The Effect of Implementing 5E (Engagement, Exploration, Explanation, Elaboration, Evaluation) Oriented Learning Model of Human Nervous System toward Student's Learning Outcome for Grade XI in Science Program SMA Negeri 8 Academic Year 2014/2015

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ABSTRACT

This research aims to determine the effect of 5E (Engagement - Exploration – Explanation – Elaboration – Evaluation) Learning Model toward student learning outcomes on human nervous system concepts. This research was conducted in SMA Negeri 8 Medan, academic year 2014/2015. The method used in this study is quasi-experimental methods. The population in this research is all grade XI science students SMAN 8 Medan with 5 (five) classes academic year 2014/2015. From the population was taken 80 students as the sample by using random sampling. They are students of class XI Science 3 (consist of 40 students) as an experimental class use 5E Learning Model, while the students of class XI IPA 4 (consist of 40 students) as a control use direct learning model. The early data be obtained from the average pretest that value of 55.16 post-test from experimental class and control class 53.66. For posttest in experiment class is 80.92 and control class is 74.33. After that tested by normality test, homogeneity test and hypothesis test. Based on data from result of research used t_{test} to obtain t_{count} is 3.88 and t_{table} at 5% significance level of 1.991. Because t-test > t-table so the results of this research indicate that there were significant difference toward leraning outcome between experimental class use 5E Learning Model and control class use direct learning model on human nervous system concept.

Keyword: 5E Learning Model, Learning Outcomes.

INTRODUCTION

Learning process contain activities interaction between teachers and students in order to achieve the learning objectives (Hamdani 2011). The interactions in the form of communication effectively, support in competition, and motivate their future to be better. By interaction, the teacher was not going to understand every problem for each of student, but will acquire enough information for those students who are struggling with specific tasks. The research indicates that learning outcome and student behavior are influenced by the quality of the teacher and student interaction (Hamdani 2011).

Biology was one of subject that contains activity interaction, because learning biology was part of learning process. The interaction in learning biology for senior high school had a lot

of difficult experiences. Difficult experiences namely, difficult to remember the concept, understand the mechanism, memorize the latin name, and to know part of picture. Based on Lazarowitz (1992) thought many students had difficult experiences in physiological abstract concepts. Because to study about physiology, the students must know about organ or structure and its function.

Many concepts or topics in biology especially in human nervous system topic can be perceived as difficult to learn by students Senior High School (Tekkaya 2001). The difficult of Human Nervous System Topic usually in this topic contain abstract mechanism. Because the students was hard to imagine the organ or structure in human nervous system in detail. If students cannot imagine its organ or structure, they got confused to understand relation between structure or organ with its function. Beside that, this topic is fully complex either physical and chemical mechanism (Ibayati 2011) Human nervous system topic is one of the important materials for students in order to mastering the concepts, especially in human physiology. Usually mechanism topic is one of principle on human nervous system that lead to difficulties in understanding this material. For example it is closely

related to physiological mechanisms of formation and delivery of nerve impulses.

Human nervous system was one of important topic but difficult, so the students did not reach minimum completeness (score 75) which was about 65% for human nervous system from their daily test. Based on observation in SMAN 8 Medan, researcher found low of student's learning outcome of Biology subject in grade XI IPA 3. Beside that, the researcher got information based on interviewed to one of teacher in SMAN 8 Medan, Ratna Tarigan, on January 14th 2015, said that the some teachers in SMAN 8 still use direct learning model. Direct learning model was learning model that was applied in teaching learning process in biological class was less of variety. This condition caused the class was looked monotone, so the students are not active in learning process. When the teacher was explaining the learning material verbally, students are listening to the teacher's explanation but the others did not listen at all. The teacher relies on the handbook was teaching. According to her, the students show less enthusiasm to the handbook content. This condition was as if focusing to the student's cognitive

without stimulating the student's scientific attitude and psychomotor improvement.

The student's retention rate was low in biology learning. This case be prove by score their mid semester test. When did mid semester test, student's score to be worse. Based on the above problems, the researcher want to know the effect of 5E (Engagement, Exploration, Explanation, Elaboration, Evaluation) model learning to improve student's cognitive learning outcome. This research carried as part of alternative solutions. The 5E model was a constructivist model which provides learning a newly concept to comprehend deeply a known concept. The 5E model sequences will gave some experiences to students to have opportunity constructed their understanding of a concept. The model led students through five phases of learning that are easily described using words that begin with the letter E: Engage, Explore, Explain, Elaborate, and Evaluate. 5E model also motivates and increase student's retention rate to be included into a topic by several phases of learning, to explore a subject, to be given a definition for their experiences, to obtain more detailed information about their learning and to evaluate it in diffusion and osmosis learning material (Tekkaya 2001).

Based on the background described above, the author was interested to know the effect of implementing, the percentage from the increase of learning outcome, the effect of retention rate's student toward using 5E (Engagement, Exploration, Explanation, Elaboration, Evaluation) learning model in Human Nervous System for Grade XI in Science Program SMA NEGERI 8 Medan Academic Year 2014/2015.

RESEARCH METHODOLOGY

Location and Time. This research had been conducted in SMAN 8 Medan Jl. Sampali Street No 23, grade XI academic year 2014/2015 from April until May 2015.

Population and Sample. The population in this research was all grade XI science students SMAN 8 Medan with 5 (five) classes academic year 2014/2015. The sample is selected with random sampling by taking 2 (two) classes from reguler class as the sample to representative the whole population in SMA Negeri 8 Medan. Where the researcher obtains the data from the teacher about student learning outcomes to make sure that the sample which was taking in the same quality. This technique is also choosen in effectiveness of research. So the sample of this research are XI IPA 3 and XI IPA 4.

Research variable. Independent variable was using 5E learning model on human nervous system topic. While, dependent variable was student's learning outcome on human nervous system topic.

Research Design. The type of this research is quasi experimental. This research conducted in experimental design and divided into two classes, experiment class which is applying 5E oriented learning model and control class which is applying direct learning model.

RESULT

Pretest Data

Before treatment, experimental class and control class were giving pre-test in order to see early ability of students cognitive. From the chart known that the mean of experiment class is 55.16 with ± 12.53, and the mean of control class is 53,66 $\pm 7,38$. The lowest score in experiment class is 33.33 while the highest score is 73.33. In control class has the lowest score is 43.33, and the highest score is 63.33 (figure 2).

Hypothesis data testing was done using t_{test}. t_{test} used to determine the similarity of student's ability. Hypothesis test is a requirement that used to determine whether the H_a in the research accepted or rejected. The hypothesis data pretest in both class t_{table} = 1.991 and t_{count} = 0.06 obtained from the result interpolation table. Because t_{count} < t_{table} (0.06 < 1,991) then it can be conclude that sample has student's knowledge is similar because pretest score of both classes have no significance different.

Posttest Data

After treatment done, the post test given to experiment class and control class. The purpose is to know the student's learning outcome in both classes. The result of post-test in both clases. From the chart can be seen that the average of experiment class is 80.92 with ± 8.12, and the average of control class is 73,66 with $\pm 7,21$. The lowest score in experiment class is

Figure 2. The Difference of Student's Learning Outcomes
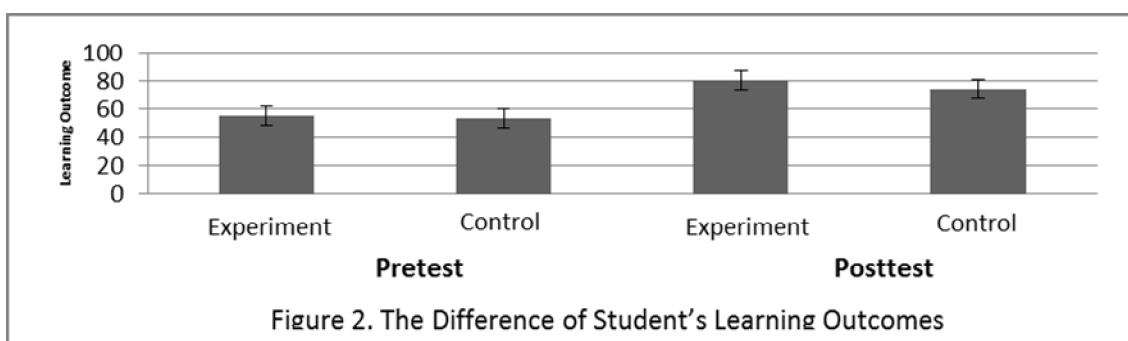
66.67, and the highest score is 93.33. While, in control class has the lowest score is 66.67, and the highest score is 8 Data of pre-test and post-test in experiment class and control class, therefore gained the average, deviation standard, total score, the highest score and the lowest score. After the treatment was done, t_{test} is used. The purpose was to differentiate the result of post test in experiment class that had been taught by 5E learning model and control class that had been taught by direct learning model on Human Nervous System topic in SMA Negeri 8 Medan AY 2014/2015. Statistically the hypothesis was:

Ho ; $\mu_1 \leq \mu_2$

Ha ; $\mu_1 > \mu_2$

The posttest result of normality test in experiment class is 0.1349 for for L_{count} and L_{tabel} = 0.1582. If L_{count} < L_{tabel} so the data be distributed normally. Because 0.1349 < 0.1582, it is mean posttest data distribute normally (can be seen at table 3). While in control class is 0.1281 for L_{count} and L_{tabel} = 0.1582. Because 0.1281< 0.1582, means the data are distribute normally (table 4).

The value of t_{table} on significant level α = 0,05 then gained t_{table} = 1,991

and t_{count} = 3,230, because $t_{count} > t_{tabel,}$ so, H_0 rejected, there was difference significant between students that was taught by 5E oriented learning model and students that was taught by direct learning model at Human Nervous System Topic in Grade XI SMA Negeri 8 Medan Academic Year 2014/2015. It proved that 5E learning model give effect better than direct learning model. The result of learning outcomes in experiment class was higher than control class (can be seen at figure 2).

The result data got different student's learning outcome after treatment. The hypothesis data posttest in both classes t_{table} = 1.991 and t_{count} = 3.88 obtained from the result interpolation table. Because $t_{count} > t_{table}$ (3.88 > 1.98) then H_0 is rejected and H_a accepted. Based on these criteria, it can be conclude that there is difference in student learning outcome score of students taught by using 5E learning model and direct learning model.

Retention rate in experiment class and control class has significant difference. In experiment class obtained retention rate is 91% and in control class obtained retention rate is 89%. There is difference 2% of retention rate between experiment class and control class (can be seen at table 5).

Table 3. Normality Post - Test In Experiment Class

No	X_i	f_i	$X_i f_i$	f_k	Z_i	$F(Z_i)$	$S(Z_i)$	$\|F(Z_i - S(Z_i)\|$
1	66.67	7	466.67	7	-1.75	0.0401	0.175	0.1349
2	76.67	4	306.68	11	-0.52	0.3015	0.275	0.0265
3	80	9	720	20	-0.11	0.4562	0.500	0.0438
4	83.33	8	666.64	28	0.29	0.6141	0.700	0.0859
5	86.67	5	433.35	33	0.66	0.7454	0.825	0.0796
6	90	3	270	36	1.11	0.8665	0.900	0.0335
7	93.33	4	279.99	40	1.52	0.9357	1.000	0.0643
	TOTAL	40	3236.667					

M = 80.92
SD = 8.12

L_{count} = 0.1349 < L_{table} = 0.1582
The Data is distribute normally

Table 4. Normality Post - Test in Control Class

No	X_i	f_i	$X_i f_i$	f_k	Z_i	$F(Z_i)$	$S(Z_i)$	$\|F(Z_i - S(Z_i)\|$
1	63.33	5	316.65	5	-1.50	0.0606	0.125	0.0644
2	66.67	6	400.02	11	-1.05	0.1469	0.275	0.1281
3	70	4	280	15	-0.59	0.2912	0.375	0.0835
4	73.33	4	293.32	19	-0.13	0.4483	0.475	0.0267
5	76.67	9	690.03	28	0.32	0.6255	0.700	0.0745
6	80	7	560	35	0.77	0.7794	0.875	0.0956
7	86.67	5	433.35	40	1.69	0.9545	1.000	0.0455
	TOTAL	40	2973.333					

M = 73.59
SD = 7.21

L_{count} = 0.1281 < L_{table} = 0.1582
The Data is distribute normally

Table 5. Retention Rate

	Score Retention Average	Retention Rate Average
E. Class	73	91%
C. Class	66.42	89%

DISCUSSION

5E oriented learning model was given good effect toward student's learning outcome. It was caused by 5E oriented learning model had some advantages according Wibowo (2009) the advantages of 5E learning model such as : 1). Students actively participate in the learning process and understand how that they learn and increase meta-cognitive abilities, 2). The teacher is a facilitator and teacher active guiding, 3) Learning will be more meaningful for the students as they to develop what they know, 4). Increase motivation for learners are actively

involved in the learning process. 5E Learning model is born from learning constructivism paradigm which is part of Vygotsky social constructivism and Ausebel meaningful learning theory (Allen 1973). This learning model consist of engagement, exploration, explanation, elaboration and evaluation phase (Bybee. *et al* 2006). Every "E" in Learning Model shows a part from sequential process to help students learning from their experiences and then linked it to a new concetps (Calik & Mehmet 2008). According to Colburn and Clough research (Allen 1973), they showed that Learning Model 5E is an effective way to assist students, enjoying knowledge, understanding contents, and applying scientific concepts and process for authentic situation.

5E oriented learning model can stimulate the student to be active in teaching and learning process caused by this model prioritize the activity and effectiveness. This argue be supported by Herbart proposes two ideas as foundations for teaching: interest and conceptual understanding. The first principle of effective instruction consists of the students' interest in the subject. Herbart suggests two types of interest, one based on direct experiences with the natural world and the second based on social interactions (Herbart 1901). It

can increase student's knowledge in thinking. Beside that 5E oriented learning model to increase student's curiosity by worksheet that relation human nervous system concept in daily life, and to increase student's motivation in learning process because the students be engaged to discussing directly. Beside that in 5E oriented learning model in experiment class, the students be guided to constructing their own knowledge to get new knowledge. So the students feel are motivated for studying because the students are engaged actively in process learning.

According (Qarareh 2012) that learning using the learning model is an active cognitive process, in which the student gone through various, explorative educational experiences which enable him to explore the knowledge intended to be taught. The learner engages in a mental activity represented by the re-organization, re-arrangement and alternation that the learner introduces to the learning material. Consequently, learning using the learning model was indeed a meaningful learning that increases learner's educational achievement. 5E Learning model was concerned with the entire content to be learnt and with the cognitive structures. Therefore, this model deals with the selection and organization of content experiences in

order to facilitate the material to be learnt within learner's cognitive structures and create new knowledge structures to bring about cognitive development. Furthermore, this method was concerned with increasing learner's motivation towards learning, a thing that increases achievement and stresses the importance of practice, which helps to learn actively. There was difference in control class, although the teacher can handle class condition easily and can explain material in short time. But students to be passive. The students only listen based on teacher's saying and the others did nothing else. Therefore, it can be concluded that 5E oriented model can increase student's learning outcome.

Each of step in 5E oriented learning model make students to be more active. Because in engagement step, the students would be engaged to do short activity. The students were stimulated to starting their learning process. Then it was exploration step. In this step the students in experiment class will be given worksheet about human nervous system. The students must explore the answer from the problem. Then, there was explanation step. In this step, the student will explain their answer based on result of exploration. After that, elaboration step. In this stage the student will elaborate

their prior knowledge and new knowledge that would be expressed by mind mapping. And the last step is evaluation. In this stage, the teacher would gave the reinforcement for important concept about the topic. While in direct learning model, the teacher explain the topic without attentive student's early knowledge or student's idea had been owned before the students study about the topic formally. Beside that in direst learning model was belong to teacher – centered. Where the teacher only center in teaching and learning process to transferring the teacher's saying to student.

For 5E oriented learning model, teaching learning process is belong to student-centered. Where the students not only be transferred the knowledge by the teacher. But also to get the concept oriented on student learning activity directly, the teacher only as a guide or facilitator in managing every step. It can bring positive effect to the students because teaching learning process be meaningful. Beside that, 5E oriented learning model has objective to avoiding the student memorizing teacher's saying in direct learning model. In implementing 5E oriented learning model will express student's creativity in every step. In 5E oriented learning model, the student be guided

to be active and creative especially to doing the worksheet, making the question and work together with their group during learning process. After 21 days, the researcher to do test the student with some instrument test used when pretest and posttest to knowing student's retention rate in experiment class and control class. Based on result of calculation obtained score of student's retention rate in experiment class is higher than student's rate in control class. It is mean that 5E oriented learning model can be implemented in learning process to increase of student's retention rate.

Several studies have shown that the 5E Learning Model was successfully applied to a variety of grade levels. For example, in their study of an eighth-grade genetics class, Tekkaya (2006) compared the effectiveness of the 5E Learning Model with the effectiveness of expository instruction. According to the authors' conclusions, the activities for students in the 5E Learning Model helped them to activate their prior knowledge and to overcome struggling with their misconceptions. In addition to the knowledge gains, these students had the opportunity to explain, to argue, and to debate their ideas, practices that helped the students further extend the conceptual understanding.

CONCLUSION

Based on research, the students learning outcome on nervous system topic class XI Science Program in SMA Negeri 8 Medan after given the treatment of 5E (Engagement–Exploration–Explanation–Elaboration–Evaluation) Learning Model in experiment class 80.91 and in control class had been taught by direct learning model is 74.33. TEffect of implementation 5E in experiment class has significant different about 13% and Student's retention rate in experiment class was higher than student's retention rate in control class.

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REFERENCES

Allen, L. R. 1973. An evaluation of children's performance in certain cognitive, affective, and motivational aspects of the Systems and Subsystems unit of the Science Curriculum Improvement Study elementary science program. Journal of Research in Science. Teaching. 10: 125-134

Bybee, et al. 2006. The BSCS 5E instructional model: Origins and effectiveness. A report prepared for the Office of Science Education National Institutes of Health. BSCS.org. *Education Journal*: [Accessed: March, 13th 2015] Available: http://science.education.nih.gov/houseofreps.nsf/b82d55fa138783c2852572c9004f5566/$FILE/Appendix%20D.pdf.

Calik, M. and Mehmet, A. K. 2008. Using different conceptual change method embedded within the 5E Model: A sample teaching for heat and temperature: 3-7.

Hamdani. 2011. Strategi Belajar Mengajar. Pustaka Setia: Bandung.

Herbart, J. 1901. Outlines of Educational Doctrine, trans. C.DeGarmo; ed. A. Lange. New York: Macmillan.

Ibayati. Y. 2002. Analisis Strategi Mengajar pada Topik Sistem Saraf di SMU. Tesis.Program Pascasarjana. Universitas Pendidikan Indonesia: Bandung

Lazarowitz. 1992. High School Students' Difficulties in Learning Biology Concepts. J. Biol. Educ, 26: 215 – 224

Qarareh, Ahmed. 2012. The Effect of Using The Learning Cycle Method in Teaching Science On The Educational Achievement of The Sixth Graders. Int J. Edu Sci, 4: 123 – 132

Tekkaya et al. 2001. Biology Concepts Perceived As Difficult by Turkish High School Students. Hacettepe Univ. J. Educ, 21: 145 – 150

Wibowo. 2009. Penerapan Model Pembelajaran Siklus Belajar (Learning Cycle) 5e Dalam Meningkatkan Hasil Belajar Siswa Pada Matapelajaran Teknologi Informasi Dan Komunikasi. FMIPA. UPI