Learning RTE to Increase Learning Result of Chemical Bonds in Senior High School

Hasnah1, Herdini2, and Miharty3*  

1Mahasiswa Magister Pendidikan Kimia Fakultas Keguruan dan Ilmu Pendidikan, Universitas Riau  
2,3Fakultas Keguruan dan Ilmu Pendidikan, Universitas Riau

hasnah230692@gmail.com, herdinimunir@yahoo.co.id, Miharty.19@gmail.com

*Corresponding Author  
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Abstract: The research about Rotating Trio Exchange (RTE) learning has been done to improve student study result on the subject of chemical bonds in class of X Science, Senior High School of Bangkinang. The research is from experimental research with pretest-posttest design. Samples consist of two classes i.e. class X Science1 as the experimental class and class X Science2 as the control class of randomly chosen after the normality test and homogeneity test. Experimental class is a class that treated by applying RTE, while the control class without applying RTE. Data analysis technique uses the t-test. Based on the results of data process by using t-test formula we obtain ttest>tabel (1.92>1.67). It means that the applications of cooperative learning RTE can improve student study result on the subject of chemical bonds in class of X Science, Senior High School of Bangkinang with effect of 5.45%.

Keywords: learning (RTE); Study Result; Chemical Bonds.

1. Introduction

Learning is a process of behavior change and experience of practice. This means that the purpose of the activity is a change in behavior, both regarding the knowledge, attitude skills, even covering all aspects of the organism or personal [7].

Learning is a process containing a series of actions of teachers and students on the basis of reciprocal relationships that take place in educational situations to achieve certain goals which is a major requirement for the ongoing learning process. Interaction happens to have broad meaning that is educative interaction, interpreted as an activity of interaction between lecturers who carry out teaching tasks with studying citizens who are carrying out learning activities [4].

Any teaching and learning activities will result in learning achievement. Irawan (2012) learning achievement is a result achieved by someone in the mastery of knowledge and skills developed in the lesson, usually indicated by the test the value scores provided by the teacher [10]. Each subject given in the school contributes to building the knowledge and skills of the students that are needed later, not least the chemistry lesson.

In the academic year 2014/2015, the Ministry of Education and Culture began to implement the 2013 curriculum throughout the level of educational units in Indonesia. In the implementation of the 2013 curriculum prioritizes 3 aspects, namely: knowledge, attitude, and skills. Skill or skill is a new aspect in the curriculum in Indonesia, skills or skills such as the ability to express opinions, discuss or deliberate, make reports and presentations. Application of curriculum 2013 students are required to be active during the learning process and student-centered learning with the application of scientific approach.

Chemistry as part of science is concerned with how to figure out and understand nature systematically. A teacher studying chemistry requires not only skill, but also a thought process for
understanding, discovering, developing concepts, theories and laws and solving problems in everyday life. Subjects in chemistry are not only memorized, but also the understanding, analysis and ability of students to link learning to everyday life. One of the materials studied in chemistry learning is chemical bonding. Chemical bonding is the basis of chemistry learning.

The results of interviews from chemistry teachers obtained information in SMA Negeri 1 Bangkinang Kota that one of the material that is difficult to understand by students is the subject of chemical bonding, as evidenced from the average value of replication of the subject matter in the academic year 2013/2014 which is 67, where the standard average -the highest grade of the SMA Negeri 1 Bangkinang Kota is 75. The low student value on the subject of chemical bond is caused because the students are less actively involved in the learning process. Teachers do use the method used in explaining chemical bonding material with the method of discussion, questioning and assignment but the results have not been satisfactory. Therefore, the cooperative learning model of Rotating Trio Exchange (RTE) can make students more active and make learning fun.

Student achievement can be achieved maximally if in the learning process teachers use the right way of learning. The application of learning model that able to overcome the problem of students' learning activity is using cooperative learning model, one of them is Rotating Trio Exchange (RTE) model. Implementation of RTE model will prevent students from boredom and boredom, because in RTE model students are required to rotate or rotate and move so that students keep moving so as not to feel bored and also will not be sleepy.

Students will also consciously participate actively in the discussion because they can not only rely on a group of friends who are smart in learning, they must understand the learning materials because the model of this RTE students will make a presentation of the results of the representation of a member of a group designated by the teacher, then every student must understand and understand with their findings during the discussion. In addition, student learning motivation also arises because in the RTE model held group awards, this reward becomes a motivation that fosters the desire of students to excel during the learning.

Application of Rotating Trio Exchange cooperative learning model is considered effective enough to improve student achievement. As Arifin's (2011) research has done by applying Rotating Trio Exchange (RTE) cooperative learning model on Physics subject of Kalor, it can improve students' learning outcomes [11]. Desfarita (2013) by applying Rotating Trio Exchange (RTE) cooperative learning model on Chemistry subject of Hydrocarbon subject, can improve student achievement by 5.50%. Based on the above description, conducted research on cooperative learning model with Rotating Trio Exchange type in chemistry learning process with a research proposal entitled: RTE Learning to improve learning result of chemical bond in SMA.

2. Related Works

Gagne in Suprijono (2009), learning is a change in ability achieved through activity [29]. Changes in the ability is not obtained directly from the process of a person's growth naturally. Slameto (2003) states that learning is a process by which a person undertakes to gain a whole new behavioral change as a result of his own experience in interaction with the environment [22]. Learning will produce a learning achievement. Irawan (2012) learning achievement is a result achieved in the mastery of knowledge and skills developed in the lesson [10]. It is usually shown by the teacher's grade score test. Djamarah (1994) said that learning achievement is the result obtained in the form of impressions that result in changes in the individual as a result of activity in learning [6].

Slameto (2003) states that the factors that affect student achievement, among others [22]:

a. Internal factors of students. The internal factors of the students are the factors that come from within the students themselves, covering the physiological aspects (student's physical condition), psychological aspects (aspects of intelligence, talent, interest and student motivation) and fatigue factors (physical fatigue and spiritual fatigue).

b. External factors of students. External factors are factors that come from outside the student self, such as family, school environment, learning tools, strategies, methods and learning models. Efficient learning can be achieved if you can use the right learning model. Learning models are needed to achieve maximum results.
Learning model is one of the factors that influence learning achievement. A teacher must apply the appropriate learning model, which can enable the students as a whole, so that the expected competencies can be achieved and the learning outcomes can be improved. This is in line with the new curriculum learning objectives of the 2013 curriculum.

In the learning process, the teacher acts as a mentor, the teacher must give motivation and motivation, so that conducive interaction process occurs, how to teach the teacher must be effective and understood by the students in using the model, technique or teaching method that will be delivered to the students the process of learning and adapted to the concept that is taught based on the needs of students in the learning process [3].

Sulistyowati (2009) stated that cooperative learning comes from two cooperative words which means doing something together with each other helping each other as a team of teams [28]. Cooperative learning is a learning model that is currently widely used to realize student-centered learning activities (student oriented). Cooperative learning believes that the success of learners will be achieved if each member of his group is successful. Groups are made small, usually consisting of three to five people so that interaction between group members becomes maximal and effective.

Trianto (2007) stated that the aim of group formation in cooperative learning is to give opportunity to all students to be actively involved in the process of thinking and learning activities [31]. During work in groups, the task of group members is to achieve the completeness of the material presented by the teacher and help each other's friends to achieve mastery in the learning process.

Slavin (2009) says that in order to achieve the goals to be achieved, group members must help their group's friends to make their group successful and more importantly encourage members of one group to do the maximum effort [23].

Roger and David Johnson in Lie (2004) stated that not all group work can be considered cooperative learning [13]. There are five elements that must be applied, namely:

1. Positive interdependence. The success of a work depends heavily on the efforts of each of its members, to create an effective working group, the teacher needs to arrange tasks such that each member of the group must complete its own tasks so that others can achieve their goals. Each student gets their own value and the value of the group. The group value is formed from the contribution of each member.

2. Individual responsibility. If the tasks and scoring patterns are conducted according to the cooperative learning model procedure, each student will be responsible for doing the best. The key to the success of group methods is the preparation of teachers in the preparation of their duties.

3. Face to face. Each group should be given the opportunity to meet face to face and discuss. This interaction activity will provide a synergy that benefits all members. The essence of synergy is to appreciate the differences, take advantage of the advantages, fill in the respective deficiencies.

4. Communication between members. Communication between members requires learners equipped with various communication skills. Not every student has the skills to listen and speak. The success of a group also depends on the willingness of its members to listen to each other and their ability to express their opinions.

5. Evaluate group process. Teachers need to schedule specific times for the group to evaluate the group work process and the results of their collaboration in order to further cooperate more effectively. Isjoni (2009) who proposed the purpose of applying the learning model is that students can learn in groups with their friends by mutual respect for opinions and provide opportunities to others to express their ideas by sharing their opinions in groups [11].

3. Material & Methodology

This research is an experimental research conducted on two classes. The experimental class uses the Rotating Trio Exchange co-operative learning, while the control class does not use the Rotating Trio Exchange (RTE) cooperative learning.

Before the treatment, both classes were given pretest on the material to be taught i.e. chemical bonds. After the treatment is given posttest with the number of questions and the same time with pretest. The difference between the posttest and pretest results between the control class and the experimental class is the data to be used to see improvement in student learning achievement after
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treatment. The research design used is the Randomized Control Pretest-Posttest Group design which
can be seen in Table 1 [18].

<table>
<thead>
<tr>
<th>Table 1. Research Design</th>
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<tbody>
<tr>
<td>Class</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Experiment</td>
</tr>
<tr>
<td>Control</td>
</tr>
</tbody>
</table>

Where:
T₀: Initial data (data before treatment), taken from the pretest grade of the experimental class and the
control class
X: The treatment of the experimental class with the application of cooperative learning Rotating Trio
Exchange (RTÉ)
T₁: The final data (data after treatment), is taken from the posttest grade of the experimental class and the
control class.

The steps of implementation of this research are as follows:
1. Stage of preparation
   a. Choose the subject that will be studied by applying the cooperative learning model Rotating
      Trio Exchange (RTÉ), which is the subject of chemical bond.
   b. Preparation of research tools that include learning tools in the form of syllabus, Learning
      Implementation Plan (RPP), Student Worksheet (LKS), about evaluation.
   c. Preparing the symbols 0, 1, 2 as a medium in the cooperative learning model Rotating Trio
      Exchange.
   d. Establish a group of students for the experimental class and control class, the number of group
      members consists of 3-4 people. The established groups are academically heterogeneous. This
      heterogeneous group is seen from the test value of prerequisite materials.
2. Implementation stage
   a. Define control and experiment classes
   b. Group students into small groups of 3-4 people in the experimental class and control class
   c. In the experimental class and control class is given pretest.
   d. In the experimental class, after being given pretest results the teacher explains to the students
      the cooperative learning model Rotating Trio Exchange.
   e. Furthermore, in the experimental class is given the treatment of cooperative learning model
      Rotating Trio Exchange, while the control class is given treatment without the cooperative
      learning model Rotating Trio Exchange.
3. Stage reporting
   a. Analyze the data obtained by using statistical formula to test the hypothesis.
   b. Report the results of research in the form of a thesis

The population is the whole subject of the study. The population in this study is all students of
class X MIA SMA Negeri 1 Bangkinang City. The sample in this research is two classes that have the
same ability level. The sample is selected after normality test and homogeneity test of prerequisite
material test value in all population. The prerequisite material test contains the atomic structure and
the periodic system of elements. After two normally distributed classes have a homogeneous ability,
the two classes will be drawn to determine the experimental class and control class.

The instruments in this study are:
1. Data
   The study used primary data that is data obtained directly from the source. Primary data in the
study were obtained from:
   a. The results of the prerequisite material test
   b. The result of pretest / posttest
2. Data collection instruments
   a. Problem test of prerequisite materials
b. About pretest / posttest.

3. Learning Tool
   a. Syllabus
   b. Lesson plan
   c. Student Worksheet group discussion method.
   d. Evaluation Sheet
   e. Package Book

   Technique used to collect data in this research is test technique. The data collected were obtained from:
   1. Homogeneity test (atomic structure and elemental periodic system) used for homogeneity test.
   2. Pretest is done in both classes before entering the subject of chemical bond and before being treated. Giving pretest aims to determine the basic ability of students on the subject of chemical bonds, which will be used for data processing.
   3. Posttest is given to both classes after completion of the subject of chemical bonding throughout the treatment process is given. The question of the given posttest is the same as the pretest question. The posttest and pretest value differences of the two classes were used to determine the improvement of student achievement given treatment with the Rotating Trio Exchange cooperative learning model, and without the cooperative learning model of the Rotating Trio Exchange.

Data analysis technique

Prerequisite Analysis:

1. Normality test
   The first rarity in the study is the normality test to see whether data is normally distributed or not. Preliminary data in this study were tested for normality using Lilliefors normality test with hypothesis formulation:
   \[ H_0: f(X) = \text{normal} \]
   With the test criteria (\( \alpha = 0.05 \)):
   Accept \( H_0 \) if \( L_{max} \leq L_{\text{table}} \)
   Rare tests of Lilliefors normality:
   1) Compile student value data from the smallest to the largest (\( X_i \))
   2) Filling the frequency column according to the data distribution of student value (\( f \))
   3) Cumulative frequency (\( F = f \))
   4) \( F_z = \) the cumulative frequency ratio (\( F \)) to the number of samples (\( n \))
   5) Calculate the \( Z \) score with the formula, \( Z = \) where is the average value of the group and \( S_d \) is the standard deviation
   6) Determine the area of scores \( Z \) table (\( P \leq Z \)) from each score score \( Z \)
   7) Determine the price of L calculate the formulation of the difference between \( F_z \) and \( Z \) score area
   After the data is entered it will be obtained \( L_{\text{max}} \) count price will be compared with \( L_{\text{table}} \) price, where \( L_{\text{table}} \) price obtained by formulation [1].

2. Homogeneity test
   The homogeneity test is intended to show that both groups of samples are from populations of the same variance. The data used for homogeneity test in this study is data obtained from the test value of prerequisite materials ie atomic structure and elemental periodic system.
   The test hypothesis is as follows:
   \[ H_0: \sigma_1^2 = \sigma_2^2 \]
   (meaning the sample variance 1 equals the sample variance 2 or can be said both homogeneous variance)
   To calculate the variance of each sample we use formula:
   \[ S_1^2 = \frac{n_1 \sum F(X_1)^2 - (\sum F(X_1))^2}{n_1(n_1-1)} \]  \hspace{1cm} (1)
   \[ S_2^2 = \frac{n_2 \sum F(X_2)^2 - (\sum F(X_2))^2}{n_2(n_2-1)} \]  \hspace{1cm} (2)
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Testing homogeneity of variance using F test with formula:

Test Criteria H0 accepted if F arithmetic < F table, then the sample is said to have the same or homogeneous variance. To test the equality of two averages of each sample used the formula:

\[ t = \frac{\overline{x}_1 - \overline{x}_2}{S_g \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \quad \text{where} \quad S_g^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} \]  

(3)

3. Hypothesis Testing

Hypothesis testing is done by using the t-test formula to see the comparison between experiment class and control class values. The t-test used is the right-t test with the probability criterion (1-\( \alpha \)), with the test hypothesis.

H1: \( \mu > \mu_0 \)

(meaning improvement of student achievement by using cooperative learning model Rotating Trio Exchange bigger than improvement student achievement without the application of cooperative learning model Rotating Trio Exchange).

The t-test is also used to see the comparison between the experimental learning achievement of the experimental group and the control group. The t-test used is the right-t test with the probability criterion (1-\( \alpha \)), the formula used is as follows:

\[ t = \frac{\overline{x}_1 - \overline{x}_2}{S_g \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \quad \text{where} \quad S_g^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} \]  

(4)

Testing criteria H0 accepted if \( t_{\text{hitung}} > t_{\text{table}} \) with \( df = n_1 + n_2 - 2 \) with \( \alpha = 0.05 \). For another price t degree the hypothesis is rejected [25].

Determination of the increase in student’s chemical learning achievement is done with the coefficient of determination (Kp) obtained by the formula:

\[ t = \frac{r \sqrt{n-2}}{\sqrt{1-r^2}} \quad \text{thus becoming} \quad r^2 = \frac{t^2}{t^2 + n-2} \]  

(5)

\[ Kp = r^2 \times 100\% \]

4. Results and Discussion

The analysis result of research data described are normality test data, test data homogeneity, hypothesis test data and results of improved analysis of learning achievement. Data processing of the assessment results are as follows:

1. Data Homogeneity Test

The data treated using the t-test should be normally distributed first. Therefore, before analyzing the data is done normality test. The result of normality test data analysis is needed to see whether the data obtained has normal distribution. Testing statistics can be done based on the criteria that the data is processed normal distribution. The test is performed on prerequisite material test data, pretest and posttest data.

a. Results of Testing Data Processing

Prerequisite material test data were known to be normally distributed after normality test with Lilliefors in sample 1 and sample 2, but in sample 3, sample 4, sample 5, sample 6, prerequisite material test data were not normally distributed. The results of data processing normality test for homogeneity can be seen in Table 2.

\[
\text{Table 2. Result of Testing Data Processing}
\]

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>( \overline{X} )</th>
<th>S</th>
<th>L_{\text{maks}}</th>
<th>L_{\text{abel}}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampel 1</td>
<td>34</td>
<td>71.2941</td>
<td>9.6217</td>
<td>0.1506</td>
<td>0.1519</td>
</tr>
<tr>
<td>Sampel 2</td>
<td>32</td>
<td>71.125</td>
<td>9.7839</td>
<td>0.1079</td>
<td>0.1566</td>
</tr>
</tbody>
</table>

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b. Normality of Difference between Pretest and Posttest Value (see Table 3)

<table>
<thead>
<tr>
<th>Table 3. Data Experimental Class and Control Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Pretest</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Posttest</td>
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</tr>
</tbody>
</table>

From Table 3 it can be seen that the experimental class and control class have $L_{maks} < L_{tabl}$. This shows that both groups of samples are normally distributed.

2. Homogeneity Test
Furthermore the test data of prerequisite materials that have been tested for normality, tested homogeneity. From the result of normality test of prerequisite material can be seen that the normal distributed class that is sample 1 and sample 2 so homogeneity test only done for both group of sample. The prerequisite material test data from the two sample groups first tested the variance and then tested the two-party average equations to determine the homogeneity of the two classes. The data to be tested for homogeneity must have a homogeneous variance. The results of homogeneity test analysis can be seen in Table 4.

| Table 4. Results of Data Analysis Test Homogeneity Second Sample Group |
|-----------------------------|--------|--------|--------|--------|----------|----------|
| Grup            | $N$   | $\sum X$ | $\bar{X}$ | $F_{tabl}$ | $F_{hitung}$ | $t_{tabl}$ | $t_{hitung}$ |
| Sampel 1        | 34    | 2424   | 71.2941 | 1.72   | 1.0168  | 2.00      | 0.0702       |
| Sampel 2        | 32    | 2276   | 71.125  |        |             |           |              |

From Table 4 it can be seen that the acquisition of $F_{count}$ is 1.0168 and $F_{table}$ is 1.72 with chance $\alpha = 0.05$ and $dk = 64$ means $F_{hitung} < F_{table}$ (1.0168 < 1.72). This shows that both groups of samples have the same variance. To know the average equality of the two samples is continued with the two-$t$ test. From Table 4 it can be seen that $t_{hitung}$ and $t_{table}$ on probability $t_{0.975}$ with $dk = 64$ is 2.00, mean $t_{hitung}$ value lies between $-t_{table}$ and $t_{table}$ (-2.00 < 0.0702 < 2.00). This shows that sample 1 has the same ability as sample 2 or it can be said both homogeneous samples.

3. Hypothesis Testing
Hypothesis test is done to find out whether the hypothesis accepted or rejected. The data used to test the hypothesis is the difference between the average posttest value and the average pretest value in the experimental class after the applied learning model cooperative Rotating Trio Exchange and the difference between the mean posttest value and the average pretest grade of the control class. Results of data processing hypothesis test can be seen in Table 5.

| Table 5. Hypothesis test results |
|-----------------|-------|-------|--------|--------|----------|----------|
| Class           | $n$   | $\sum X$ | $\bar{X}$ | $S_g$  | $t_{tabl}$ | $T_{count}$ |
| Exsperimen      | 34    | 1325   | 38.9411 | 16.8227 | 1.67      | 1.9214    |
| Control         | 32    | 992.5  | 31.0156 |        |           |           |
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5. Conclusion

Based on the results of data analysis and discussion it can be concluded:
1. Implementation of Rotating Trio Exchange (RTE) cooperative learning model can improve student learning outcomes on high school chemical bonding subject.
2. The influence of the implementation of Rotating Trio Exchange (RTE) cooperative learning model on student learning outcomes on the subject of chemical bonds is 5.45%.

References