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INQUIRY IN THE LABORATORY TO IMPROVE THE MULTIPLE INTELLIGENCES OF STUDENT AS FUTURE CHEMISTRY TEACHER

Sri Wardani[1], Sri Susilogati[2]

[1]Department of Chemistry Education, Faculty of Natural and Science, Semarang State University, Semarang, Indonesia
[2] Department of Chemistry Education, Faculty of Natural and Science, Semarang State University, Semarang, Indonesia

ABSTRACT

This study aims to get results of laboratory inquiry activity-based lectures on student as future chemistry teacher. Research data analysis used mixed method with Embedded Experimental model. The model was implemented to 29 students of the experimental class and 35 students of the control class. Multiple Intelligences developed is related to the lectures in the laboratory, they are logical mathematics and intrapersonal intelligence. The process of laboratory inquiry activities undertaken continuously will become habit of mind to develop self-potential to become more optimal. The results showed significant increase between the control class and experimental class for mathematics logical intelligence and intrapersonal intelligence. The highest achievements are in logical analysis indicator (logical mathematics intelligence) and metacognition indicator (intrapersonal intelligence).

Key Word: laboratory inquiry activity, multiple intelligences

INTRODUCTION

Activity in the laboratory in the learning process of science including chemistry, should be done through the exploration stage of self-experience, starting from the analysis of the supporting journal in developing a work design preparatory, up to discovering new knowledge, this stage trains basic skills of inquiry (Cacciatore & Sevian 2009).

Stages of inquiry in the laboratory begins with the search for information from various sources, in this step the intelligence associated with great effort in designing an experiment properly including developing intrapersonal intelligence / multiple intelligence. During the stage of designing experiments, it needs a discussion with the members of the group to bring together the search results that have been obtained; this process highly develops interpersonal intelligence / multiple intelligences (Wardani, 2014). After designing the experiment, some stages are carried out such as the stage of preparing experiment, conducting experiment, analyzing the results of the experiment, then at this stage the development of logic and mathematical figures which can develop logical mathematics intelligence is required (Wardani, 2013).

Gardner (2003) stated that everyone has intelligence which is different with all of their potentials, both in children and adults. Furthermore, he stated that everyone has multiple intelligences with different levels of development. However, the multiple intelligences owned by human beings must be balanced with tolerance of any differences such as race, ethnicity, religion, and others (Tilaar, 2008). Gardner in Lazear (2004) identifies eight types of human intelligence. Those eight kinds of human intelligences are linguistic intelligence, logical mathematics intelligence, visual spatial intelligence, musical intelligence, kinesthetic intelligence, interpersonal intelligence, intrapersonal intelligence, and naturalist intelligence.

According to NRC (2005) practicum using a lab manual is still verifiable, so it is not effective for science teaching anymore. This opinion is supported by the results of a field study conducted for the chemistry lab analysis instrument subject which shows the results of pretest understanding of the concept, 80% of students scored below 50 (score 100), while 20% scored between 50-79. This condition is caused by an understanding of the concept of students as future teachers which is still low. The condition related to the meaningless problem of chemistry lab including analytical chemistry, is also expressed by Gianpiera Adanni (2006);, Amarasiriwardena (2007); Kipnis & Hofstein, (2007); and Guy Ashkenazi and Gabriela (2007).

The learning process which is done today generally only transfers information that has been finished and tested. That learning process has been proven to have weaknesses in our learning system, because students finally end up just as the users of information. This learning system also does not foster the creativity of students because it tends to be passive and instant. To foster the creativity of students, it needs a learning model that can develop multiple intelligences of students. The development of multiple intelligences is highly determined by internal and external factors. Internal factors that influence the development of multiple intelligences are the role of genetic, lifestyle, nutrition, and breastfeeding. Meanwhile, the external factors that influence the development of multiple intelligences are environmental influences, motivation, and experience in the learning process, including the stage of inquiry (Gunawan, 2004; Wardani, 2013).

Based on the above explanation, the problem that will be revealed in this paper is whether the model of laboratory inquiry activity-based lecture can improve the multiple intelligence of student as future chemistry teacher.

METHODS

This study was designed by using a mixed method with embedded experimental model. The model is implemented to 29 students of the experimental class and 35 students of the control class. Experimental method with pretest - posttest control group design was used in this study. The experimental class was given a treatment in the form of laboratory inquiry activity-based Instrument Analytical Chemistry learning, while the learning in the control class was in the form of laboratory experiments with standard lab procedure. Measurement data to reveal an increase in the Multiple Intelligence were by means of tests and observation. Increasing of logical mathematics was analyzed from the results of pretest and posttest, by calculating the price (N-gain) of each indicator of logical mathematics between the experimental class and control class. While the increasing of interpersonal and intrapersonal intelligence was seen from the observation that was analyzed descriptively. Learning steps are adapted from Cacciatore & Sevian (2009), the learning begins with a contract of lectures, and then followed by: (1) orienting student on the problem, pretest, (2) organizing student to study, (3) guiding group investigation, (4) presenting the results of research project, (5) analyzing and evaluating the problem-solving process, and (6) students work on the posttest.

RESULT AND EXPLANATION

Multiple Intelligences which are expected to increase through the laboratory inquiry activity is logical mathematics intelligence, intrapersonal and interpersonal. The increase of logical mathematics intelligence is measured after the implementation of the model which includes the analysis of the results of the pretest-posttest for each indicator of logical mathematics. Indicators of logical mathematics intelligence revealed in this study are problem solving (PS), thinking pattern (TP), calculation processes (CP), logical analysis (LA) and mathematical operations (MO). Results of the analysis of the pretest-posttest score of each indicator of logical mathematics intelligence mathematics in the control class and experimental class in % N-gain are shown in Figure 1.

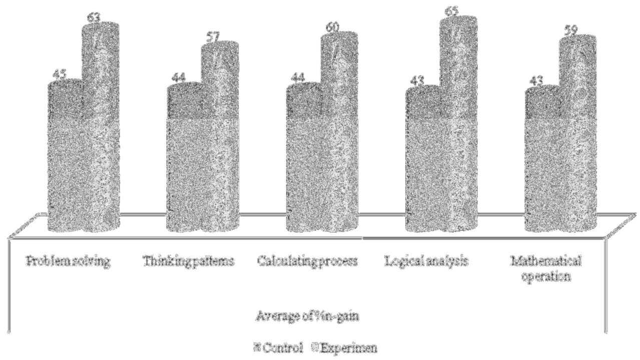

Figure 1. Mean% N-gain of each indicator of logical mathematics intelligence in the control class and experimental class

The increase in the average % N-gain of each indicator of logical mathematics, the highest one is occurred in logical analysis indicator, and then followed with problem solving indicator, calculation processes, and mathematical operations, while the lowest % N-gain is in the thinking pattern indicator. However, all of them belong to the increase level with medium category. The increase of % N-gain in the experimental class is higher than the control class. This happens because the implementation of inquiry activity model in the experimental class can provide a good learning situation for developing logical mathematics intelligence.

The highest increase occurred in the logical analysis indicator, followed by problem solving, calculation processes, and mathematical operations, as well as the lowest for an increase in the thinking pattern indicator. Strengthening towards the increase is obtained through tabulation with t-test, in which it was found that an increase in all of the indicators differed significantly. Other studies that support this result are Herayanti (2009), Iriany (2009), and Nuryati (2010), which indicate that the inquiry approach can improve the mathematical problem solving and logical mathematics reasoning skills / logical analysis.

Each indicator in the logical mathematics intelligence can develop well at the stage of inquiry activity, because in stage which is started with the problem, it is always trained how to plan solving problems, carry out experiments which have been designed, analyze data from the implementation of the experiment so that the increase will be better. Then in each step of inquiry activity, the students always have to calculate and use mathematical stages. Thus the calculation processes and mathematical operations skills are trained. In the implementation of the model, the students always think of observational data processing steps after the experiments, so that the thinking pattern skill is trained.

This model provides an opportunity for students to be actively involved in the process of making the experimental design, conducting the experiment, directly involved in solving the problem and conducting experiments, analyzing the experimental data logically, to reporting the results of the experiment. Thus, students experience a situation that led to the increase in the logical mathematics intelligence. These results are in line with the results of the study conducted by Wildfire (2010), that the inquiry activity can improve the mathematical understanding and logical mathematics reasoning skills in students. The development of logical mathematics intelligence is strengthened again in the presentation step of the experimental design, each student interact with friends in their group and also other groups, in which according to the theory of learning of Vygotsy (Dahar, 1996) will enrich the intellectual development of students.

Carter, (2005) states that if a student is trained to carry out the settlement of the complex problems that this exercise will form the Habits of mind of students. This student's habit is strongly influenced by the attitude of the students towards learning. This habit of thinking is basically preceded by the establishment of a positive attitude of students towards learning. Aklinoglu (2007) stated that the learning innovation gives positive effect on the mastery of concepts and attitudes towards science learning. Habits of mind are also associated with the ability of students in doing the analysis and scientific reasoning. In the study of Anggraeni (2006) and Zulfiani, (2006); it was found that the inquiry-based science learning can improve both of those capabilities. In harmony with this finding, Cacciatore (2009) stated that the laboratory inquiry activity can establish a theory and also build complex thinking.

Intrapersonal intelligence is an ability that allows individuals to properly classify their feelings, for example, distinguish between pain and pleasure, and behave as such distinction. This intelligence allows individuals to construct their mental model accurately, and describe several models to make good decisions in their lives (Lazear, 2004).

The increase of intrapersonal intelligence can be measured with five indicators, they are self-reflection (can connect the facts to be opinion of oneself); emotional processing (show seriousness in solving problem to be a new discovery), metacognition (think about the steps in solving problems), values clarification (can show the ability to assess and connect with the opinion of oneself), and self-identity (can identify concepts and his personal opinion) Lazear 2004.

The increase of intrapersonal intelligence between the control class and experimental class is shown in Figure 2. After the implementation of the inquiry activities in the laboratory were analyzed to measure the improvement of each indicator of intrapersonal intelligence, through the stages of inquiry in analyzing journal, determining the problem, making hypotheses in experimental design and reporting experiments.

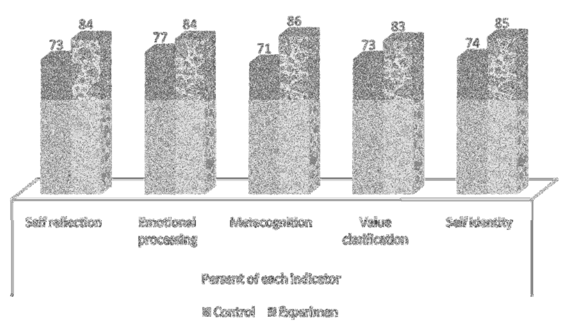

Figure 2. Percentage of each indicator of intrapersonal intelligence in the experimental class and control class

Figure 2 presents the percentage of the observation result of each indicator for the control class and experimental class. The highest increase is in the metacognition indicator. The second highest achievement is on the indicators of self-reflection and self-identity, it is presumably because at this stage of inquiry begins by identifying problems of several journals, to determine the problem. The next increase is in the value clarification indicator, while the lowest increase is in the emotional processing indicator.

This increase possibly happens since starting from designing experiments, students are trained to find the source of information as the theoretical basis and think of such a move is in compliance or not with the problem, besides the student must also be able to adjust with the equipment available in the laboratory.

In addition, during the experiment the students will always think about what steps to take if there are obstacles that occur in implementing the working steps that have been designed well. This metacognition is also potential to develop at the stage of designing the experiment, the data analysis of experimental results, report writing, and presentation of results, because in those stages, the students should always proceed their thinking process.

This result is in accordance with the opinion of Kipnis (2007) and Cacciatore (2009), which state that the inquiry-based lab learning can improve student's metacognition. A similar study also stated that the problem-based learning can improve student's metacognition (Haryani, 2011). Also the finding of Anwar (2005) that in solving complex problems, multiple intelligences including using metacognition, which is part of the Habits of Mind are required (Costa, 2000).

Self-identity is one of intrapersonal indicators that the increase belongs to high level. On this indicator the students were able to link the existing facts into their own opinions; students are able to identify the basic concepts with their personal opinions. This increase reasonably occurred because of during inquiry activity, students were trained to find references as a basic concept to solve the problem, and then analyze the observation data and process them into a new understanding. It also develops well because metacognition indicator also develops well and even better. This is similar to the findings of Haryani (2011) that an increase of metacognition in problem-based practicum occurs because metacognition is a reflection on every step in a task.

CONCLUSION

The study that has been done results in a conclusion that the laboratory inquiry activity can improve logical mathematics intelligence, with the highest percentage of N-gain is in the logical analysis indicator by 65% and increase the intrapersonal intelligence, in which the highest one is in the metacognition indicator with the percentage of observation result by 86% or it can be said that laboratory inquiry activity can improve Multiple Intelligences.

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