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Implementation of Self Assessment to Increase The Science Process Skills and The High-Level Cognitive Abilities on Plants Growth and Development through Research-Based Learning

Linawati Kuswanda^{1*}, Anna Fitri Hindriana², Awis Hamid Dani¹, M.Firman Ismana¹, and Abas Hidayat¹

¹ Sekolah Tinggi Ilmu Kesehatan Cirebon

² Universitas Kuningan, Indonesia

*alwishdani@yahoo.com

Abstract. This study aims to improve the KPS and students' high cognitive abilities after the implementation of self assessment through research-based learning. The research method used is mixed methods with Sequential Exploratory design. The population of this research is the students of class XI one of the vocational competence of nursing skills in Cirebon Regency. The research sample consisted of two classes determined by purposive random sampling technique, namely control class amounted to 27 people and 27 experimental class. The results showed that the average of self-assessment of the experimental class students is 81% with the superior category. The result of observation of experimental class KPS based on teacher observation is 88% with superior category and observation result of control class KPS is 77% with competent category. Thus, KPS increases after the implementation of self assessment. The data of research result of high level cognitive ability obtained by giving cognitive test at cognitive level of C3 until C6 growth and plant growth material in the form of pre test and post test. The collected data were analyzed by using descriptive statistics and comparative inferential statistics 2 paired sample groups. The result of descriptive analysis shows that the average value of pre test result of experiment class is 45,74 and post test result is 82,96, N-gain 0,70 with high category. The mean value of pre test result of control class 54,72 and post test result is 67,22, N-gain 0,30 with low category. KKM Biology lesson in class XI is 70, this shows the average post test experimental grade above KKM and control class is still below KKM. The result of t test dependent on pre test score and post test of high cognitive ability obtained by significance value 0,00 (sig <0,05) hence Ho refused and Ha accepted. This proves that Self Assessment can improve students' high cognitive abilities. Thus it can be concluded that the implementation of Self Assessment can improve the KPS and students' high cognitive abilities on the material growth and development of plants through research-based learning.

1. Introduction

Generally, the grading systems used by teachers are paper and pencil tests since they are considered quite practical while using authentic assessments requires more energy, money, and time and thus teachers are reluctant to use them. These thoughts and behaviors can hamper the achievement of the quality of learning and education. So we need a method of how students can think critically to improve



student competency, in line with Daniar Setyorini (2017) that Critical Thinking is one of the important competencies students have because it can help students transfer knowledge and apply problem solving abilities. The ability to think critically of Indonesian students is still very low.[1]The results of a study conducted by Clipa, Ignat and Rusu in 2011 concluded that there was a significant positive correlation between motivation, cognitive abilities of students and the level of accuracy of self-assessment.[2] A study conducted by Ritchie in 2016 concluded that structured self-assessment could improve presentation skills of students.

One of the assessments that strengthens authentic assessment as developed in 2013 curriculum learning is Self Assessment. In this study the authors are trying to implement self-assessment through research-based learning. Research-based learning is one of the student-centered learning methods, which integrates research in the learning process. RBL is multifaceted which refers to a variety of learning methods. RBL provides opportunities/chances for students to search for information, formulate hypotheses, collect data, analyze data, and make conclusions on data that has been arranged; learning with the "learning by doing" approach applies in those activities. Hoskins & Mitchell (2015) states that the advantages of implementing a research-based learning model are that it can increase the motivation of students to be more active, have independence in learning, be critical and creative so that it can improve student learning outcomes.[3]

Research-based learning is closely related to the nature of science and can be the best means of developing science process skills and high-level of cognitive ability during the learning process. In low ability students open inquiry was very inconvenient method to directly apply. Hence, adaptation and modification is needed to help low ability students, for instance, supply them with some general procedures in the first learning period or let students watching the example or attempt the activity before learning activity in the classroom. These will eventually lead students to true inquiry. In addition, in the learning activity teacher has to concern in the process of grouping and class management to maximize knowledge transfer from high to low academic ability.[4]

Science process skills are the activities in which students carry out scientific investigations to obtain scientific knowledge and skills. Students are expected to be able to describe objects and events, ask questions, construct statements, try the results of construction through inquiry and communicate ideas. Based on the background of the problem, the authors are interested in studying "Implementation of Self-assessment to Improve Science Process Skills and High-Level Cognitive Abilities on the Concept of Plants Growth and Development through Research-Based Learning among Students." This study aims to: 1. Observing the implementation of Self Assessment in improving science process skills and high-level cognitive abilities in research-based learning. 2. Assessing students' scientific process skills and high-level cognitive abilities using self-assessment through research-based learning. 3. To identify students' responses to Self Assessment in improving science process skills and high-level cognitive abilities through research-based learning.

2. Study Methods

The aspect to be examined in this study was the implementation of self-assessment to improve students' science process skills and high-level cognitive abilities in the concept of plants growth and development through research-based learning. The unit investigated by the author was the study on the application of self-assessment in the teaching and learning process among the subjects (learners) on biological concept, especially the concept of plants growth and development. This study related to scientific discipline (evaluation, teaching and learning process, biology) and information sources (learners/students). Location: RISE VHS Kedawung, Cirebon District. Study period was March 14 - May 3, 2017, using mixed methods and Sequential Exploratory models/designs.

Population in this study, the population was XI grade students of RISE VHS Kedawung Cirebon, nursing expertise competency, who received biology subjects with the same curriculum, which consisted of three classes. The samples students used in this study were two classes, namely one

class as the experimental class and one other class as the control class. This study used a purposive random sampling technique. The sample selection considered that the samples selected were the students of XI grade of RISE VHS Kedawung, Cirebon District who had the homogeneous ability based on End of Semester Exam results in the previous semester.

The data collection tools were collected and then the instruments were tested with the following details: 1. Self Assessment Instrument with total of 16 statements and 14 were valid; 2. High Level Cognitive Instrument, with total of 25 multiple choice questions and 20 items were valid; 3. Student response instrument, with total of 15 items and 10 items were valid; 4. Based on distinguishing power there were 4 bad questions, 7 moderate questions, 10 good questions and 4 very good questions. Based on the level of difficulty of the questions there were 9 easy questions, 13 medium questions and 3 difficult questions.

3. Results

3.1 Self Assessment Observation

Based on the mean percentage of self-assessment observation conducted by students, the results showed that the mean self-assessment of the 81% of students in experimental class had the superior category. Student Self Assessment results can be seen in Figure 1 as follows:

The results of self-assessment based on the KPS indicator

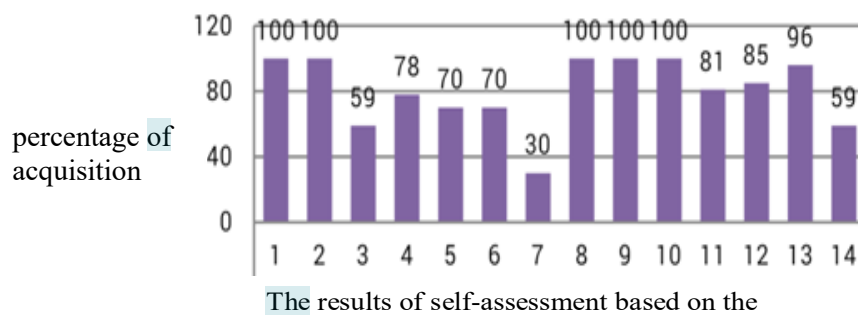


Figure 1. Graph of Percentage of Self Assessment Results

3.2 Science Process Skills (KPS) Observation

Based on the mean percentage of KPS observations conducted by teachers in the experimental class, it was shown that 88% had superior category and observation result on control class KPS showed that 77% had competent category. The results of KPS observed by teachers can be seen in Figure 2 as follows:

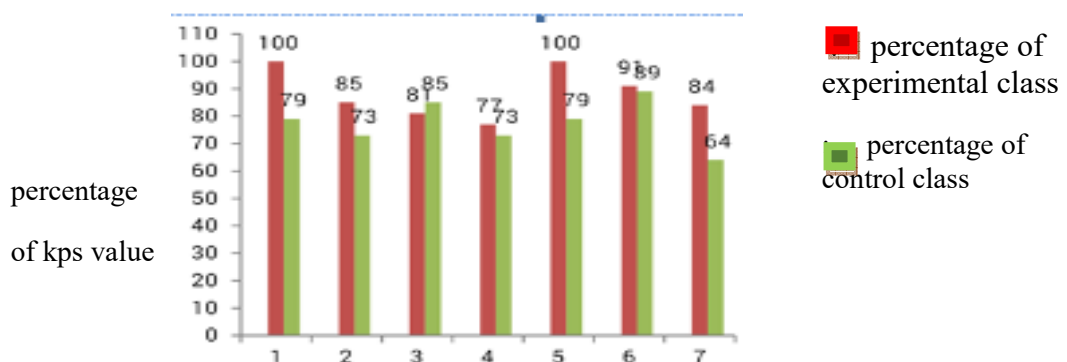


Figure 2. Graph of Percentage of KPS Value based on Students' Science Process Skills Indicator in the Experiment Class and the Control Class

3.3 High-Level Cognitive Abilities

3.3.1 Experiment Class

The mean value of pretest result in the experiment class was 45.74 and the posttest result was 82.96, this indicated that the high level of cognitive abilities among students increased after the implementation of Self Assessment. The N-gain value obtained was 0.70 which indicated that the high-level cognitive abilities among students in the experimental class increased with high criteria. Based on the above values, the Implementation of Self Assessment given to the experimental class had a positive impact as the effort to improve high-level cognitive abilities.

3.3.2 Control Class

The mean value of pretest result in the control class was 54.72 and posttest result was 67.22. The N-gain value obtained was 0.30 which indicated that the high-level cognitive abilities among students in the control class increased with low criteria. This showed that the increase in high-level cognitive abilities among students in the control class increased with low criteria.

3.4 Normality Test for Experiment Class and Control Class based on Pretest Results

The significance value from the Kolmogorov-Smirnov Test in the experimental class was 0.200. This meant that $\text{sig. } 0.200 > 0.05$. Thus it can be concluded that the pre-test data in the experimental class were normally distributed. The significance value from the Kolmogorov-Smirnov Test in the control class was 0.098. This meant that $\text{sig. } 0.098 > 0.05$. Thus it can be concluded that the pre-test data in the control class were normally distributed.

3.5 Homogeneity Test for Experiment Class and Control Class based on Pretest Results

The significance value was 0.64. Since the significance value was more than 0.05, it can be concluded that the two data groups had the same or homogeneous variants. Lavene Statistics show that the smaller the value, the greater the homogeneity.

3.6 Hypothesis test

3.6.1 The Result of Pre-Post Dependent T-Test on High-Level Cognitive Abilities for the Experiment Class

It was obtained a significance value of 0.00 ($\text{sig} < 0.05$) thus, it can be concluded that there was a significant difference in the High-Level Cognitive Abilities among students before and after learning.

3.6.2 The Result of Pre-Post Dependent T-Test on High-Level Cognitive Abilities for the Control Class

It was obtained a significance value of 0.00 ($\text{sig} < 0.05$) thus, it can be concluded that there was a significant difference in the High-Level Cognitive Abilities among students before and after learning

3.6.3 The Result of Independent T-Test on High-Level Cognitive Abilities between the Experiment Class and the Control Class

It was obtained a significance value of 0.00 ($\text{sig} < 0.05$) thus, it can be concluded that there was a significant difference in the posttest values between the control class and the experimental class.

The Result of Independent T-Test on KPS between the Experiment Class and the Control Class. It was obtained a significance value of 0.00 ($\text{sig} < 0.05$) thus, it can be concluded that there was a significant difference in KPS between the control class and the experimental class

3.6.5 Student Response

There was a positive response consisting of strongly agreed (SA) and agreed (A) responses as much as 93.5% respondents, respectively. This showed that the response of students towards positive categorical statements was very strong, and it could be assessed in all aspects of the responses on the questionnaire.

4. Discussion

4.1 The Implementation of Self Assessment in Research Based Learning

Students' positive responses and behaviors in learning activities in each research-based learning syntax were due to the teacher successfully proved the learning experience as a process of self-reflection and was committed that students would make changes in their behaviors. In this study the teacher gave appreciation to all students for all achievements in research-based learning so that students felt motivated and self assessment could continue on other learning materials and models at the replication stage.

Based on teacher observations in class, self assessment increased student motivation in following lessons. Great motivation for students is something very important for everyone to do something even though it is a complex work. Motivation will cause changes in human beings and is related to human beings, it is related to psychological problems, feelings and emotions, to further act or do something. All this is driven by the existence of goals, needs or desires to make it happen so that expectations can turn into reality. The goal of motivation is learning. Motivation to learn is a tendency of someone that is shown by their activity in following lessons and completing assignments at school and studying at home.

4.2 Science Process Skills of Students

The results of KPS observations both assessed by the students through self-assessment and by the teacher made a major contribution to their grades. In this study research-based learning conducted in the experimental class had an effect on the increase in science process skills after the implementation of self assessment.

The result of this study is supported by a study conducted by Ritchie, 2016 which concluded that the use of structured self-assessment could improve student presentation skills.[5] Furthermore, a study conducted by Suarta, 2015 also stated that authentic self-assessment model developed could be used to assess cognitive, affective, and psychomotor aspects.[6] Problem solving and self-management are part of the cognitive and affective structure of the learning process. Through this study it was evidenced that teachers could facilitate students to do self-assessment and the results of teacher observations had an effect on the increase in science process skills after the implementation of self-assessment through research-based learning.

By conducting research-based learning both in the experimental class and in the control class, there was an increase in science process skills along with the development of key skills that must be developed to deal with the challenges in the 21st century, including: Problem solving skills; Communication and collaboration skills; The skills to be active, innovative, and to equip ourselves with science; and creative and analytical thinking skills.[7] As revealed by Subali, 2011, biology as a branch of Natural Sciences provides a variety of learning experiences to understand the concepts and skills of scientific processes related to the life of living things.[8]

4.3 High-Level Cognitive Abilities of Students

Student behavior towards learning activities was very positive, among others students felt confident, uplifting, enthusiastic and confident about their cognitive process activities. This was due to the teacher could create a comfortable mood for students to do AS through research-based learning activities. The teacher's efforts included implementing varied learning methods, utilizing information technology, AS training at the initial meeting and providing motivation throughout the student

learning process. Motivation delivered by teachers is very valuable for students. As explained earlier, in this study students evaluated their cognitive abilities through pretest and posttest on high-level cognitive questions that were spread on cognitive dimensions C3 to C6. The results evidenced that they had the ability to process high-level cognition in the concept of plants growth and development.

Based on the description above it is very clear that research-based learning by implementing self-assessment conducted in this study also facilitated students in improving high-level cognitive abilities and it was proven from answers to questions based on high-level cognitive indicators given after students had research-based learning. High-level cognitive outcomes among students increased as previously explained through the results of pretest and posttest. Thus, this study can provide information to the world of education that self-assessment is effective in increasing students' high-level cognitive abilities and the same intervention can be applied to other material.

The results of this study are in line with other study that revealed self-assessment. The study conducted by Wijayanti and Mundilarto, 2015, concluded that the use of self-assessment and peer assessment was very useful. Information on learning outcomes obtained directly after conducting the test was very supportive because it could be used to monitor the learning process, learning progress and continuous improvement in student learning outcomes. The students were encouraged to be more active, motivated, more disciplined, and better prepared. In line with the research conducted by I Made Suarta which concluded the results of his research that the authentic self-assessment model developed can be used to assess cognitive, affective, and psychomotor aspects. Problem solving and self-management are part of the cognitive and affective structure of the learning process. The results of other studies by Yuni Pantiwati prove the existence there has been an influence of self and peer-assessments in active learning to metacognitive awareness and competence.[9]

Regarding high-level cognitive abilities, the category of knowledge dimension was based on the results of recent studies about the important role of students' knowledge of their own cognition and their control of that cognition in learning activities. These high-level cognitive abilities must be developed by teachers in order to produce graduates who are characterized, competent and literate to be ready to face the challenges in the 21st century. This is in line with the characteristic of 21st century education, where the learning developed must be able to encourage students to develop Higher Order Thinking Skills (HOTS). Then the teacher must be able to motivate students to understand the interconnection between concepts, both in their subjects and between subjects and the applications in the real world. The skills needed in the 21st century are also HOTS that are highly needed in preparing students to face global challenges.[10] Based on the results of student response, the mean percentage of 10 statements with positive category that obtained positive response consisting of strongly agreed and agreed responses was 93.5%. This showed that the response of students towards positive categorical statements was very strong, and it could be assessed in all aspects of the responses on the questionnaire.

5. Conclusions

The implementation of self-assessment (SA) carried out by students of the experimental class increased the ability of students' high-level of cognitive ability and science process skills on the concept of plant growth and development through research-based learning. KPS ability showed a difference between the control class and the experimental class. Almost all KPS indicators in the experimental class showed a superior value and in the control class showed a competent value. High-Level Cognitive Abilities increased both in the control class and the experimental class. However as can be seen, the mean value in the control class had not reached the KKM and the mean value in the experimental class had exceeded the KKM, and overall students generally agreed that they wanted to use self-assessment on the concept of plants growth and development.

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