The Comparison between Predict Observe Explain (POE) and Think Pair Share (TPS) Learning Model on Students Learning Achievement, Activity, and Critical Thinking Skill on Human Circulatory System

Remli Nelmian Simarmata
Student of Biology Education Department of Postgraduate Program
Universitas Negeri Medan
Medan, Indonesia
remli.simarmata@yahoo.com

Ely Djulia
Lecturer of Biology Education Department of Postgraduate Program
Universitas Negeri Medan,
Medan, Indonesia

Abstract—**This research aims to investigate the comparison of student learning achievement, critical thinking skill and activity between Predict Observe Explain and Think Pair Share learning model on the topic human circulatory system. This study was a quasi experimental research with equivalent post test control group design. The population of this study was 184 eleventh grade students of SMA Negeri 2 Balige. There were 2 classes chosen as the sample by applying cluster random sampling technique. One class was taught by Predict-Observe-Explain (POE) model while another one class was taught by TPS (Think Pair Share) model. Instruments test used consist of cognitive test in the multiple choice and essay test, critical thinking test in the essay form and observation sheet for activity. Based on data analysis, the average value of posttest in POE group higher than TPS group. While based on t-test analysis, there was no a significant difference of student learning achievement between POE with TPS learning model. Then, there was significant difference of students critical thinking skill that taught by POE learning model. The observation results show that student activity in both research classes is significantly different. The students in POE class were more active than students in TPS class. That means students activity in POE class is higher than students activity in TPS class**

Keywords—*POE(Predict-Observe-Explain), TPS (Think–Pair–Share), critical thinking skill, student activity, learning achievement.*

I. INTRODUCTION

Biology as a science provide a variety of learning experiences to understand the concepts and scientific process includes observing, hypothesizing, using of tools and materials well and right, considering the security and safety, asking questions, classifying and interpreting data, communicating findings orally or written, discovering and sifting the relevant factual information to test the ideas or solve daily problems[1]. Biology is science have to learn and practice directly.

The common problem of education is that the majority of students tend to memorize learning material but they do not understand the concept correctly, not able to apply theory and concept in the solving the problems[2]. Students are only memorize the concept and less apply those concept in daily life [3]. These case are inconsistent with the educational goals, teaching and learning activities are direct for mental formation that affect cognitive development and helps student aware the thinking process. It includes basic skills, knowledge, attitudes and motivations.

Studies of learning biology revealed that in high school had a lot of experience difficulties. The main reasons for learning difficulties were the nature of the topic, teacher's style of teaching, student's style learning and studying habits, student's negative feelings and attitudes towards the topic and a lack of resources. The characteristics of biological science include many abstract concepts, events, topics and facts that students have to learn [4]. High school students difficult to learn physiological processes that need analyzing, reasoning and critical thinking skill. Human circulatory system topic is categorized difficult to comprehend because its complicated characteristics which deal with complex mechanism [5].

Through the implementation of PPLT (Integrated Field Experience Program) 2012/2013 in SMA Negeri 2 Balige, many student experienced difficulty in learning biology. The result of Mid Semester test revealed that about 40 % of student's score under the CMC (Criteria Minimum Completeness) which is less than 75. Seen from list set value (DKN), that class XI IA, student achievement in human circulatory system topic is about 50 % below the value 75. Another biology teacher, said that is probably caused by some reason, such as the deadline for complementing all learning material. Those students with low score indicated that they have not mastered the subject. The interview result from several student said that biology lesson disinterest because contain a lot of concepts, various biological events that cannot be seen by the naked eye, some concepts are too abstract and

full memorization. The learn material through memorization, prevents meaningful learning[4]. Generally, biology lesson still carry out through teacher's lectures or teacher-centered lessons. Even, in SMA Negeri 2 Balige still dominated by teacher-centered learning so that student focus on teacher, does not accustoming to think critically [6]. Critical thinking skills are one type of thinking skill that will be achieved if students are more involved in the learning process [7].

One of teacher's mistake in class is does not attempt to find out the student prior knowledge and stimulate student critical thinking skill. The above reasons suggest that biology teachers should enable students to understand the concepts of biology and its applications to daily life. Science education researches have established that student's alternative conceptions in science are very tenacious and traditional instruction is not very effective in promoting conceptual understanding [2].

To highlight of evidence of above research studies, designing new instructions is needed to improve biology achievement. Effective instructional strategies by promoting the active role of the learner and the facilitative role of the teacher become essential. Teacher should find out the best way to convey the concepts to be taught so that students can remember longer and learn how to relate it to real life. Teacher should choose and use teaching and learning method to improve student learning achievement and critical thinking.

Teacher need to know the prior knowledge and student's understanding of concepts in learning that can do in various ways, such as test, query, and interview. This study follow the principles of constructivist learning. Learning is process to construct knowledge through real experiences from the field. So, teachers should make biology lessons interest and attractive for students to learn more effectively. Teachers might accomplish this by using visual materials, teaching through practical work, giving examples from student's daily lives, linking the topics to each other [4].

The POE strategy provides more effective teaching strategy. POE (Predict – Observe – Explain) is learning strategy which developed to find out student's understanding about concept with constructivist approach. One of the ways to promote student's attitudes toward science is to use laboratory in science courses. Methods can be used to think about results of experiments for students in laboratory [8]. The POE strategy was firstly developed by White and Gunstone (1992). In the POE strategy, students are asked to do experiments for the prediction, then make the observation and description and then ask to compare their observations with the predictions[9]

Furthermore, cooperative learning very effective in solving the problems encountered in the effort to enable students to learn [10]. According to the Johnson & Johnson model, cooperative learning is instruction that involves students working in teams to accomplish a common goal Cooperative learning can be used in for any type of assignment that can be given to students in lecture classes, laboratories, or project-based courses [11]. Putting students in group learning

situations is the best way to foster critical thinking [12]. Think-Pair-Share is one of cooperative learning strategies students are prompted to think about a topic or problem, record their ideas, pair with a neighbor, and share their ideas.

Previous studies was conducted POE strategy in high school in the subjects of physics states that POE can improve student's mastery of concepts in the material on the pressure and creative thinking skills. The learning strategy using POE was effective to increase the critical and creative thinking skills [13]. Research with entitled "Effect of constructivist-oriented on elementary school student cognitive structures", applied POE strategy in constructivist-oriented biological learning to enhance students' conceptual learning and knowledge construction [14]. Applying POE models assisted with multimedia to make learning process more interesting, interactive, and facilitate the understanding of the students so that they can think critically and use the scientific method to solve problems. And the result shows the increasing of student learning outcome[15].

The comparison between NHT (Numbered head Together) and TPS (Think- Pair-Share) that result of student learning outcomes in TPS (Think- Pair-Share) teaching is better than NHT (Numbered Head Together) [16]. There was significant main impact of treatment (Think-Pair-Share) on the student's achievement[17]. Think – Pair –Share has significant effect on student's learning achievement [18].

Based on the explanation above, the purpose of this research is to compare those two learning models, POE and TPS on student learning achievement, activity and critical thinking skill on Human Circulatory System on eleventh grade students.

II. RESEARCH METHOD

This research has been carried out at SMAN 2 Balige in Jalan Kartini Soposurung Balige. The population in this research was the grade eleventh of regular class at SMAN 2 Balige with total number of students was 184. The sample was selected by random cluster sampling with taking two classes as the sample to represent the entire population in SMAN 2 Balige is about sixty students. The instruments used in this study were cognitive test in the multiple choice (25 questions) and essay test (5 questions), critical thinking test in the essay form (5 questions) and observation sheet for activity.

The implementation of POE (*Predict-Observe–Explain*) model have been conducted in experimental design and divided into two groups namely class with use POE (*Predict-Observe–Explain*) model and class with TPS (*Think – Pair – Share*) learning model. Pre test and post test have been administered to both of classes before and after treatment. Instrument test was tested to 22 students in twelve grade class to find out the validity, reliability, item dicriminant, difficulty level. And then validated instrument was given to eleventh class.

Requirement test for data analysis used normality, homogeneity test, and percentage criteria for critical thinking skill and activity observation data. Determining the increasing

of learning achievement, critical thinking skill and activity by using t-test. If $t_{obs} < t_{table}$, Ho will be accepted and Ha will be rejected. If $t_{obs} > t_{table}$, Ho will be rejected and Ha will be accepted.

III. RESULT AND DISCUSSION

A. Instrument Testing

The achievement test which consists of 50 multiple choice questions and 7 essay questions was tested of 22 students of XII IA SMA Negeri 2 Balige and the results are From 50 multiple questions, as many as 34 multiple choice and 7 essay questions are classified as valid question. The result of the instrument reliability analysis showed that the entire multiple question by KR-20 is reliable (r = 0.876). While, essay instrument test was calculated by Alpha Formula with high reliable r = 0.97). There are 12 items categorized as easy questions, 27 items categorized as moderate questions and 11 item categorized as difficult questions for multiple choices. While for essay there are 5 items categorized as moderate questions and 2 questions are difficult. There are 15 items categorized as poor questions, 17 items as satisfactory questions, 16 items as good questions and 2 items as excellent questions for multiple choices. While for essay there are 5 items categorized as poor questions and 2 items as satisfactory questions.

B. Description of Reseacrh Data

1) Student Pretest

Pre test was given to three classes of grade XII IA SMA Negeri 2 Balige. The result of pre test of those classes was calculated using t test in order to select two classes as the object of this research. The classes that have no significant difference in pre test result were chosen as experimental and control class.
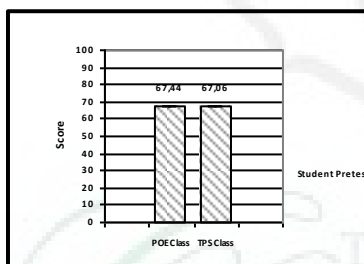

Fig. 1. Student's pre-test data of Class XI IA SMA Negeri 2 Balige in Human Circulatory System

From Fig.1 can be seen the pre test score of experimental class and control class are 67.44 and 67.06. Statistical analysis indicates there is no significant difference in pre test of students between experimental and control class. It indicates both class have the same level before given treatment.

2) Student Learning Achievement

The post test data as the data of students learning achievement was obtained after being given treatments with different learning model. Class that taught by Predict – Observe - Explain (POE) model with has average score about 80.31 and deviation standard is 6.51 with minimum value 66 and maximum value is 92. Whereas class that taught by using Think – Pair – Share (TPS) learning model has average score about 78.44 and deviation standard is 8.57 with minimum value is 65 and high score is 92 (Figure 2).

Based on Fig. 2, that post test in POE class is better than TPS class. Statistical analysis indicates there is no significant difference of student's learning achievement between POE group and TPS group.
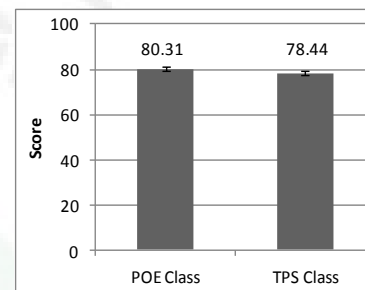

Fig. 2. Student's Post-test learning achievement data of Class XI IA SMA Negeri 2 Balige in Human Circulatory System

3) Student Critical Thinking Skill

At the critical thinking data result, the average value of post test in POE Class is 79.81 with standard deviation is 5.71. This value was higher than the average value of post test in TPS class is 70.06 with standard deviation is 7.18 (Figure 3).

The average value of pre-test and post test in POE class showed the difference. Average value of pretest in POE class is 57.00. This value was lower than the posttest value about 79.81. While, the average value of pretest in TPS class is 53.63 and posttest is 70.06. The gain score of pretest between POE classes with TPS class is about 3.37 while, in posttest is 9.75. Data analysis showed that the implementation Predict – Observe – Explain (POE) learning model better than Think – Pair – Share (TPS).
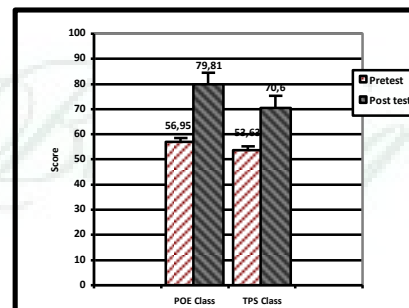

Fig. 3. Student's critical thinking skill of Grade XI IA SMA Negeri 2 Balige on Human Circulatory System Topic before (pre-test) and after (post-test) using Predict – Observe-Explain (POE) and Think – Pair – Share (TPS) Learning model.

Figure 3 above showed the percentage of student's critical thinking skill per indicator before treatment in both of class. Diagram showed that there is no significant difference percentage student's critical thinking skill at all. But, based on statistically analysis there was significant different that showed student have difference capability in critical thinking. It means that students capability in critical thinking initially was different one each other.

Student's critical thinking skill in both of class was assessed by essay test with 4 indicator. Those was summarizing the problem question, identifying assumption, determining solution or problem and determining conclusion of the solution which the percentage in both class can be seen on figure 4 for pretest and figure 5 for posttest data.
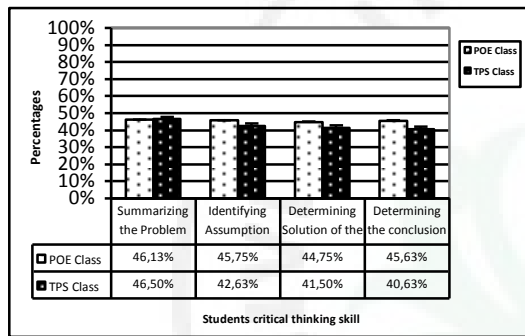

Fig. 4. Data pre-test of Student's Critical thinking skill of grade XI IA SMA Negeri 2 Balige on Human circulatory System.
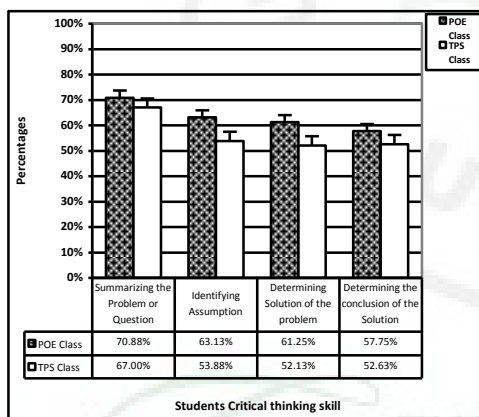

Fig. 5. Student's Critical thinking skill of grade XI IA SMA Negeri 2 Balige on Human Circulatory System in Class in POE and TPS Learning.

4) Student Learning Activity

Students learning activity was observed by two observers and used observation sheet with some indicators include hypothesizing/predicting, observing or investigating, analysing data and making conclusion. The summary of the observation result of learning activity can be seen on Figure 6.

The average of student's activity in class that taught using Predict-Observe-Explain (POE) model is 60.55% and in class that taught by Think-pair Share (TPS) learning model is 50.26%. It means that student's activity in POE class is higher

than students' activity in TPS class and it was obtained for each indicator. The highest one is indicator 2 which is students were observing or do investigation during the learning process. Student was actively paying attention to work during practicum and find out the truth concept that very helpful to understand the topic and fully engaged in the learning process. Whereas in TPS class, the students are less active learning process.
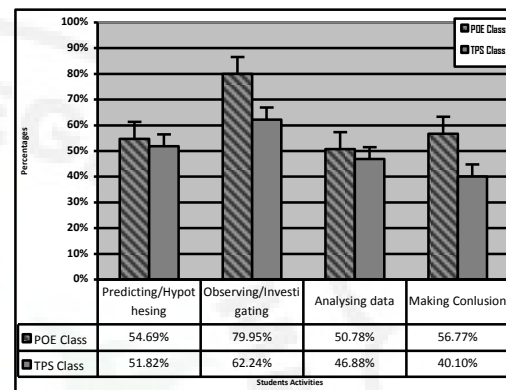

Fig. 6. Variance of student learning activity in Grade XI IA SMA Negeri 2 Balige on Human Circulatory System topic

C. Analysis of Research Data

Data were analysed with some test. Those are Normality and Homogeneity Test. Normality test was conducted by using Liliefors test. The result obtained that all the data of post test and activity in control and experimental class were normally distributed at significance level α = 0.05. There is no out layers and extreme data. The lowest score is 65 and the highest score is 92 for post test. The data of activity showed that control class was categorized as fair (50.26%) and experimental class was categorized as active (60.55%).

Homogeneity test of research data was done by using F-test. F_{count} for pre-test = 1.818, post test = 1.738, critical thinking = 1.775 and student activity = 1.564, while F_{table} with α = 0.05, df numerator and denumerator 31 F0.05(31,31) is 1.822. Because of $F_{count} < F_{table}$, then data of pre-test, post test, critical thinking skill and student activity have homogenous variance. Test of homogeneity of the data was mainly done for both research classes that determine whether the two groups of students who made as research sample has a homogenous variance and can be as representative of the population. It has fulfilled the requirements to hypothesis testing.

Hypothesis test was done by using t-test and used to analysed post test and student activity data. Based on the calculation, known the average value of student's posttest in experimental class is 80.31 and the average value in control class is 78.44. The combining variance for both posttests data is 1.87. The value of t_{table} = 1.669 at the level of significance 0.05. Comparison of tcount with t_{table} is 0.197<1.669 ($t_{count} < t_{table}$) and it means that Ho was accepted Ha was rejected. It indicated student learning achievement in learning human circulatory system topic that taught by Predict-Observe-

Explain (POE) model is not higher than student learning achievement that taught by Think – Pair – Share (TPS) in SMA Negeri 2 Balige academic year 2013/2014. While, for students critical thinking skill data, the average value in experimental class 79.81 and the average value in control class is 70.6. The combining variance for both post tests II data is 9,16. The value of t_{table} = 1.669 at the level of significance 0.05. The comparison of t_{count} with t_{table} is 5.761 > 1.669 (t_{coun} > t_{table}) and it means that Ha was accepted and Ho was rejected. It indicates student critical thinking skill in learning human circulatory system topic which taught using POE model with flash cards is higher than student which taught using TPS learning model in SMA Negeri Balige academic year 2013/2014.

For student activity data, the average score of students activity in experimental class is 29 and the average score in control class is 24. The combining variance for both post tests II data is 5. The value of t_{table} = 1.669 at the level of significance 0.05. Comparison of t_{count} with t_{table} is 4.793 > 1.669 (t_{count} > t_{table}) and it means that Ha was accepted and Ho was rejected. It indicates student learning activity in learning human circulatory system topic which taught using POE model with flash cards is more active than student which taught using TPS learning model in SMA Negeri Balige academic year 2013/2014.

D. Discussion

1) Student Learning Achievement

This study was done in SMA Negeri 2 Balige. This senior high school is located in the location with junior high school of Yayasan Soposurung. This condition is affecting the situation of learning process. There are many schools around the SMA Negeri 2 Balige such as SMA Negeri 1 Balige, SMP Negeri, SMK Negeri 1 Balige, but those have not distracted each other. The windows position of each class is closed by curtain so student could have good concentration. The situation out of class almost quiet.

Pre test was given to two classes. Statistical analysis indicates there is no significant difference in pre test of students between POE and TPS class. Both classes have the same level before treatments given. Statistically, the result of t-test calculation for total score of post test data showed that post test score of class that taught using Predict – Observe-Explain (POE) model is not higher than post test of control class that taught using Think – Pair – Share (TPS). POE class has average score 80.31, whereas TPS class has average score 78.44. The analysis result showed the students learning achievement in POE class has a no significant improvement compared with students learning achievement in TPS class. It can be seen from the hypothesis testing by using t-test that shows the value of t_{count} (0.197) < t_{table} (1.669).

The average value of TPS class was 70.06 and percentage of students who reached CCM in TPS class was about 62.5%.This finding is different with the result of study conducted by Berutu (2011) by Think – Pair – Share learning model on the Ecosystem topic in Grade X SMA Neger 12 Medan. She found that the average value was 86.75 with

percentage of student who reached CCM (70) after taught using TPS model is 100%. If the CCM is 75, the percentage of students who pass will be 75%. These research findings still low. Low percentage of students who reached CCM in TPS class in this study is possibly caused by the situation of learning process. The concentration of students during learning process, less learning activity and interest. The location and condition of the school, learning activity during lesson as external factors and student's interest as internal factor that may affect student learning achievement [19].

The percentage of students who reached CCM in POE class is about 81.25% with average value 80.31. This result is influenced by the condition where actively involved in learning process. Students become more interest to the learning model then give attention. This condition makes students get better understanding about the lesson than TPS class and reach CCM. It is relevant with the finding of Manurung [15] where the students which taught by POE have reached CCM with average value from 70 in cycle I to 85 in cycle II.

POE model was helpfully constructing students understanding. Students become easier to understand the concepts given in accordance with activity steps by Predict-Observe-Explain. The result shows above conclude that learning achievement depends on how the learning process experienced by students [20]. POE learning which allow students for hypothesis formulation and testing by students, improve student's information and memory. Learning by doing concept support this finding.

Student's understanding of concepts is important to construct critical thinking ability. Although, statistically analysis there is no significant difference between student achievements that taught by Predict – Observe – Explain (POE) with taught by Think –Pair- Share (TPS). According to constructivism theory, this is because both learning model have process to construct knowledge through real experiences from the field. But, POE learning model give positive impact in raising student achievement in mastery concept of human circulatory topic in grade XII IA SMA Negeri 2 Balige academic year 2013/2014.

2) Student Critical Thinking Skill

Student's critical thinking skill in both of class was assessed by essay test with 4 indicators. Those was summarizing the problem question, identifying assumption, determining solution or problem and determining conclusion.

From the data analysis showed that the percentage of student's critical thinking skill per indicator before treatment in both of class. Diagram showed that there is no significant difference percentage student's critical thinking skill at all. POE class is 45.56% and TPS class is 42.81%. It is categorized as moderate level. But, based on statistically analysis there was significant different that showed student have difference capability in critical thinking. It means that students capability in critical thinking initially was different one each other. The prominent skill in both classes is summarizing the problem or question which can be seen on

the diagram that POE and TPS class have almost similar percentages is about 46% that categorized as moderate level. It is categorised as moderate. While, for three other indicator there is differences that below 46%.

After treatment, there was rising of student critical thinking skill for all indicators in both classes. POE class is about 63.25%, moderate-categorized level. While in TPS class is about 56.41%, moderate-categorized level. The summarizing the problem skill in both classes is high-categorized level (67% and 70.88%). Student's understanding of concepts is important to construct critical thinking ability. From the above analysis and discussion, it indicates that student's critical thinking skill in learning human circulatory system topic which taught by Predict-Observe-Explain (POE) is higher than Think-Pair-Share (TPS). The excelenncy of POE strategy is help students to begin evaluating their own learning and construct new meanings which is this is foster the critical thinking. the relationship between POE syntax and crtitical thinking skill are by predicting students able to give reasons, observing make student able to apply the principle, decide action and by explanation student able to justify, make conclution, defining term [21]. Those are some of critical thinking ability.

3) Student Learning Activity

Student activity was observed for both POE and TPS classes during research by helping of researcher friend and biology teacher of the school. Observation sheet which used to collect data of student activity contains four indicators. There are hypothesizing and/or predicting, observing and/or investigating, Analysing data (giving suggestion or argument) and making conclusion. Each indicator consists of three levels of contribution. Students who actively answering question by predicting with their own was categorized into level three as active.

The result of student activity in class which taught using Predict – Observe – Explain (POE) learning model the contribution of students for all indicators is categorized as active about 60.55%. The contribution of students in hypothesizing and/or predicting and analysing data (giving suggestion or argument) and making conclusion is categorized as active, and the contribution of student in observing is categorized as very active.

In class which taught using Think – Pair – Share (TPS) learning model the contribution of students for all indicators is categorized as fair below 60% (50.25%) The enthusiasm of students in this class was lower than experimental class. Students have less predicting to answer question because they have less idea to share.

The average of all indicators of student activity in POE class is 60.55% and categorized as active class. Then student activity in control class is 50.25% and categorized as fairly active class. Statistical analysis for the average of student activity for both classes is significantly different. It indicates student learning activity in learning human circulatory system topic which taught by Predict-Observe-Explain (POE) is more active than student which taught by Think-Pair-Share (TPS).

IV. CONCLUTION

There is no significant difference on student learning achievement between Predict–Observe–Explain (POE) with using Think–Pair-Share (TPS) learning model on the topic of Human Circulatory. However, there are a significant difference on student critical thinking and learning activity that taught by Predict – Observe – Explain (POE) learning model compare with using Think – Pair – Share (TPS).

REFERENCES

[1] Badan Standar Nasional Pendidikan, Permendiknas RI, 2006

[2] Sanjaya, W., Strategi Pembelajaran Berorientasi Standar Proses Pendidikan, Jakarta: Kencana Prenada Media Group, 2011.

[3] Trianto, Model Pembelajaran Terpadu Konsep,Strategi Dan Implementasinya Dalam Kurikulum Tingkat Satuan Pendidikan (KTSP), Jakarta : Bumi Aksara, 2011.

[4] Cimer, A., "What makes Biology Learning Difficult and Effective: Student's View", Educational Research and Reviews. Vol 7(3), pp.61-71, 2012.

[5] Cos'tu, B., " Investigating the effectiveness of a POE-based teaching activity on students' understanding of condensation", Instr Sci (40), pp 47-67, 2011.

[6] Tarigan, W.P, "A Comparison Between Cooperative Learning Type Group Investigation with E-learning on Students Learning Achievement and Critical Thinking in Grade XI SMA Negeri 2 Balige at A.Y. 2011/2012, Undergraduate Thesis, Universitas Negeri Medan, 2012. Unpublished.

[7] Badan Standar Nasional Pendidikan, Permendiknas RI, 2006

[8] Bybee, The BSCS 5E Instructional Model: Origins, Effectiveness and Applications. Full report, Colorado Spings, 2011

[9] Joyce, C., Predict, Observe, Explain (POE). 2006, Accessed online http://arb.nzcer.org.nz/strategies/poe.ph p, February. 8,2013

[10] Slavin, R. E., Educational Psychology: Theory and Practice (5th Ed.), USA: Allyn and Bacon, Boston, 2006.

[11] Kearney, M., Student and Teacher Perceptions of the Use of Multimedia Supported Predict–Observe–Explain Tasks to Probe Understanding. Research in Science Education, Printed in the Netherlands: Kluwer Academic Publishers, vol 31, pp589–615, 2001

[12] Jonassen, D., Objectivism vs. Constructivism. Educational Research Technology and Development, 39 (3), pp. 5-24, 1991.

[13] Vighnarajah, L and Bakar., "The Shift in the Role of Teachers in the Learning Process, European Journal of Social Sciences,7(2), pp. 33-36, 2008.

[14] Kusrinaningrum, The Efffectiveness of Using POE Strategy (Predict Observe Explain) for Increasing the Critical thinking and Creative Thinking Skills for Student at SMPN 1 Karangtengah on Pressure subject of Natural Science Learning, Undergraduate Thesis. 2012. Unpublished.

[15] Wu, Y.T and Tsai, Chin Chung, "Effect of Constructivist-oriented Instruction on Elementary School Student's Cognitive Struture", Journal of Biological Education, Summer 2005, pp,113-119.

[16] Manurung, L., Penerapan POE (Predict-Observe-Explain) Menggunakan Multimedia Terhadap Hasil Belajar Siswa Pada Daur Biogeokimia di Kelas X-1 SMA Negeri 2 Lubuk Pakam T.P. 2010/2011, Undergraduate Thesis, Universitas Negeri Medan, 2011. unpublished.

[17] Berutu, Perbedaaan Hasil Belajar Siswa Menggunakan Numbered Head Together dengan Think Pair Share, Undergraduate thesis, 2011. Unpublished.

[18] Ifamuyiwa, A.S., and S.K. Onakoya, "Impact of Think-Pair-Share Instructional Strategy on Students' Achievement in Secondary School Mathematics", Journal of the Science Teachers Association of Nigeria, 2013.

[19] Siahaan, H.L, Penagruh Model Pembelajaran Think –Pair –Share Terhadap Hasil eblajar Siswa Menggunakan Peta Pikiran Terhadap Kelas X SMU Pada Pokok Bahsan Struktur Atom. Undergraduate Thesis, 2013.

[20] Slameto, Belajar dan Faktor-Faktor yang Mempengaruhinya, Jakarta: Rineka Cipta, 2010.

[21] Samosir, H., Model Pembelajaran Predict – Observe –Explain – Write (POEW) untuk Meningkatkan Penguasaan Konsep Kalor & Keterampilan Berpikir Kritis Siswa SMA.(Tesis), Sekolah Pascasarjana UPI, 2010. Unpublished.