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The Implementation of Pedagogical Content Knowledge (PCK) based Guided Inquiry on Science Teacher Students

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Abstract

The aim of this study is examining the learning of Integrated Sciences through PCK based guided inquiry on prospective science teacher students. This research method was descriptive qualitative involving 33 science teacher students who taking Integrated Science 1 Subject in academic year 2016/2017. The research instrument used was the observation sheet to know the implementation PCK based guided inquiry. The results showed that the implementation of the activities of lecturer and science teacher students during the learning process using PCK based guided inquiry was very good conducted.

Keywords: PCK, Guided Inquiry, Science Teacher Students

INTRODUCTION

Learning concepts is the main outcome of education because to solve problems, a student must know the relevant rules, and these rules are based on the concepts he/she obtains. Learning concepts requires the ability to discover the same featues on a number of objects. Because people experience different stimuli, people form concepts according to the grouping of stimuli in a certain way (Dahar, 1988; Winkel, 1996).

Posner, et al. (1998), in the learning process there is a process of concept change. The concept changes through two stages, namely the stage of assimilation and the stage of accommodation. The stage of assimilation of students using the concepts that have been possessed to deal with the new phenomenon. Stage of accommodation, students change the concept that does not fit again with the new phenomenon faced. The existence of this alteration may cause the original concept to be wrong or vice versa. The use of misconceptions can be said to be misconceptions. Learning process is a complex result, it is students who determine whether or not learning is happening (Dimyati & Mudjiono, 2006). Teachers function as mentors and directors, while those that move the process must come from students. Thus, a teacher needs to apply an approach that directs students actively participate and explore their own potential, so that students are able to develop scientific process skills such as observing, classifying, predicting, measuring, summarizing, and communicating.

One of the learning models involving student activeness to construct their own knowledge is guided inquiry model. The guided inquiry learning model is an application of constructivism learning based on observation and scientific study. This is in line with Elusegun (2005) explain that the implication of contructivism can encourage student inquiry. Inquiri can be interpreted as a process of asking questions and finding answers to scientific questions asked by teachers to students.

The development of PCK based learning in educating science student teachers has begun to be applied, so that the availability of assessment tools is needed in measuring the success rate of learning. Pedagogical Content Knowledge (PCK) according to Loughran, et al (2012) is knowledge in designing teaching situations to help learners' understanding of the content of facts of science. PCK according to Anwar, et al (2016) is an important knowledge in the process of developing science literacy and the ability to transform teachers' knowledge into the

learning process. PCK assessment tool is expected to provide an overview of the professional knowledge of students and the special skills of science student teachers with a variety of potential students.

From the results of interviews with science teacher students, they are still having difficulties about learning Integrated Science. Students have not been able to distinguish the integrated model applied in Integrated Science 1 lesson. This led the study to examine the implementation of PCK based guided inquiry to science teacher students.

METHOD

This research used descriptive qualitative research method. Subjects in this study are science student teachers taking Integrated Science 1 subject of odd semester in academic year 2016/2017 which amounted to 33 students at the Department of Science Education at one of university in Banten, Indonesia. The research instrument used is an observation sheet on Integrated Science 1. Observation sheet for PCK-based Guided Inquiry implementation to reduce the misconception of science student teachers in Integrated Science 1 subject. The observation sheet contains activities referring to the guided inquiry stage, among others: orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses and formulating conclusions.

This observation was made in the form of a checklist (√) in the "yes" or "no" columns if the criteria referred to in the checklist are shown by lecturers and students during the learning process. On the observation sheet also provided a description column showing the number of students who perform activities in accordance with the stage guided inquiry.

Technique analysis of observation data adjusted based on Singarimbun and Effendi (2011), the answers obtained are symbolized in the form of numbers called codes that have been determined by researchers. Each indicator statement relates to the research objectives. Each stage of lecturers and science student teachers activity has assessment criteria: 3 = very good, 2 = enough, 1 = less and 0 = not good. The first stage in coding is to study respondents' answers. The way the calculation as pattern 1:

$$\frac{\text{score}}{\text{value of each the stages}} = \Sigma \text{ any indicator of the respondent's answer} \quad (1)$$

The number of respondents is 33 science teachers students. Based on the observation instrument guide, it can be seen the calculation of each indicator PCK based Guided Inquiry on the lecture activity and science teacher students in the criteria can be seen on Table 1, Table 2, and Table 3.

Table 1. Criteria for PCK Based Guided Inquiry in Lecturer Activity

Range	Criteria
0 – 6	Not good
7 – 12	good
13 – 18	very good

(Modification from Singarimbun & Effendi, 2011)

Table 2. PCK Performance Guided Inquiry Criteria for each Indicator on Student Activity Prospective Teachers

Range	Criteria
0 – 33	Not good
34 – 66	good
67 – 99	very good

(Modification from Singarimbun & Effendi, 2011)

Table 3. PCK Guided Inquiry Performance Calculation Codes in Student Activity Prospective Students Overall

Range	Criteria
0 – 198	Not good
199 – 396	good
397 – 594	very good

(Modification from Singarimbun & Effendi, 2011)

RESULTS AND DISCUSSION

Pedagogical Content Knowledge (PCK) based Guided Inquiry

In this study to know the implementation of each step of PCK based guided inquiry, then developed research instrument in the form of observation sheet. The observation sheet was chosen because it was considered to directly observe the activities of lecturers and science student teachers during the learning process of Integrated Science 1. On the observation sheet each step PCK based guided inqury consists of three indicators in the form of activities undertaken by faculty and science teacher students. Provision of checklist on each activity that appears both lecturers and science student teachers are given the value of one and zero for that does not appear.

Table 4 made by the observer on the implementation of PCK based guided inquiry stage conducted by the lecturer, all indicators at each stage are very good done, this can be seen through the observation sheet. In the learning process lecturers provide guidance to prospective students of teachers, so that students who think slow still able to follow the activities that are being implemented. This is in accordance

with Diepen-Scheerboom (2017) which suggests that guided inquiry learning is an inquiry learning model which in the implementation of the teacher provides sufficient guidance for students. The data of observation result of science student teachers during learning process of Integrated Science 1 can be seen on Table 5.

Table 4 showed the data of implementation of PCK based guided inquiry stages in lecturer's activities, at this stage the lecturers have conditioned the science student teachers in the group to be ready to implement the Integrated Science 1 learning process, stimulate and invite to think of a phenomenon presented on the theme of water purification. Lecturers direct science student teachers to form knowledge, content and pedagogy so as to have a knowledge of how to teach an integrated science materials to learners. Lecturers direct science student teachers to understand and be able to integrate knowledge of the content into the knowledge of curriculum, learning, teaching and learners on the theme of water purification.

All 33 students sit in groups and prepare for Integrated Science 1 learning activities and pay attention to the phenomenon presented on the theme of water purification. At the stage of preparing to form knowledge, content and pedagogy so as to have a knowledge of how to teach an Integrated Science 1 materials to students followed by 22 students. Student candidates integrate the knowledge content into the knowledge of the curriculum, learning, teaching and pserta on the theme of water purification carried out as many as 22 people.

Based on Table 5 can be known amount of value for orientation stage equal to 77, so that can be stated for PCK-based Guided Inquiry at orientation stage executed very well by lecturer and science student teachers. From the description of the activities of lecturers and students have described the activities in the orientation stage according to Hosnan (2014), that educators stimulate and invite students to think solve problems.

Table 6 showed the data of the stage of formulating problems, it shows that the lecturer directs the science student teachers to formulate the problem so as to gain experience in the process of learning Integrated Science 1 as an effort to develop mental through the process of thinking. Lecturers encourage prospective teachers to raise questions based on the phenomena presented on the theme of water purification. In addition, lecturers guide science student teachers understand the problems that arise in the theme of water purification in the implementation of Integrated Science. Formulate the problem so as to gain experience in the process of learning Integrated Science 1 conducted by 23 science teacher students. Bring up some questions based on the phenomenon

presented on the theme of water purification carried out by 21 prospective teachers. Understanding the problems that arise on the theme of water purification in Integrated Science 1 subject implemented by 22 science teacher students.

Based on Table 6, it concluded that the number of values for indicators at the stage of formulating the problem by science student teachers during the Integrated Science 1 learning process amounted to 66. The number stated that the student candidate has done the activity of formulating the problem quite well. The activity at this stage of formulating the problem has not been implemented maximally, this is because the students still do not understand how to raise questions from the theme of water purifier which can encourage student's thinking ability to solve it.

Table 7 showed the data of the stage of formulating hypotheses, at this stage the lecturer asks science student teachers in groups to make temporary answers to the problems found. The lecturer directs the science student teachers to plan temporary answers in every problems at theme of water purification to train logical and rational thinking. The lecturer directs to presenting and formulating the subject so it can be making it into something that can be comprehensively understood and it can be used in solving the problem.

All science student teachers as much 33 persons discuss in groups to make temporary answers to the problems they found. Discussion activities in groups to plan temporary answers to any problems on the theme of water purification were carried out by 30 science student teachers. Discussion activities in groups to present and formulate something that can be understood comprehensively so that it can be used in solving problem followed by 29 science student teachers.

Based on Table 7, got the total amount 92 for the stage formulated the hypothesis on the activities of science student teachers in the process of learning Integrated Science 1. Those amount is categorized that the stage of formulating hypotheses are carried out very good. At this stage the amount of value obtained is quite large, this is because at this stage science student teachers do it in groups. Group learning can make college students actively exchange ideas to make hypothesize from the problems presented.

Table 8 showed the data of the stage of collecting data, at this the stage the lecturer directs the science student teachers in the activity to get the information needed to test the temporary answer which submitted. Lecturers provide motivation to science student teachers in the process of collecting data at the theme of water purification. The lecturer conditions the science student teachers to maximize potential thinking in collecting data which will be provision in testing them temporary answer.

At the activity of geting the information needed to test the temporary answer which proposed implemented 20 people. A total of 22 college student of science student teachers are more motivated in the process of collecting data on the theme of water purification. Maximizing the potential of think in collecting data that will be a provision in testing the temporary answer was implemented by 24 science student teachers. Based on the activity of collecting data obtained the total sum value 66. The amount states that the stage of collecting data carried out fairly well. At this stage science student teachers activity has not done maximally, this is because of to much data obtained from each college student. The amount of data obtained allows college students experiencing confusion that is really relevant to be used as a reference to solve the problems.

Table 9 showed at the stage of testing the hypothesis, at this stage the lecturer conditioned the science student teachers in the process of determining answer that is considered accepted in accordance with the data or information obtained based on data collection. The lecturer directs the science student teachers to test a temporary answer that is deemed to be most appropriate to the relevant data. The lecturer directs the science student teachers to test the temporary answer by referring to the concept and Integrated Science 1 content on the water purification theme.

Activities determine the answers that are considered acceptable in accordance with the theme of data or information obtained based on data collection conducted by 25 science student teachers. The activity of do testing for the temporary answer which is deemed to be most match to the relevant data is done by 21 science student teachers. The activity tested temporary answer with reference to the concept and content of Integrated Science 1 on the theme of water purification implemented 21 science student teachers Based on data of the stages of testing the hypothesis obtained the total value 67. That value state that the stages of testing the hypotheses on the Integrated Science 1 learning process of water purification theme is carried out well.

Table 10 showed the stage of formulating the conclusion, at this stage the lecturer asks the college science student teachers in groups to discuss formulating the conclusions from testing the hypothesis that has been done. Lecturers direct the science student teachers in the process of describing the findings obtained based on the results of testing the hypothesis in accordance with the relevant data. The lecturer asks from each group representative to express the conclusions of the results of the Integrated Science subject on the theme of water purification.

The activities of science student teachers in groups discuss to formulate the conclusion of testing hypothesis that has been conducted by 22 science student teachers. Activities describing the findings obtained based on the results of hypothesis testing in accordance with relevant data implemented by 22 science student teachers and group representative activities revealed the conclusions of the results of learning Integrated Science on the theme of water purification implemented by 26 science teacher students.

Based on that, obtained a total value 70. It can be concluded that the stages of formulating conclusions at the end of teaching and learning activities are done very well. Content and pedagogy are equally important and nothing more important and they should be able to run together and co-exist at the same time and are considered effective can enhancing the learning process of science student teachers in the idea of *Pedagogical Content Knowledge (National Science Teacher Association (NSTA) Standard* in Enfield, 2003).

The result of observation of activity of science teacher students during learning process of Integrated Science 1 can be seen on Table 11 it got total amount 438. That amount can be categorized as activity of science teacher students based on PCK-based guided inquiry to reduce misconception Integrated Science implemented was very good.

Table 4. Data of Implementation of PCK Based Guided Inquiry Stages in Lecturer's Activities

No	Step	Indicator	Amount	Criteria
1.	Orientation	1a, 1b, 1c	3	Very good
2.	Formulate the Problem	2a, 2b, 2c	3	Very good
3.	Formulate a Hypothesis	3a, 3b, 3c	3	Very good
4.	Collecting Data	4a, 4b, 4c	3	Very good
5.	Test the Hypothesis	5a, 5b, 5c	3	Very good
6.	Formulate Conclusion	6a, 6b, 6c	3	Very good
	Total		18	Done very good

Table 5. Data of the Stage of Orientation

No.	Indicator	Responden
1.	Seat in groups and prepare for Integrated Science learning activities and pay attention to the phenomenon presented on the theme of water purification	33
2.	Preparing to form knowledge, content and pedagogy so as to have a knowledge of how to teach an Integrated Science materials to learners	22
3.	Integrate the knowledge of the content into the knowledge of the curriculum, learning, teaching and learners on the theme of water purification	22
	Total	77

Table 6. Data of the Stage of Formulating Problems

No.	Indicator	Responden
1.	Formulate the problem so as to gain experience in the Integrated Science learning process	23
2.	Bring up some questions based on the phenomenon presented on the theme of water purification	21
3.	Understand the problems that arise on the theme of water purification in Integrated Science learning	22
	Total	66

Table 7. Data of the Stage of Formulating Hypothesis

No.	Indicator	Responden
1.	Discussion in groups to make temporary answers to problems found	33
2.	Discussion in groups to design temporary answers on any issues on the water purification theme	30
3.	Discussion in groups to present and formulate something that can be comprehensively so that it can be used in solving problems	29
	Total	92

Table 8. Data of the Stage of Collecting Data

No.	Indicator	Responden
1.	Retrieves the information needed to test the temporary answer posed	20
2.	More motivated in the process of collecting data on the theme of water purification	22
3.	Maximize the potential of thinking in collecting data that will be provisioned in testing the temporary answer	24
	Total	66

Table 9. Data of the Stage of Testing Hypothesis

No.	Indicator	Responden
1.	Determining the answer deemed to be received in accordance with the data or information obtained based on the data collection	25
2.	Testing the temporary answer deemed most appropriate by the relevant data	21
3.	Testing the temporary answer by referring to the concept and Integrated science content on the water purification theme.	21
	Total	67

Table 10. Data of the Stage of Formulating Conclusion

No.	Indicator	Responden
1.	In groups discuss formulating the conclusions of the hypothesis testing that has been done	22
2.	Describe the findings obtained based on the results of testing the hypothesis in accordance with relevant data	22
3.	The group representatives revealed the conclusion of the results of the Integrated Science learning on the theme of water purification	26
	Total	70

Table 11. Recap of Data of the Implementation of PCK based Guided Inquiry Stages to Reduce Integrated Science Misconception on Science Teacher Students.

No.	PCK-Based Guided Inquiry Stages	Amount	Category
1.	Orientation	77	Done very good
2.	Formulate the Problem	66	Pretty good
3.	Formulate a Hypothesis	92	Done very good
4.	Collecting Data	66	Pretty good
5.	Test the Hypothesis	67	Done very good
6.	Formulate Conclusion	70	Done very good
	Total	438	Done very good

The recapitulation of activities prospective teacher students with Pedagogical Content Knowledge (PCK) based Guided Inquiry can be found at Figure 1.

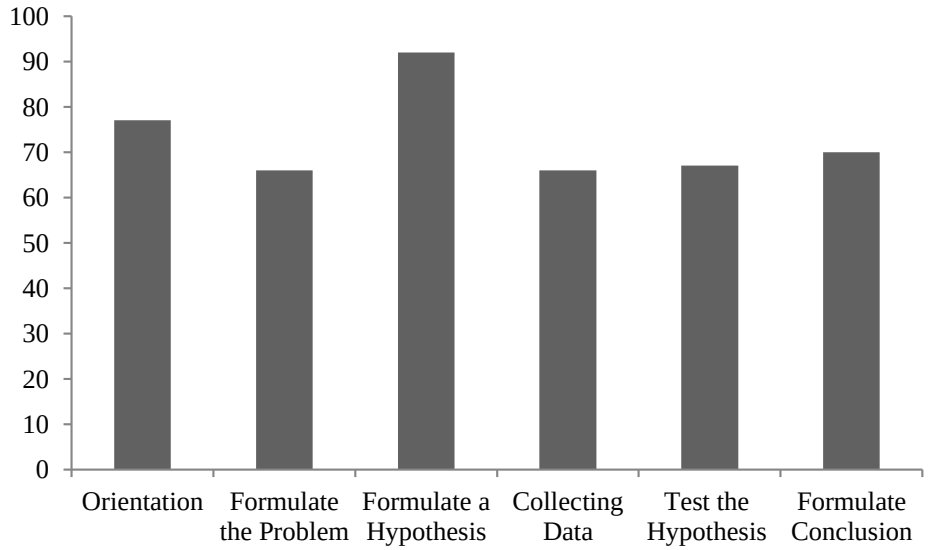

Figure 1. Activities Prospective Teacher Student with Pedagogical Content Knowledge (PCK) - Based Guided Inquiry

Based on Figure 1 to reduce misconception of Integrated Science, and then it is known that studies with PCK based guided inquiry emphasize to

maximum student activity to search and discover. This means that learning with PCK based guided inquiry on puts the science teacher students as a learning subject. All the activities which done by science student teachers are directed to seek and find their own answers from something in question, so it is expected can growing Pedagogical Content Knowledge science teacher students. In addition, learning with Guided Inquiry based on PCK can develop systematic, logical, and critical thinking skills, or develop intellectual ability as part of the mental process.

CONCLUSION

The implementation of the activities of lecturers and science teacher students during the learning process using Guided Inquiry based on Pedagogical Content Knowledge (PCK) is categorized as execute very good.

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