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Cognitive Learning Outcomes of Students in Physics Science Learning Through the Application of the *Rotating Trio Exchange* (RTE) Strategy in Class VII SMP Negeri 5 Pekanbaru

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ABSTRACT

This study aims to determine the differences in cognitive learning outcomes of physics students through the application of the *Rotating Trio Exchange* (RTE) learning strategy with conventional learning in grade VII SMP Negeri 5 Pekanbaru in the 2011/2012 academic year even semester on the subject matter of Motion. This study was conducted with a *Randomized Control Group Only Design research* design with a static design of two groups, namely the experimental class group and the control class group. The determination of the sample class was determined by normality test and homogeneity test, class VII3 became an experimental class by applying the *Rotating Trio Exchange* (RTE) learning strategy and class VII1 became a control class with conventional learning. The research instruments used are learning devices and data collection instruments. Data collection techniques are learning outcome tests conducted after the learning process. Data is analyzed through descriptive and inferential analysis. From the results of descriptive data analysis, the cognitive learning outcomes of Science Physics students in the experimental class were higher than the control class. From inferential analysis through manual calculation of the statistical value of the t test and through the SPSS 16 *Independent-Sample T Test* program , tcount = 1.996 while ttable = 2.0465. Based on the criteria for testing the tcalculate hypothesis < ttabel or (1.996 < 2.0465), so that there is no difference in the cognitive learning outcomes of Science Physics students in grade VII SMP Negeri 5 Pekanbaru who apply *the Rotating Trio Exchange* (RTE) learning strategy with classes that apply conventional learning.

Keywords: *Cognitive Learning Outcomes, Rotating Trio Exchange (RTE) Learning Strategies, Motion*

1 Introduction

Science education as a very important means for the material progress of a nation, has long been realized by all nations in this world. Perhaps there are no other subjects that receive so much attention from various parties as the attention given to science education, both in terms of philosophy, goals, content and methods of presentation (Irianti, 2006).

Physics is one branch of science and is a science that is born and developed through the steps of observation, formulation of hypothetical problems, hypothesis testing through experiments, drawing conclusions, and finding theories and concepts. It can be said that Physics is a science that studies symptoms through a series of processes known as scientific processes that are built on the basis of scientific attitudes and the results are realized as scientific products composed of three most important components in the form of concepts, principles and theories that apply universally (Trianto, 2010).

In teaching science, a teacher is required to be able to invite his students to use the environment as a learning resource. The environment is the most authentic source of learning and will not run out if used. In this case, science is seen as a process of human efforts to understand various natural phenomena. For this reason, a certain procedure is needed that is analytical, careful, complete and connects one natural

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phenomenon with another natural phenomenon so that the whole forms a new point of view about the object it observes (Irianti, 2006).

Science learning in particular is expected to provide knowledge (cognitive), which is the main goal of learning (Trianto, 2010). Cognitive goals oriented to the ability to think include simpler intellectual abilities to the ability to solve a problem (Zulhelmi, 2006). Science learning is also expected to provide skills (psychomotor), scientific attitude ability (affective), understanding, habits and appreciation in finding answers to a problem. Because these characteristics distinguish it from other learning (Trianto, 2010).

Education is the process of achieving pre-formulated goals. The purpose of education will determine in which direction the learner is taken. The curriculum as a tool to achieve goals must be adapted to educational goals. The objectives will be guidelines or benchmarks for all educational activities, material determination, methods, and evaluations that will be carried out. Thus, the purpose of education is one of the important factors in education (Baheram, 2009).

With the end of a learning process, students get a learning outcome. Learning outcomes are the result of an interaction between learning and teaching. From the teacher's side, the teaching action ends with the process of evaluating learning outcomes. From the student side, learning outcomes are the end of the part and the peak of the learning process (Dimyati and Mudjiono, 2006).

Based on information obtained by researchers from observations and interviews with physics teachers of SMP Negeri 5 Pekanbaru before conducting research, namely on February 15, 2012 on the learning outcomes of grade VII students in the even semester of the 2011/2012 academic year, problems were found about the low learning outcomes for Physics Science subjects where the cognitive learning outcomes of Physics students could not be said to be fully successful.

One of the causes of incomplete learning of Physics Science in schools is in the Physics learning process, the interaction that occurs is only interaction between teachers and students or in other words the teacher-centered learning process, while interaction between students and students does not occur. One of the causes of incomplete learning in schools is that the role of teachers in the classroom is more dominant than students.

Currently, there are still many teachers who use the lecture method in teaching and learning activities and the current learning system is still teacher centric, not student centric. Now is not the time for students to only receive information from the teacher but students must be given the widest possible opportunity to explore and find facts and evidence for themselves so that students understand more about what is being learned (Poniman, 2008). This teacher-dominated learning makes students passive and less participating. Students only hear and record the material delivered by the teacher.

Another reason for low student scores is because Physics lessons are closely related to mathematics. Weak mathematical abilities of students will automatically have difficulty in understanding Physics, because most of the solving of Physics problems is done through a mathematical approach. For example, on motion material.

Motion material is the subject matter in the Science Physics lesson in junior high school in accordance with the standard guidance of the 2006 curriculum content.

1. Competency Standards: Understanding natural phenomena through observation.
2. Basic Competencies : Analyze experimental data of regular straight motion and regular changing straight motion and their application in everyday life.

For this reason, it is very necessary to apply updates in Physics learning and teachers are required to use a learning strategy that is fun and can help students to be active and mentally involved and encourage students to be able to share their knowledge with others so that interaction between students and students can occur when the learning process and student motivation and learning outcomes become better. One learning strategy that fits the theory is the *Rotating Trio Exchange* (RTE) learning strategy.

In education, strategy is defined as a *plan, method or series of activities designed to achieve a particular educational goal* (J.R. David. 1976). Thus, learning strategies can be interpreted as planning that contains a series of activities designed to achieve certain educational goals (Sanjaya, 2010).

The *Rotating Trio Exchange* (RTE) strategy is one strategy that involves students in learning immediately (*immediate learning involvement strategies*). The *Rotating Trio Exchange* strategy is a technique of rotating the exchange of opinions of groups of three people, which is a way for students to discuss problems with three members. Rotating three-person group exchanges is a detailed way for students to discuss issues with some (and usually not all) of their classmates. This exchange of opinions can easily be directed to the material to be taught in class (Silberman, 2007).

The application of the technique of rotating the exchange of opinions of groups of three people is believed to increase student activeness in learning, because students are invited to think actively in solving problems from the teacher. This exchange of opinions is directed at the subject matter (basic competencies) to be taught in class (Ramadhan, 2009).

Through the use of this RTE learning strategy, students are expected to be able to exchange opinions with their classmates related to the subject matter being studied, both in the form of material that students do not understand, and in the form of questions related to the material that has been learned and share the knowledge of Physics they already have with other students. Thus, it can improve students' Physics learning activities and outcomes. The use of RTE learning strategies is also expected to bridge teachers to get to know the real conditions of students, both individuals and groups.

The problem that will be discussed in this study is whether there is a difference in the cognitive learning outcomes of Physics Science students in classes that use *Rotating Trio Exchange* (RTE) learning strategies with classes that use conventional learning?

This study aims to describe learning outcomes and determine the differences in cognitive learning outcomes of Science Physics grade VII students of SMP Negeri 5 Pekanbaru on Motion material through the application of *Rotating Trio Exchange* (RTE) learning strategies with classes that use conventional learning.

The research benefits to be achieved in this study are for students, learning physics through the application of *Rotating Trio Exchange* (RTE) learning strategies can improve student learning outcomes. For teachers, as an alternative or other option learning model to improve the quality of Physics Science learning in class VII SMP Negeri 5 Pekanbaru. For researchers, additional knowledge in an effort to increase knowledge and provision as prospective teachers.

In accordance with the formulation of the problem and the theoretical studies carried out, the hypotheses proposed are:

There are significant differences in the cognitive learning outcomes of students in physics science learning in grade VII SMP Negeri 5 Pekanbaru which applies the *Rotating Trio Exchange* (RTE) learning strategy with classes that apply conventional learning.

2 Research Methodology

This research was conducted in grade VII of SMP Negeri 5 Pekanbaru in the even semester of the 2011/2012 academic year. The research was conducted from April to May 2012. The population in this study was all grade VII students of SMP Negeri 5 Pekanbaru who were enrolled in the even semester of the 2010/2011 academic year totaling 7 classes. From the results of the draw, class VII was selected$_3$ As an experimental class that is treated with learning strategies *Rotating Trio Exchange* (RTE) and class VII1 as a control class with conventional learning.

Data were analyzed using descriptive analysis and inferential analysis. Descriptive analysis was conducted to review the condition of student learning outcomes after learning in experimental classes and control classes. The descriptive analysis intended in this study is used to provide an overview of student cognitive learning outcomes including absorption, learning effectiveness and learning completeness, namely student learning completeness and completeness of learning objectives. Inferential analysis was used to determine the significance of changes in the average learning outcomes index of classes after learning.

To see if there are differences in physics learning outcomes through the application of the *Rotating Trio Exchange* (RTE) strategy with conventional learning, a t test through SPSS version 16 and a manual t test is used, namely a t test for *separated variants* (inhomogeneous variants). This is because the data is included in the n1 ≠ n2 criteria and is not homogeneous. The t-test equation for *separated variants* is,

$$t = \frac{\bar{X}_1 \overline{-X}_2}{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}$$

Where: $\bar{X}_1$ = Average score of the experimental group
$\bar{X}_2$ = Average score of the control group
n1 = Number of experimental group students
n2 = Number of students in the control group
S12 = Variance of experimental class learning outcomes
S22 = Variance of control class learning outcomes (Sugiyono, 2011)

In this study using two research instruments, namely learning tools consisting of syllabus and assessment systems, RPP, LKS and quiz questions; and data collection instruments in the form of cognitive skills learning outcomes tests.

Data collection techniques in this study are test techniques / giving tests to experimental classes and control classes, where data is collected by providing learning outcome tests. The provision of this learning outcome test is carried out after learning through the application of the *Rotating Trio Exchange* (RTE) learning strategy.

3 Results and Discussion

3.1 Descriptive Analysis of Science Learning Outcomes Physics Students of Experimental Class and Control Class

Absorption and Effectiveness of Learning

The absorption of experimental class and control class students on the subject of Motion as in Table 1.

Table 1. Absorption and Effectiveness of Student Learning on the Subject of Motion

Subject Matter Description	Control Class			Experimental Class		
	Average (%)	Absorbency Category	Categories Effectiveness	Average (%)	Absorbency Category	Categories Effectiveness
Meeting I	75,55	Good	Effective	89,66	Very Good	Highly Effective
Meeting II	65	Good enough	Quite Effective	68,96	Good enough	Quite Effective
Meeting III	73,33	Good	Effective	80,17	Good	Effective
Meeting IV	65,83	Good enough	Quite Effective	75	Good	Effective
Average (%)	69,93	Good enough	Quite Effective	78,45	Good	Effective

Based on Table 1. It can be concluded that the average absorption of students and the effectiveness of learning on the subject of Motion in the experimental class is better than the control class.

Student Learning Completeness

Completeness of student learning outcomes on the subject of Motion in the control class and experimental class as in Table 2.

Table 2. Completeness of Student Learning on the Subject of Motion

Material Description	Student Learning Completeness					
	Control Class			Experimental Class		
	Complete (%)	Not Complete (%)	Category	Complete (%)	Not Complete (%)	Category
Meeting I	40 %	60%	Incomplete	68,96%	31,04%	Incomplete
Meeting II	56,67 %	43,33%	Incomplete	58,62%	41,38%	Incomplete
Meeting III	76,67 %	23,33%	Complete	86,21%	13,79%	Complete
Meeting IV	50 %	50%	Incomplete	75,86%	24,14%	Complete
Classical Completeness	36,67 %	63,33%	Incomplete	62,07%	37,93%	Incomplete

Table 2 shows that in the control class, the completeness of student learning was classically 36.67% with the category of incomplete. While in the experimental class, the completeness of student learning classically was 62.07% with the category of incomplete. From the large percentage of student learning completeness, it can be seen that students who master the subject matter in the experimental group are more than the control class even though both classes fall into the incomplete category because the classical completeness of the experimental class and the control class < 85%.

Completeness of Learning Objectives

The completeness of learning objectives on the subject of Motion can be seen in Table 3.

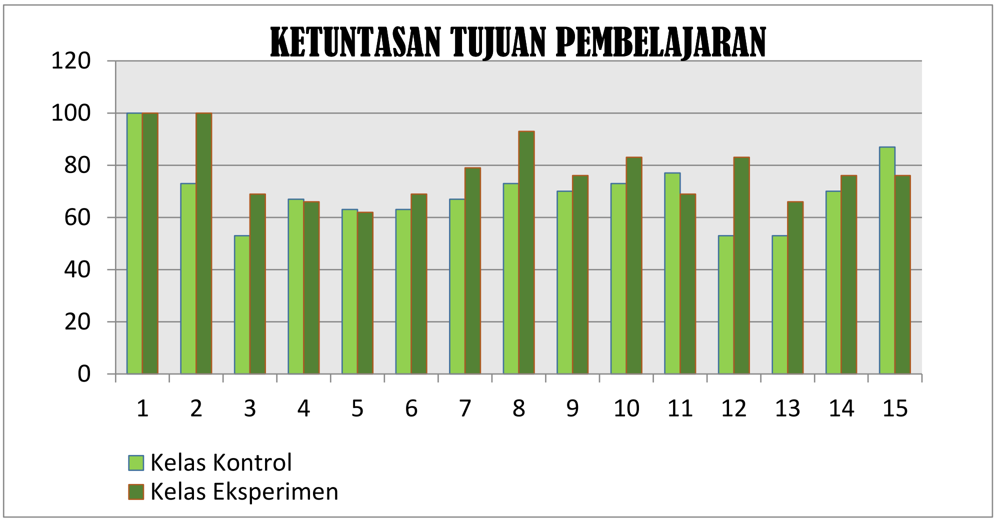
Table 3. Completeness of Learning on the Subject of Motion

No. TP	Student Learning Completeness					
	Control Class			Experimental Class		
	Sum student Complete	Completeness (%)	Category	Sum student Complete	Completeness (%)	Category
1	30	100	T	29	100	T
2	22	73	TT	29	100	T
3	16	53	TT	20	69	TT
4	20	67	TT	19	66	TT
5	19	63	TT	18	62	TT
6	19	63	TT	20	69	TT
7	20	67	TT	23	79	T
8	22	73	TT	27	93	T
9	21	70	TT	22	76	T
10	22	73	TT	24	83	T
11	23	77	T	20	69	TT
12	16	53	TT	24	83	T
13	16	53	TT	19	66	TT
14	21	70	TT	22	76	T
15	26	87	T	22	76	T
Completeness Subject Matter		**20**	**TT**		**60**	**TT**

Ket : T = Complete, TT = Incomplete

From Table 3, it is known that the completeness of learning materials in the experimental class is 60% with the number of completed TP is 9 TP and incomplete TP is 6 TP. While in the dick class, the completeness of TP is 20% with the number of completed TP is 3 TP and incomplete is 12 TP. Learning materials in both classes are declared incomplete because the percentage of completeness of the learning material obtained does not meet the criteria, namely complete if the percentage of completeness of learning material ≥ 85%. However, the completeness of the learning material in the experimental class is better than the control class.

The difference in the completeness of learning objectives in the control and experimental classes can be seen in the graph below.



Picture 1 : Control Class and Experiment Class Learning Objectives Completion Graph

3.2 Inferential Analysis of Science Learning Outcomes Physics Students of Experimental Class and Control Class

After obtaining the learning outcome test data, a normality test was carried out using SPSS 16 with the criteria used, namely if the skewnes ratio is between -2 to 2, then the data distribution is normal. In the experimental class, a comparison between *skewness and* standard error of skewness *was obtained which was -0.737 (-2<-0.737<2) so that the experimental class data was* normally distributed. As for the control class, the comparison between *skewness and* standard error of skewness *is -0.705 (-2<-0.705<2), the control class data is* normally distributed.

The homogeneity test of the variance of the experimental class and the control class is carried out with the F test i.e.,

$$F_{hitung} = \frac{S_1^2}{S_2^2} = \frac{8{,}048569}{3{,}090564} = 2{,}6042$$

At a significance of 0.05 based on the distribution table F obtained the value of Ftable = 1.8752. Based on the homogeneity testing criteria, it turns out that Fcalculate > Ftable (2.6042 > 1.8752). Thus it can be said that the experimental class variant and the control class variant are not homogeneous. So that the hypothesis test (t test) is carried out using the t-test *separated variant formula.*

From the calculation results using the *t-test separated variant* formula and using the SPSS 16 program, the calculation results of the t test were obtained, namely tcalculate = 1.996. The value of ttable for the significance level of 95% obtained ttable = 2.0465. Based on the test criteria for the t value, the results of t $_{\text{are calculated}}$ < ttable or (1.996 < 2.0465), so that based on the comparison of the t value, Ho is accepted. Thus, it can be concluded that there is no significant difference in the cognitive learning outcomes of physics students in grade VII SMP Negeri 5 Pekanbaru who apply *the Rotating Trio Exchange* (RTE) learning strategy with classes that apply conventional learning.

In general, learning through the application of *Rotating Trio Exchange* (RTE) learning strategies when compared to conventional learning is better and more effective. After being observed, there are several things that affect the course of research through the application of the *Rotating Trio Exchange* (RTE) learning strategy with conventional learning, including:

Time Management that has not been maximized

The learning process through the application of the Rotating Trio Exchange *(RTE) learning strategy* takes more time than conventional learning because students must follow the RTE procedure by exchanging group members. This causes a lack of explanation and varied questions related to the subject of Gerak so that students still rely on what is learned with their respective trio groups and through notes so that the learning results are still not optimal.

Students are not yet familiar with the application of the ***Rotating Trio Exchange (RTE) learning strategy***

In the experimental class, there are still students who are incomplete because students are still awkward with the application of the *Rotating Trio Exchange* (RTE) learning strategy. Students who usually directly receive learning material from the teacher, are required to be more active in learning activities. Students still look awkward because they very rarely work in groups, especially in the form of exchanging group members on every new problem given by the teacher to solve and understand. This certainly makes students need to adapt to new groups continuously in every change of problems given by the teacher.

Students do not understand counting problems in the form of story questions

In the concept of calculation, students are accustomed to receiving directly the concept of formulas and answers from the teacher without knowing the calculation processes so that when given questions containing the concept of calculation in this case in the form of story questions (both questions on LKS, exercises, quizzes and test questions) students during learning through the application of the *Rotating Trio Exchange* learning strategy(RTE) took a long time to discuss with their respective trio groups and still needed guidance in resolving them

4 Conclusion

Based on descriptive and inferential analysis of research data that has been carried out by applying the *Rotating Trio Exchange* (RTE) learning strategy in learning Physics science on the subject of Motion in grade VII students of SMP Negeri 5 Pekanbaru, the following conclusions were obtained: average absorption of students, learning effectiveness and completeness of student learning on the subject of Motion in the experimental class is better than the control class. Based on hypothesis testing conducted with a 95% confidence level obtained tcount: 1.966 and ttable: 2.0465 (tcount < ttable), Ho was accepted, namely there was no significant difference in the cognitive learning outcomes of physics students in grade VII SMP Negeri 5 Pekanbaru who applied *the Rotating Trio Exchange* (RTE) learning strategy with classes that applied conventional learning.

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