.

The Observation and Simulation Model (OBSIM) has five syntaxes including 1) modeling (teaching simulation by the teacher), 2) discussion (discussing the teaching simulation of the teacher), 3) enrichment (giving teaching material according to the topic exemplified in teaching modeling), 4) teaching practice (simulation by students), and 5). feedback and stabilization [7]. Based on this syntax, it allows students to try and develop their thinking. At the discussion stage, it allows students to give questions and ideas about what is obtained from the previous stage, namely modeling. This opportunity to raise questions and ideas can train students to think creatively. One indicator of creative thinking skills is students' curiosity about something that raises questions so that it will generate new ideas according to their perspective [22]. Also, critical thinking skills can be trained and developed by the teacher during learning by applying a learning model [23–25].

Creative thinking is one of the skills needed to develop in a society, so it is necessary to develop these skills as early as possible [27]. These creative thinking skills are useful for the future. Therefore they must have these skills [28]. Based on definition from Lucas creativity can be assessed based on five habits of creative thinking namely Inquisitive, Imaginative, Persistent, Collaborative, and Disciplined [29]. The creativity skills can make someone's life more enjoyable and valuable, the complex elements of society that require a person to be creative [16]. Another definition of creative thinking, it can involve several compounds, and the beginning of a problem then try to find a solution to the problem, then appear new ideas to solve the problem [17]. The conclusion from several definitions of creative thinking is High-level thinking skills need to be trained to prepare personalities

in the future[31]. Therefore, the implementation of the ObSim model with multi-representation skills is expected to improve students' creative thinking skills.

2. Methods

The purpose of this research to explore the profile of student multiple representation skills under the implementation of OBSIM model of teaching. The research also compares student achievement between traditional learning with learning using the OBSIM model in Alternating Current course. The methods are using qualitative and quantitative methods. Quantitative methods are used to analyze student achievement tests in solving problems related to Alternating current topics. Qualitative methods are used to analyze data from the results of observation conducted on students to find out their multiple representation skills. The independent variable of this research is the OBSIM learning model. The dependent variable is student learning outcomes and the profile of student multiple representation skills. After the student does the task, interviews were conducted with the experimental class to find out their opinions about the implementation of the OBSIM model integrated with computer programming activities. The research design uses two types composed of control classes and experimental classes selected by purposive random sampling and examined using a pre-test and post-test using the following design.

Table 1. Design of Research using Mix Methods

Group	Pre-test	Treatment	Post-test
Control Class n=29 Student (14 males and 26 females)	O_1	-	O_2
Experiment Class n=30 Student (8 males and 22 females)	O_3	X	O_4

O_1 & O_3 = both groups were examined using a pre-test in order to find out their thinking skills, which was expected to be at the same level.

O_2 = the post-test result of the control class.

O_4 = the post-test result of experiment class

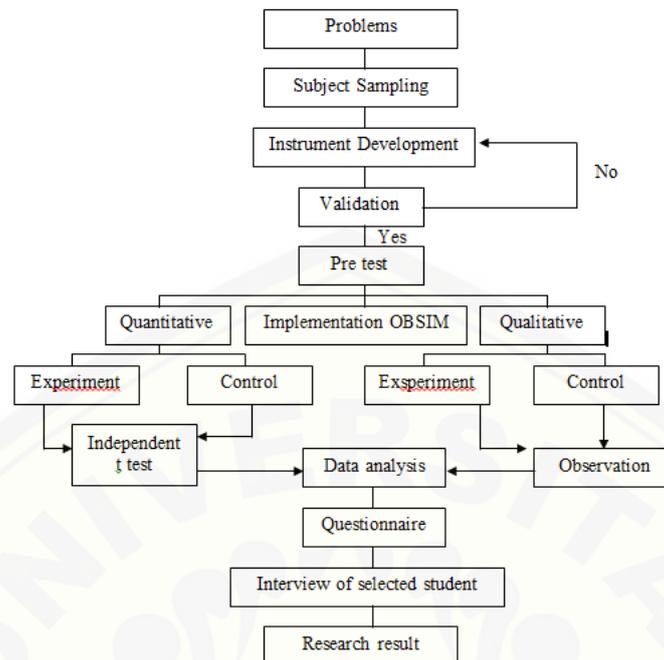


Figure 1. The model of the triangulation method

2.1 Population

In this study, the population used was fifth-semester students from the Natural Science Education Program, Faculty of teacher training, and education at the University of Jember. Next, class selection uses cluster sampling to randomly select two classes. The total number of students in this study was 59 students, with ages ranging from 19-21 years. There were 30 students in the experimental class consisting of 8 males and 22 females. In the control class, there were 29 students composed of 6 males and 23 females. Data is taken from September to December 2019.

2.2 Instrumen

The instruments used in this study were task, observation sheets, interviews, and questionnaires. Interviews and questionnaires were only given to the experimental class, which consisted of several question items. The observation of student activity sheets in both classes using a Likert scale from an interval of level 1 until 5. The instrument sheet was validated by the expert. After the student discusses the topic in the alternating current course, students should presentation the concept of electrical current and voltage in multiple representations.

3. Task

In this study, students were given assignments about alternating electrical circuits. It aims to determine students' critical thinking skills after the learning process under the implementation OBSIM model of teaching.

3.1 Alternating Current

The alternating current is an electrical current that expresses in sinusoid graphical representation because of electrical current and voltage change in the periodical system. The source of alternating current is from a generator, a simple device that converts mechanical energy into electrical energy. The schematics diagram of the alternating current generator shown in Figure 2. Parts of alternating current divided into two parts stator (static parts) and rotor (rotation parts).

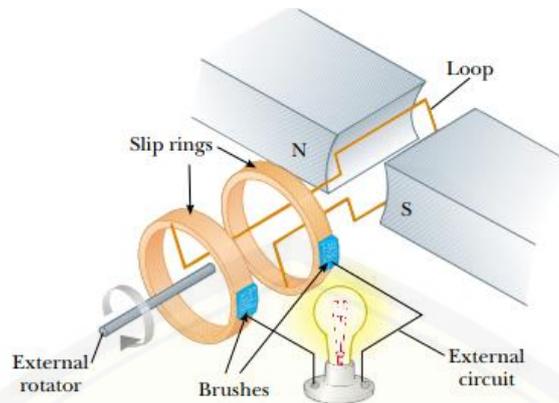


Figure 2. Schematics of alternating current generator [30]

An alternating current circuit consists of circuit elements and an AC generator that provides the alternating current and voltage. The basic principle of the ac generator is from Faraday’s law of induction. When a conducting loop is rotated in a magnetic field at constant ω as angular frequency $\omega = 2\pi f$, The voltage in alternating current express in the equation below

$$V = V_{max} \sin(\omega t)$$

The value of $\omega = 2\pi f$, which is f is the frequency of the generator (the voltage source), and T is the period. The generator determines the frequency of the current in any circuit connected to the generator. Because the output voltage of an ac generator varies sinusoidally with time, the voltage is positive during one half of the cycle and negative during the other half. Likewise, the current in any circuit driven by an ac generator is an alternating current that also varies sinusoidally with time shown in Figure 3. The Commercial electric power plants use a frequency of 60 Hz, which corresponds to an angular frequency of 377 rad/s with the value of voltage is 220-240 V.

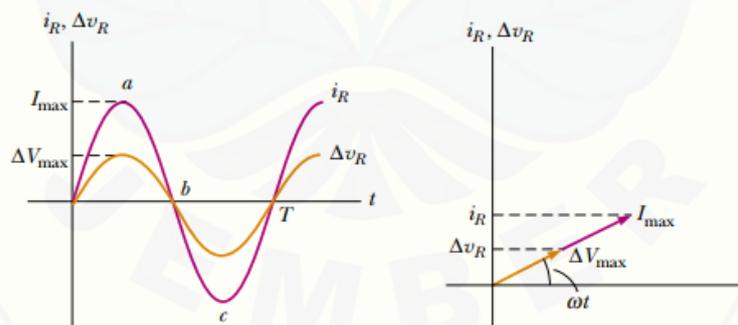


Figure 3. The sinusoid graphics of alternating current [30]

The computer programming in this section using Matlab software to making graphics of alternating current. The student should make mind mapping the relation between a concept in the alternating-current circuit course. The first step is to write the identity of the program, clear the M-File, write the algorithm, define the content, input the variable, and write the equation of voltage in alternating current, and the last steps plotting the graphics. The steps of the algorithm in the Matlab Program shown in Figure 4.

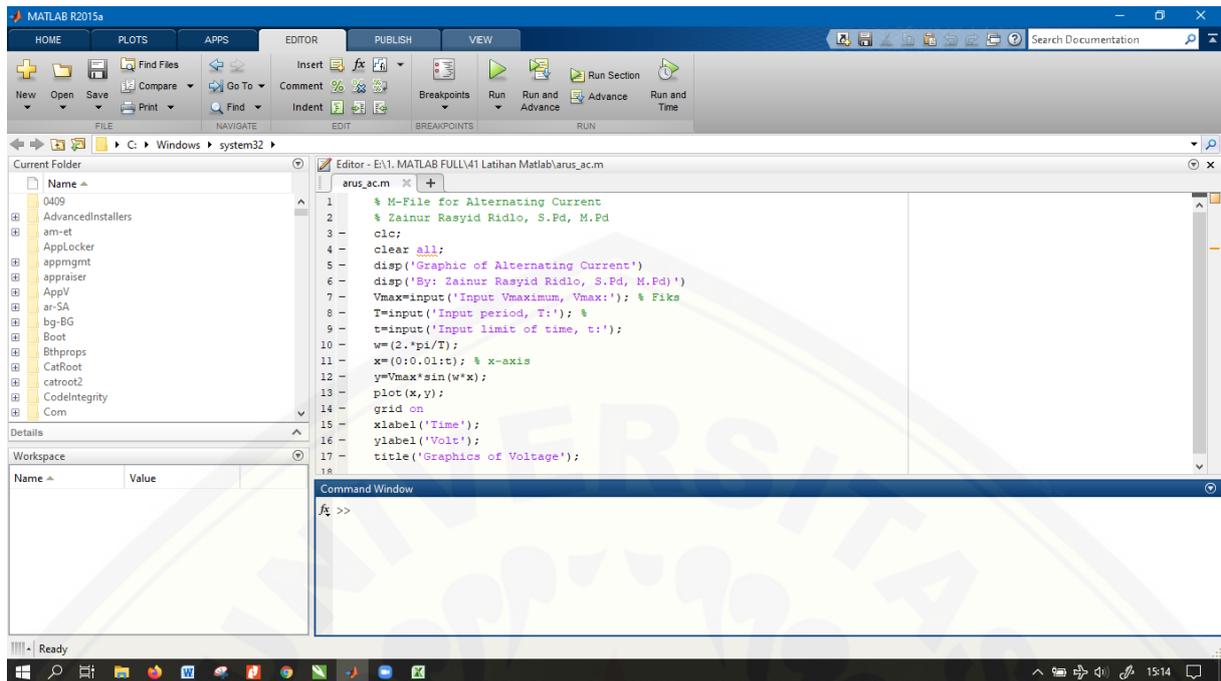


Figure 4. The Interface of Matlab Software

3.2 Multiple representation skills in alternating-current circuit course

The multiple representation skills in alternating current course related to four dimensions of skills, namely verbal representation, mathematics representation, programming representation, and graphical representation. The student activities under the implementation of OBSIM model in the fourth stage is teaching practice as teacher model to express alternating current material in multiple representations. Figure 5 explain about multiple representations in alternating current circuits course.

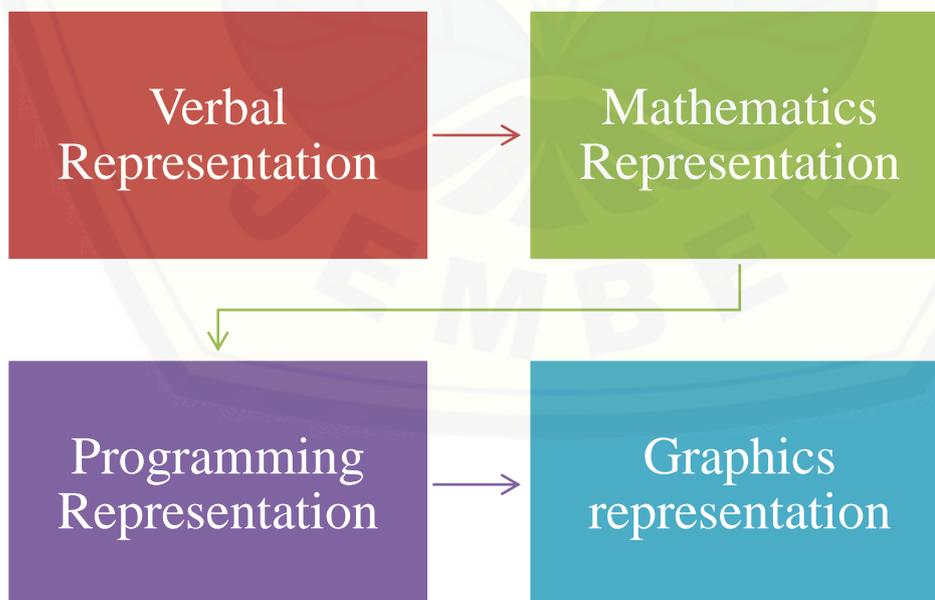


Figure 5. Expression of Multiple Representation in Alternating Current Course

The multiple representation skills in alternating current circuits course divided into four skills, verbal representation, mathematics representation, Programming Representation, and Graphics Representation. The explanation of multiple representations shows in Table 2 below.

Table 2. Multiple Representation Skills in Alternating Current Course

Representation	Student Activity	Output/Product
Verbal Representation	Explain the concept of alternating current	Information about the concept of alternating current
Mathematics Representation	Write the equation of voltage and electrical current	Equation of voltage and electrical current
Programming Representation	Creating M-File (Matlab Programming) of Alternating Current equation	M-File (Matlab File)
Graphics Representation	Checking the result from M-File	Graphics of electrical current and voltage

4. Result

The teaching and learning process gives the result of implementation OBSIM model of teaching in the Experiment class integrated with programming activities compares with the control class that using the traditional method, the analysis of student achievement test using an independent sample t-test. The result of the pre-test score from control compares with experiment class is a normal distribution, which means the class is homogenous. Further analysis is explained by statistic software (SPSS). The result of the Pre-test score indicates significant differences between the control class and experiment class, as seen in Table 3.

Table 3. The table display pre-test result and mean value control class and experiment class

Group	N	Mean	Std. Deviation	Std. Error Mean
Control Group	30	52.1333	10.03351	1.83186
Experiment Group	29	50.4828	10.26304	1.90580

The significance value serves as the basic information to analyze and get a decision from the data result. The significant value is set at 5 % or 0.05. The average achievement test in the control class is 52.13, with a Standart deviation of 10.03351, and the average achievement test in the experimental class is 50.48, with a standard deviation of 10.26304. The different mean of a control class and experimental class is not significant.

Table 4. The comparison of pre-test results and mean value control class and experiment class

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pre-Test Scores	Equal variance assumed	.056	.814	.625	57	.535	1.65057	2.64241	-3.64076	6.94
	Equal variance not assumed			.624	56.815	.535	1.65057	2.64344	-3.64320	6.94

The display of analysis from SPSS software shown in Table 4 about the pretest from the experimental class and control class. The result of the t-test indicates the value of significant (2-tailed) 0.535 with criteria of significant value is 0.05. According to the criteria of homogeneity, statistic means the two classes (control class and experiment class) are homogenous because of the value of sig (2-tailed) bigger than 0.05.

The result of the post-test also analyzed by using SPSS software. Table 5. displays a comparison between post-test results from the control class and experiment class. The mean from the control class reaches 73.2667 with a standard deviation value of 15.43380, while the mean of experiment class reaches 80.8655 with Standart Deviation value 4.17888. The information from Table 6 shows that there is a significant value between two classes indicated with the value of t in Levene's Test score - 2.595 and -2.634, according to the value of $p < 0.005$

Table 5. The table display post-test result and mean value control class and experiment class

Group	N	Mean	Std. Deviation	Std. Error Mean
Control Group	30	73.2667	15.43380	2.81781
Experiment Group	29	80.9655	4.17888	.77600

Table 6. The comparison of pre-test results and mean value control class and experiment class

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Post-Test Scores	Equal variance assumed	4.687	.035	-2.595	57	.012	-7.69885	2.96655	-13.63	-1.75
	Equal variance not assumed			-2.634	33.367	.013	-7.69885	2.92271	-13.64	-1.75

The information from Table 6. also shows the result of the independent sample t-test indicates a significant value of 0.012 ($p \leq 0.05$). Thus, it is a significant value. The findings conclude that two classes have differences in terms of student multiple representations and creative thinking skills test after implementation of OBSIM model of teaching. Figure 6 and Figure 7 express student profile multiple representation skills in control class and experiment class.

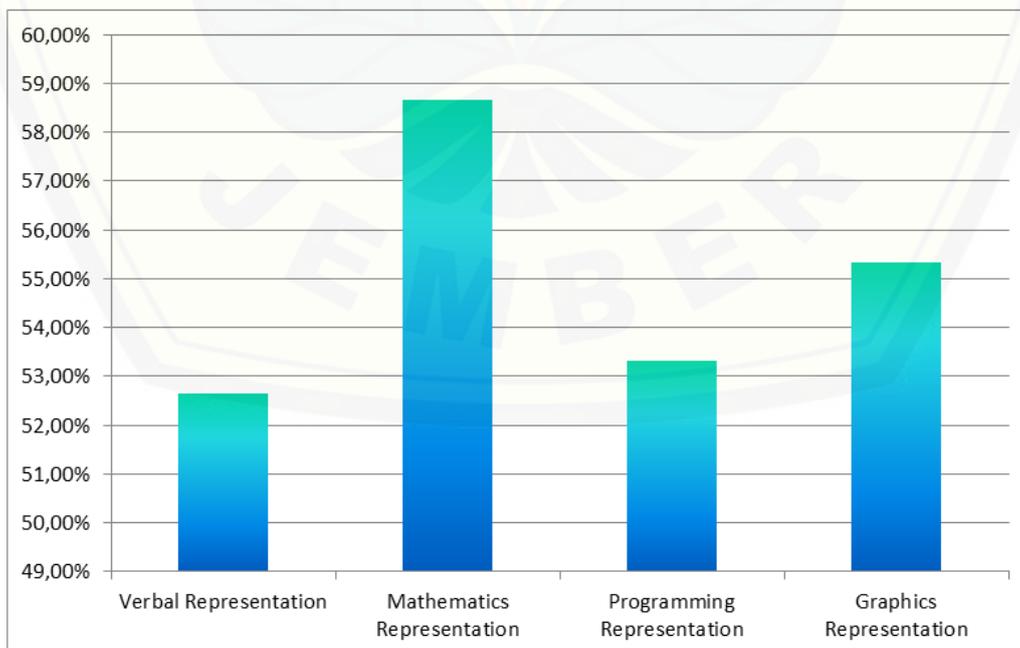


Figure 6. Student Profile Multiple Representation in Control Class

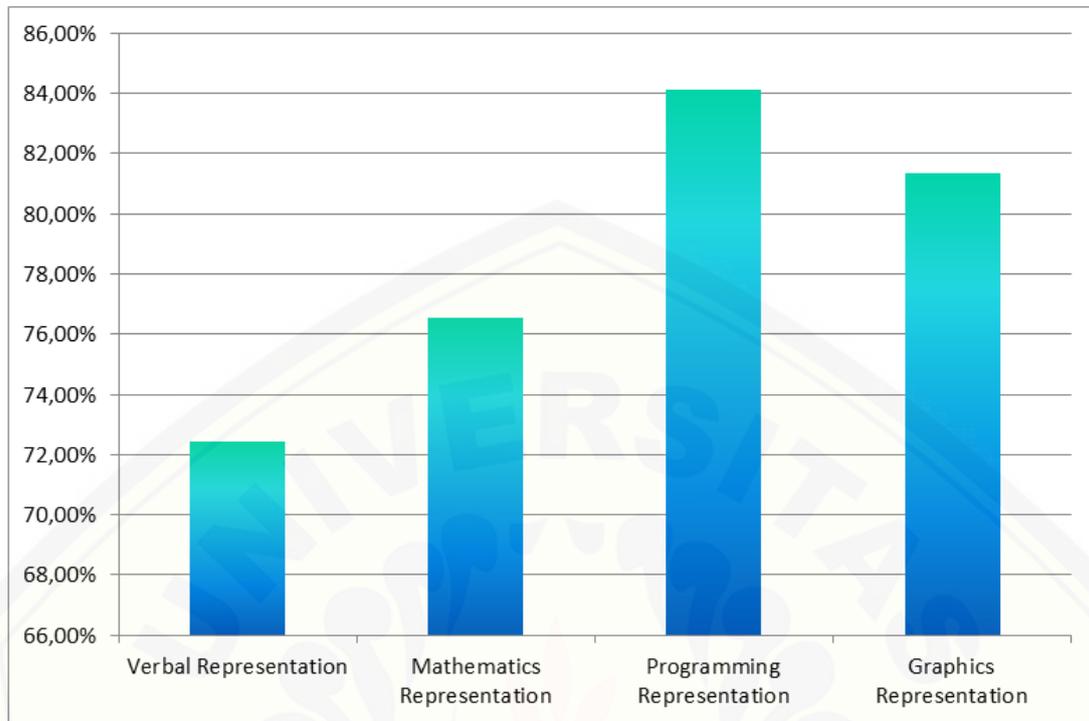


Figure 7. Student Profile Multiple Representation in Experiment Class

5. Discussion

The implementation of OBSIM model of teaching produces student profile multiple representations related to creative thinking skills. Table 3 shows the mean score from control class is 52.13 and the experiment class is 50.48 there is no significant value between both of score, but in post-test score in control class 73.26 and experiment class is 80.96 the different score between control class and experimental class is significant because in control class the teaching and learning are in traditional style with discussion and direct explanation. Experiment class, the teaching and learning process, using OBSIM model of teaching which contains five syntaxes including namely modeling (teaching simulation by the teacher), discussion (discussing the teaching simulation of the teacher), enrichment (giving teaching material according to the topic exemplified in teaching modeling), teaching practice (simulation by students), and feedback and stabilization.

Modeling steps are about teaching simulation by lecture, the activity in this section divided into two parts, lecture activity, and student activity. Lecture activity is explained about alternating current materials and how to write an algorithm in Matlab software. The student activity is collecting information related to this material and information about the Matlab algorithm. The second step is the discussion the student and teacher discuss teaching style related to several concepts in alternating current material, mathematics formulation, how to sketch graphics in alternating current, write the algorithm, and compare the mathematics formulation, sketch graphics from student and result from Matlab programming.

The third step in OBSIM model is enrichment, the lecture giving complete teaching material related to alternating current and Matlab material; for Matlab material, the lecture also shares the sample of M-File. The fourth step is teaching practice, the student simulated to teaching electrical current material start from a definition of alternating current and another related concept, write the equation of voltage, writing Matlab program, and also check the graphic result from matlab programming.

The last step of the OBSIM model is feedback and stabilization, teacher give feedback from student presentation in teaching activities related to content and multiple representation skills the average from each multiple representation skills explain in Figure 6 and Figure 7. The average of multiple representation skills in the control class is 55%, and the average multiple representation skills in the experimental class are 78%. At the end of the learning and teaching process, the teacher does the assessment for both class and analyze the result.

6. Conclusion

The implementation of OBSIM model can improving student multiple representations skills. It's shown because the post-test of the experimental class is bigger than the control class, and the score of student test in experimental class increased, and for the average of student multiple representation skills from the experimental class is bigger than the control class.

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