IMPLEMENTATION OF 5E LEARNING CYCLE MODEL ON PROCESS SCIENCE SKILLS PROSPECTIVE STUDENT TEACHER OF UNIVERSITY OF TANJUNGPURA

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Abstract

The main purpose of this study to determine whether there was significant difference of process science skills between student who were taught through learning 5E learning cycle and conventional model on colligative properties of solutions concept. Nonequivalent control group design was adopted in this study as research design. Population consisted of all second semester students of chemistry education program according to purposive sampling technique, A1 and A2 class were chosen as experimental and control group. Process science skill test was used to collect data. According to independent t test, it was found that p-value = 0.017<a = 0.05, which meant if there was a significant difference of process science skill between students who were taught through 5E learning cycle and conventional model on colligative properties of solutions concept.

Keywords: 5E learning cycle, process science skill.

INTRODUCTION

Problems that human face on 21st century are more complex, rapid change, and full of paradox (Moeloek dkk :2010), therefore Indonesian students should have ability to solve complex 21st century issues, which one of them is science process skills. According Hasyim, Saputro & Fadilah (2015), education on 21st century demand students to solve problems through information collected and making decision according to prove they have acquired scientifically. Samatowa (2006:137) says that science process skills are intellectual skills that scientist have and use to study natural phenomena. These skills can be learn by students in simply way according to their development.

Learning on 21st century especially chemistry should be able in training students science process skills through laboratory experiments. According to Siska (2013), laboratory activity is a medium for scientific learning as product and process. Therefore it will give positive effect for students. Accomplishment of learning goals depend on learning process that is experienced by students (Hasyim, Saputro & Fadilah, 2015). Science process skills on chemistry can grow and develop well by facilitation of teachers who have good science process skills, therefore, science process skills prospective teachers should be trained in their early education.

Learning cycle (LC) is one of models that can support the development of science process skills. LC has 5 phases. They are engagement, explanation, elaboration, and evaluation (Lorsbach, 2002). Engagement includes making connection from past experiences, exposing misconceptions and reducing cognitive conflict. Exploration includes laboratory activity to develop lectures and students experiences by introducing and discussing concept, process, and skills. Explanation, in which, students are asked to explain their exploration and engagement experiences using common term. Elaboration, in which, students are involved in new situation that needs identical explanation. Evaluation, in which, the instructor observes each students knowledge and understanding.

Through LC, students are able to identify the pattern of phenomena studied, introduce concepts that have relationship with phenomena and discuss it, then use the concepts to new situation. Research conducted by Balci, Cakiroglu & Tekkaya, (2006) shows that LC can enhance process of thinking and correct misconceptions. According to Gazali, Hifayat & Yuliati (2015) science process skills of students who learn through 5E LC are better than those who learn through EEK. The main goal of This study is to determine whether there is a significant difference of science process skills between students who learn through 5E LC model and conventional model.

LITERATURE AND HYPOTHESIS

1. Science process skills

According to Dimyati and Mudjiono (2009), science process skills can be defined as a role model of intellectual social, and physical skills which is sourced from students themselves. Science process skills can develop basic skills of students in laboratory activity. Science process skills aim to make students active in learning (Rustaman dkk, 2005)

Basic skills consist of following six skills. They are : a) observing; b) classifying ; c) communicating ; d)assessing ;e) predicting ; f) concluding (Dimyati and Mudjiono, 2009). Observing is the most basic skill on acquiring knowledge. It also grows others process skills. Classifying is a process skill of selecting various object according to its special characteristics. Communicating is defined as a delivery of fact, concept and principle of knowledge in form of audio, visual or audiovisual. Assessing is defined as comparing an object with a standard that is stated beforehand. Predicting is an activity of stating what will happen in the future, according to certain tendency and pattern or relation among facts, concepts, and principles on science. Concluding is defined as a skill of judging condition of object according to facts, concepts and principles that have already known. Questioning aims to ask explanation about what, why, how, or asking hypothesis background.

Integrated process sills consist of following ten skills : a) introducing variable; b)making data table; c) making graphs; d) drawing relationship among variables; e) collecting and analyzing data; f) analyzing research; g)formulating hypothesis; h)defining variables; i) designing research; j) conducting experiment Dimyati dan Mudjiono (2009). Introducing variables is defined as to show concepts which have more than one value. Making data table is a skill of students to present data. Making graphs is a skill of analyzing data to be visualized in form of line or two dimensional figures where manipulated variable is in horizontal line and result variable is in vertical line. Drawing relationship among variables is defined as a skill to describe relationship between independent variable and independent variable. Collecting and analyzing data is a skill of acquiring information from other people or any sources by means of verbal, writings or observation and then examine it quantitatively and qualitatively as a foundation of hypothesis testing or concluding. Analyzing research is a skill of analyzing other scientist research paper so as to obtain more information. Formulating hypothesis is defined as a skill to state prediction which is regarded true about a factor on a situation therefore there will be a consequence. Defining variables is defined as a skill to describe variables so as to avoid ambiguity. Designing research is activity of describing manipulated variables which is carried out by means of experiment.

2. Learning Cycle Model

LC is a student-centered approach based learning model (Simatupang, 2008) where each phase has special function and give contribution to educators and learners about science, technology, attitudes and skills (Byber, taylor, Gardner, Pamela Van Scoutter, & Landes, 2006).

a. Engagement includes making connection from past experiences, exposing misconceptions and reducing cognitive conflict.
b. Exploration includes laboratory activity to develop lectures and students experiences by introducing and discussing concept, process, and skills.
c. Explanation, in which, students are asked to explain their exploration and engagement experiences using common term.
d. Elaboration, in which, students are involved in new situation that needs identical explanation.
e. Evaluation, in which, the instructor observes each students knowledge and understanding.

Phase	Summary
Engagement	The teacher or a curriculum task accesses the learners' prior knowledge and help them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities
Exploration	Exploration experiences provide students with a common base of activities within which current concept (i.e., misconceptions), processes, and skills are identified and conceptual change is facilitated. learners may complete lab activities that help them use prior knowledge to generate new ideas , explore questions and possibilities, and design and conduct a preliminary investigation.
Explanation	The explanation phase focuses students' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills or behaviors. This phase also provides opportunities for teachers to directly introduce a concept, process, or skill. Learners explain their understanding of the concept. An explanation from the teacher of the curriculum task may guide them toward a deeper understanding, which is a critical part of this phase.
Elaboration	Teachers challenge and extend students' conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information, and adequate skills. Students apply their understanding of concept by conducting additional activities.
Evaluation	The evaluation phase encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress toward achieving the educational objectives.

Biological science curriculum study (BSCS) 5E Instructional Model (Byber, Taylor, Gardner, Pamela van Scotter, & Landes, 2006)

Hypothesis of this study is "there is a significant difference of science process skills between students taught through 5E Learning cycle model and students taught through conventional model.

METHODS

The design of this study is nonequivalent control group design type of quasy experiment design (Sugiono, 2008) as we can see on the figure below:

E	O_1	X_1	O_2
K	O_3	-	O_4

Population on this study consists of all second semester students of chemistry education program. According to purposive sampling technique, A1 class and A2 class are chosen as experimental and control group respectively.

To collect data, science process skills test is administered to students. Indicators on science process skills test include : 1) questioning, 2) formulating hypothesis, 3) communicating (presenting data in form of graphs), 4) classifying and concluding which is adopted from Dimyati and Mudjiono (2009) and Rustaman dkk (2005). This study consist of three stages. They are : 1) preparation, in which students are asked to identify and, formulate problems, design learning tools, validate and examine reliability. 2) execution in which students are asked to answer pretest, attend class using 5E Learning Cycle Model (experimental group), attend class using conventional model (control group), and answer posttest. 3) final in which data are analyzed, and discussion and conclusion are formulated.

Data analysis is carried out to determine whether there is a significant difference of science process skills between students taught using learning cycle and conventional model. Data analysis is done by SPSS software. There are four steps which is stated as follows : 1) conduct normality test for both classes to examine students' prior knowledge. 2) if data have normal distribution, independent t- test is chosen to test hypothesis. 3) if one of classes has no normal distribution, U Mann whitney test is then chosen. 4) if students' prior knowledge are significantly difference, gain score has to be stated to test hypothesis, and the same procedure form number 1 until 3 has to be conducted.

FINDINGS AND DISCUSSION

Students' science process skills from both classes are shown on table 2. as follows :

No.		Experimental group			Control group		
		Pretest	*Posttest*	*Gain*	*Pretest*	*Posttest*	*Gain*
1	Average score	8,21	12.76	4.55	5,83	7.06	2.52
2	Variance	3,59	3,69	8.04	7,51	11.38	12.12
3	Deviation standard	1,89	1.92	2.84	2.74	3.37	3.48

According to test of normality on control group, it shows that P-value < $\alpha = 0,05$, which means data are from population that has no normal distribution, on the contrary, posttest and gain score of control group and pretest, posttest, and gain score of experimental group have P-value > $\alpha = 0,05$, which means data are from population that has normal distribution. According to U Mann Whitney test of students' science process skills, it

shows P-value =0.000 < α = 0,05, which means there is a significant difference of prior science process skills between students form experimental and control group. According to independent t test toward gain score, it shows P-value = 0.017 < α = 0.05 which means there is a significant difference of science process skills between students from experimental and control group.

This study confirms that there is a significant difference of science process skills between students from experimental and students from control group where average score of experimental group is higher than average score of control group. This significant difference is caused by treatment for experimental group. Learning cycle model has five phases including : engagement, exploration, explanation, elaboration, and evaluation. Engagement phase in which teachers access students' prior knowledge by questioning prior concepts (solution) that has connection to colligative properties of solutions. According to Mulyasa (2011), teachers can relate what students will learn to what concepts they have already had, to make connection. Besides apersepsi, teachers motivate students by proposing challenging questions in regard of daily phenomena. According to Kiswoyowati (2011), in order to enhance students' life skills, teachers have to motivate and engage students on learning activities.

The second phase of 5E learning cycle is exploration, in which students are asked to do lab activities in group accompanied with worksheet. Groups are made as heterogeneous as possible to increase confidence. According to Astutik (2012) 5E Learning cycle can arouse students' courage and motivation and make them more confident. This phase gives opportunity to students to improve science process skills independently. Students engage in lab activities such as observation and exploration.

According to Carin, Bass, & Contant (2005), students try to understand and explore subject using experience and thinking by formulating and testing hypothesis, collecting data, observation, inferring and elaboration. During this phase, students are trained to propose question, formulate hypothesis, communicate result, clarify findings, and make conclusion. Guidance is given while students construct their knowledge toward phenomena in worksheet. According to Gazali, Hidayat, & Yuliati (2015), during exploration phase, important skills such as focusing, gathering information, collecting, organizing, analyzing data, and making generalization are involved and trained.

During explanation phase, each group should present their work on previous phase. Each group is given opportunity to show their skills. In this phase students share and discuss their findings. Every member has opportunity to question and answer, and give opinions. Elaboration phase, students are asked to do additional lab activities. Elaboration phase allows students to improve their skills. Students are promoted to extend their knowledge and skills. According to Rahmawati, Koes, & Dasna (2016) elaboration phase can be done by doing new lab activities. According to Gazali, Hidayat, & Yuliati (2015) elaboration during learning familiarizes students to organize, analyze, generalize, and evaluate concepts they have constructed.

The last phase is evaluation in which students are asked to finish test. According to Utami, Hastuti, Yamtinah, Padmini, & Arroyan (2013) there are two important things to be examined. They are stated as follows 1) experiences of students 2) reflections to do next step. Students have to find and simplify complex information by examining and revising old rules. (constructivism theory). Every phase in Learning cycle model has its own special function. It has contribution for teacher and student. (Byber, taylor, Gardner, Pamela van Scotter & Landes (2006). According to Abraham & Renner (1986): Beth & Hewson (1999); Gerber, Cavallo, & Marek (2001); McComas (1992) in (Hanuscin & Lee, 2008) learning cycle can improve students achievement on science, gain better

retention, improve behavior toward science, improve thinking skills, improve process skills which is better than traditional learning.

CONCLUSION AND ADVICE

To conclude, there is a significant difference of science process skills between students taught with learning cycle model and students taught conventional model. Teacher must give guidance on exploration phase for advice. The guidance will ease students to finish worksheet.

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