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THE RESULTS OF USING GUIDED INQUIRY ACTIVITIES WITH STRUCTURED ARGUMENTATION SCAFFOLD WITH PEER FEEDBACK

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The research objective was to test the quality of using the guided inquiry activities with structured argumentation scaffold and peer feedback. This was a trial period of the full research about the effects of using the guided inquiry activities with structured argumentation scaffold and peer feedback to promote high school students' ability in constructing a scientific explanation. The participants were a classroom of 43 eleventh graders who studied Biology II in the second semester of the 2016 academic year at Demonstration School of Suan Sunandha Rajabhat University, Thailand. The Research tools were the guided inquiry activities with structured argumentation scaffold and peer feedback, the classroom observation form and the interview form. The activities were administered for 6 weeks, 3 periods a week. The procedures and happening during the class period were observed by the researcher. The teacher was interviewed each week after teaching provided more information. Data were analyzed using coding, grouping and classifying. The findings of the trial study showed the effectiveness of the activities, but some aspects needed revision.

Keywords: Inquiry, Scientific explanation, Scaffolding, Argumentation, Peer feedback.

Introduction

Science is recognized as an important thing for social and economic development in every country. The impact of science on society makes it imperative that all individuals throughout the world become scientifically literate. Accordingly, countries all over the world require an on-going dynamic revision in the management of science education. Therefore, the management of science education is one crucial component in creating strength in science in order to prepare the citizens for living in the complex society as efficient producers and consumers (The Institute for the Promotion of Teaching Science and Technology (IPST). 2011). According to various open-ended, ill-structured problems in the society nowadays, many science educators pay attention to promoting skills for learners to deal with these problems for last decades such as decision making skill, scientific explanation skill, argumentation skill. The most important thing was to represent authentic contexts of science. They should know how to choose reliable data sources and how to construct new knowledge. These experiences would be a foundation for them to become competent people in the globalize society (Palachot. 2008). As students become voting and empowered citizens after graduation, understanding of scientific concepts and scientific process will help them to make informed decisions about the complex issues facing them (Driver, Newton, & Osborne. 2000). Contrary to the goal of science education to prepare students to be rational thinkers, science is often portrayed from a "positivist perspective" as a subject in which there are clear "right answers" and where the data lead students to accept conclusions without any questions (Kuhn. 1993). As a result, the students tend to acknowledge the unproblematic collation of facts about the world without considering their origins or understanding the nature of constructing the knowledge. Establishing open-ended activities would not only make the classroom interactions much more like those of scientists, but also result in students' improvement in scientific reasoning, learning achievement and attitude towards science (Palachot. 2008).

Establishing the authenticity of the knowledge building activity in classrooms is the crucial element in this study. Implementing authentic inquiry at the beginning is probably too difficult for students who are not familiar with these practices. Students need scaffolding as a way to get rid of the barriers in learning. A scaffolder, a teacher, will enable students to complete complex mental tasks that they could not achieve by themselves (Pearson & Fielding. 1991). Many researchers successfully applied scaffolding technique in a large scale setting. In particular, McNeill; et al. (2006) found that fading written scaffold better prepared students to construct scientific explanations when they were no longer provided with the support. However, previous studies have examined students' scientific explanation and scientific reasoning, most of which uniformly indicated that students have difficulty in articulating and justifying their claims (e.g., Sadler. 2004; Hsu, et al. 2015). According to the incomplete scientific explanation, science educators should promote the environment of scientists' community. Another aspect is to focus on giving feedbacks which will be more like argumentation among scientist. Peer feedback is a way whereby students assess the quality of their colleagues' performance and give feedback to one another (Sluijsmans et al.. 2002). As a part of the constructivist approach of education, feedback is considered to be a key component of the learning and assessment activity for the reflective construction of knowledge (Hounsell. 2007). Teachers should incorporate explicit instruction on how to provide peer feedback that is timely, relevant and specific to the task or process (Hattie & Gan. 2011). These practices might be helpful for promoting students to construct a complete scientific explanation. For the above reasons, it is crucial to improve instruction in science to reach the goals of science education. The researcher proposed to develop the guided inquiry activities with structured argumentation scaffold and peer feedback to promote high school students' ability in constructing a complete scientific explanation. This trial study's results provided information to revise the activities to be suitable and ready to be used in the main study.

Research Objectives

The research objective was to test the quality of the open-ended activities with structured argumentation scaffold and peer feedback in terms of time and flow of the instructional sequences, and happening during the 3 main activities; collecting data, writing a scientific explanation and providing feedback

Research Methodology

Participants

Participants of this trial study were:

1) the classroom of 43 eleventh graders who studied Biology II in the second semester of the 2016 academic year at Demonstration School of Suan Sunandha Rajabhat University, Thailand, and
2) the teacher who taught Biology II using the activities of this research study.

Research Instruments

The research instruments were the guided inquiry activities with structured argumentation scaffold and peer feedback, the classroom observation form and the unstructured interview form.

1. The guided inquiry activities with structured argumentation scaffold and peer feedback: the activities were designed to promote high school students' scientific explanation ability. There were 3 steps of each activity (totally 3 periods) shown in Figure 1: introduction (10 minutes), learning activities (90 minutes) and conclusion (50 minutes). The instruction of this trial study took 18 periods of classroom participation (3 periods a week/activity). The structured argumentation scaffold and peer feedback were used during the conclusion step. In this step, the students were required to make a conclusion of the activities and answer the following questions of the lessons based on the scientific explanation framework. The scientific explanation framework includes 3 components as follows.

"Claim" is an assertion or a testable statement that answers the question posed.

"Evidence" is scientific information that supports the claim; come from the students' investigations or other sources, such as reading materials, learning resources, etc.

"Reasoning" is a justification which includes scientific principles to show why the evidence supports the claim.

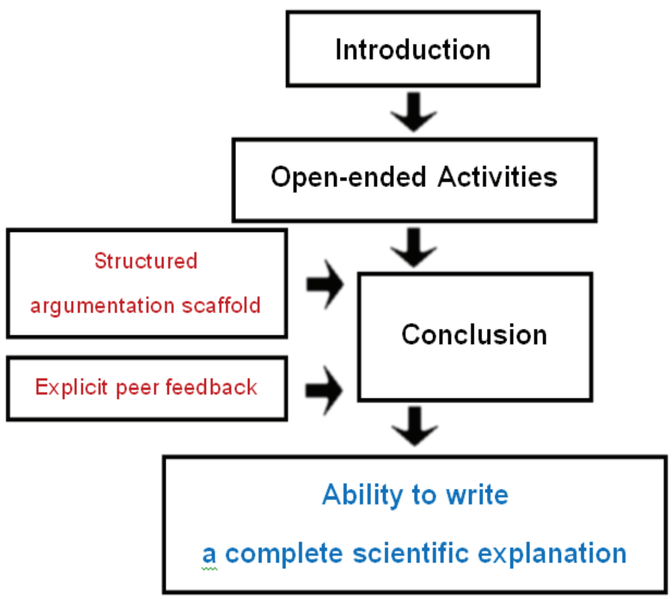

Figure 1. Steps of the instruction

2. Classroom Observation Form: The observation form was used to record the procedures and the happening during the instruction focused on time and flow of the instructional sequences, and the happening during the 3 main activities; collecting data, writing a scientific explanation, and providing feedback.

3. Unstructured Interview Form: The interview form was used to interview the teacher after teaching each week about procedures and happening during the instruction focused on time and flow of the instructional sequences, and the happening during the 3 main activities; collecting data, writing a scientific explanation, and providing feedback.

Data Collection

In this trial study, the instruction using guided inquiry activities with structured argumentation scaffold and peer feedback was implemented with a classroom of 43 students for 6 weeks, 3 periods a week, in order to test the quality of the activities in terms of time and flow of the instructional sequences and the happening during the 3 main activities; collecting data, writing a scientific explanation and providing feedback, and check some problems that might occur. The students worked in groups of six students and individual student was required to hand in a completed lab report every week. The procedures and the happening during the class period were observed by the researcher. The researcher also interviewed the teacher after teaching each week to fulfill collected data.

Data Analysis

Data from the classroom observation and the interview were analyzed using coding, grouping and classifying.

Findings

The results of the classroom observation and the interview were briefly presented in terms of time and flow of the instruction sequences and the happenings during the 3 main activities; collecting data, writing a scientific explanation, and providing feedback steps as follows.

1. Time and flow of the instruction sequences: according to the activities, the time frame was 10:90:50 minutes per activity. Overall, the flow of all activities was quite good. A main problem found in this step was that the students spent longer time than expected to finish each main activity, especially writing a scientific explanation and providing feedbacks. The students needed more time to write their own scientific explanation and critique each group's explanations. However, they needed less time for this step when time went by.

2. Collecting data: in this research, the guided inquiry activities were used as a starting point for the discussion, explanation, critique and argumentation among the students. It showed that the activities themselves were suitable, the students could understand and follow what they were asked to do. The activities were based on the guided inquiry which required the students in groups to follow the same problems and experiments or methods to collect data, but they were allowed to design their own data record, analyze data and make a conclusion. Only one problem found in this step was that their collected data of some groups were incomplete.

3. Writing a scientific explanation: it was found that few groups' data record was incomplete, leading to making an incomplete conclusion. In order to make a conclusion and write an explanation, every group of the students needed the teacher's suggestions on how to write the scientific explanation in the first few weeks, even through the teacher explained about the structure of the scientific explanation in the first week. Therefore, the teacher had to assist them to correct ideas, ask questions, point out evidences of the experiment, and relate the idea to the previous concepts because they firstly made a conclusion and answered questions by providing facts or just what they perceived from the experiment. Only a few students showed appropriate explanation.

4. Providing feedback: some students were passive. Mostly, representatives of each group who critiqued other groups' explanation were the same students. However, the students' participation in this step had increased over time. It was noticed that many students were able to discuss better and increasingly not only with their peers, but also with the teacher after a while. Gradually, the students learned how to provide a better feedback to others compared to their feedbacks and comments on the previous lessons.

The findings from the trial study were used to revise the process of learning activities to be suitable and ready to use in the main research study.

Discussion

A major question addressed in this trial study was whether the guided inquiry activities with structured argumentation scaffold and peer feedback were qualified to promote high school students' ability in constructing a scientific explanation. The results of data analysis showed the effectiveness of the activities, but some aspects needed to be considered as stated above. In case of time frame, it should be revised to be longer during the conclusion step in order for students to critique each group's explanations. However, the period of time can be adjusted when time goes by. Palachot (2008) found that some students required more time to learn and internalize the scientific thinking skills and the science process skills. Therefore, the degree of support should be adjusted to be more appropriate for these students. For the processes of science, collecting data, writing a scientific explanation and providing feedback, the students had a chance to experience how scientists work. The processes of answering questions, expressing ideas and explaining gained knowledge required the students to provide a reasonable explanation referring to their logical thinking patterns (Palachot. 2008). Moreover, the role of social interaction in determining the precise boundaries of what the student can do and what he/she can not do alone is very important (Driscoll. 2005). Even through their conclusions and scientific explanations were incomplete, including feedbacks that they provided to their peers. It is necessary for students to experience a complete depiction of the scientific enterprise. Therefore, one must actively participate in all three phases of science to fully apprehend science's complex and multifarious nature (Domin. 2009: 275-276). In addition, Hammrich (1997) found that cooperative controversy which actively engages a person in a debate of two opposing sides of an issue was proven useful to facilitate students' alternative conceptions of the Nature of Science. However, the teacher is the key person to solve the above problems. The teacher needs to work harder when the activity became more student-directed in order to explore and guide the students' thinking to the learning goals (Palachot. 2008).

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EXPLORING WAYS OF LEARNING ASSESSMENT OF PRE-SERVICE TEACHERS DURING TEACHING PRACTICE

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The purpose of this study was to explore ways of learning assessment of pre-service teachers during their teaching practice. The participants involved 25 pre-service teachers who did an internship in the second semester of the 2015 academic year at the Demonstration School of Suan Sunandha Rajabhat University, Thailand. The data were collected by semi-structured interview and review of instructional plans. The results revealed that 1) the participants focused mostly on summative assessment, and 2) most test items were multiple choice test items. Moreover, most open-ended test items were drawn from the exercises assigned to their students in the classroom. The results reflected that the teacher preparation program should put more effort on training the students about assessment for learning.

Keywords: Pre-service teachers, Formative assessment, Summative assessment.

Introduction

"What is important for citizens to know and be able to do?" That is the question that underlies the world's global metric for quality. The Programe for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) provided reliable and timely data on the mathematics and science literacy of students around the world. The PISA results in 2012 found that the scores of Thai students were below the average scores of many countries. Nowadays, students need to know not only the basic reading and arithmetic skills, but also skills that will allow them to face a world that is continually changing. They must be able to think critically, to analyze, and to make inferences. Changes in the skills base and knowledge our students need require new learning goals; these new learning goals change the relationship between assessment and instruction. Teachers need to take an active role in making decisions about the purpose of assessment and the content that is being assessed. It is important to find the way to improve the Thai students' literacy. Both instruction and assessment are important. Assessment is an integral part of instruction, as it determines whether or not the goals of education are being met. Assessment affects decisions about grades, placement, advancement, instructional needs, curriculum, and, in some cases, funding (George Lucas Educational Foundation, 2015).

Studies analyzing classroom tests, over many decades, have found that most teacher-made tests require only recall of information. However, when teachers are surveyed about how often they think they assess application, reasoning, and higher-order thinking, both elementary and secondary teachers claim that they assess these cognitive levels quite a bit. The reason that recall-level test questions are so prevalent is that they are the easiest kind to write. They are also the easiest kind of question to ask off the top of your head in class. Teachers who do not specifically plan classroom discussion questions ahead of time to tap particular higher-order thinking skills, but rather ask extemporaneous questions "on their feet" are likely to ask recall question. Contrary to some teacher' beliefs, the same thing also happens with performance assessments. Students can make posters or prepare presentation slides listing facts about elements, planets, or stars without using higher-order thinking, for example. Of course, what amount and what kind of higher-order thinking should be required for a classroom assessment depend on the particular learning goals to be assessed (Brookhart, 2010).

Assessment is one of the many concerns pre-service teachers have when entering teacher development programs (Simon, M., Chitpin, M., & Yahya, R., 2010). Graham (2005) uncovered five categories of concerns pre-service teachers have regarding classroom assessment: a) designing learning goals, b) rubrics, grading and fairness, c) grading and motivation, d) assessment validity and c) the time required to assess. As a result, this research aimed to explore ways of learning assessment that the pre-service teachers used during their teaching practice. The results of this research would be significant information for teacher preparation programs.

Research Objective

The research objective was to explore ways of learning assessment that the pre-service teachers used during their teaching practice.

Research Methodology

Participants

Participants of this study were 25 pre-service teachers who did internship in the second semester of the 2015 academic year at the Demonstration School of Suan Sunandha Rajabhat University, Thailand.

Research Instruments

The research instrument was the semi-structured interview form.

Data Collection

Data were collected by 1) the interview of the 25 pre-service teachers and their advisors, and 2) the review of their instructional plans.

Data Analysis

Collected data were analyzed using mean and percentage.

Findings

1. The percentage of mean score from formative assessment and summative assessment

Figure 1 showed the percentage of mean score from formative assessment and summative assessment. The participants used 18% of score based on formative assessment and 82% of score based on summative assessment.

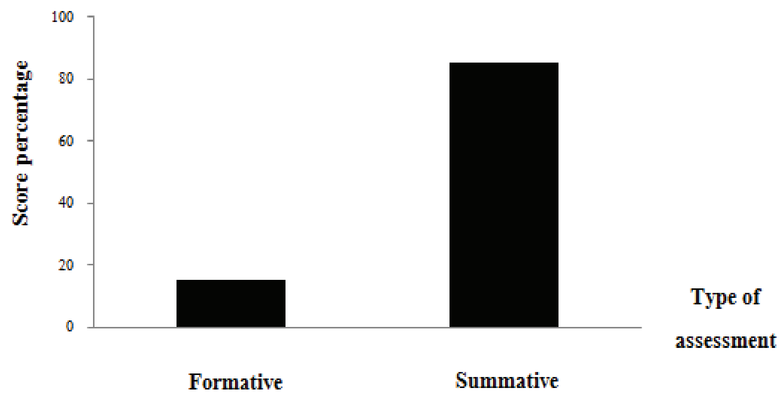

Figure 1. The percentage of mean score from formative assessment and summative assessment

2. Types of achievement test items

Figure 2 showed types of achievement test items that the participants used for achievement test. Percentage of score based on each type of test items such as essay, true-false, completion, matching and multiple choice was 5%, 5%, 10%, 5%, 75% respectively.

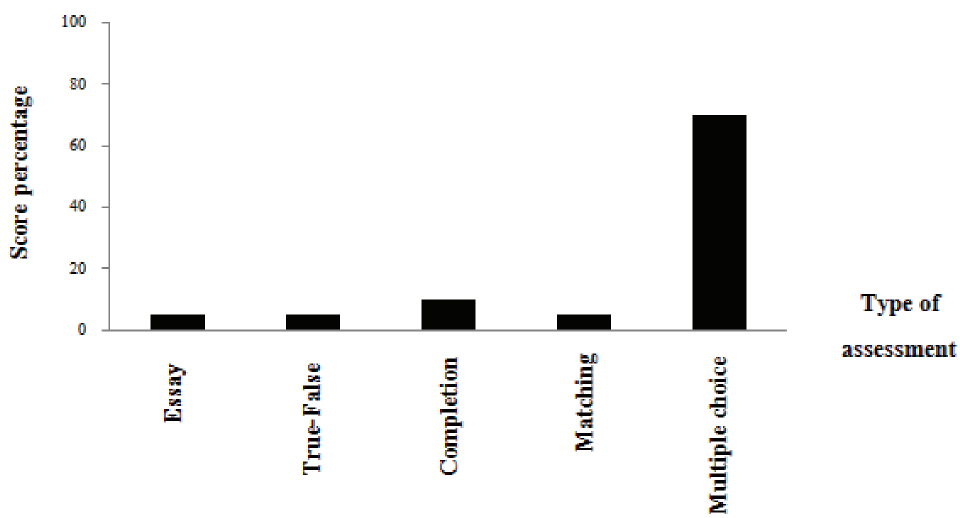

Figure 2. Types of achievement test items

Conclusion and Discussion

This research focused on exploring ways of learning assessment of 25 pre-service teachers during their teaching practice in the second semester of the 2015 academic year at the Demonstration School of Suan Sunandha Rajabhat University, Thailand.

Findings showed that 18% of the score for classroom assessment in each subject were based on formative assessment and 82% of the score were based on summative assessment. The participants focused mostly on summative assessment. Like Volante and Fazio (2007), they found that teacher candidates offered summative assessment as the main purpose of assessment. Generally, the participants should focus more on formative assessment in order to improve the students' learning. Assessment is the process of gathering data. It is the ways instructors gather data about their teaching and their students' learning. Formative assessment assists the teacher in forming new lessons, while summative assessment comes at the end of a lesson, semester or year for a summary of what the student has learned. Moreover, the goal of formative assessment is to monitor student learning to provide ongoing feedback that can be used by instructors to improve their teaching and by students to improve their learning, but the goal of summative assessment is to evaluate student learning at the end of an instructional unit by comparing it against standards and/or benchmarks (Volusia county schools, Online).

According to the percentage of score based on each type of test items such as essay, true-false, completion, matching and multiple choice were 5%, 5%, 10%, 5%, 75% respectively. The participants focused mostly on multiple choice test items. In addition, it was shown that 100% of open-ended test items were drawn from the exercises that the participants assigned to their students in the classroom. Complex achievement targets should be measured with an appropriate variety of classroom assessment tools: selected response and essay test, performance assessment, and personal communication. The types of assessment tasks may affect motivation. Appropriate tools should depend on both the students and the subject matter (Brookhart, 1997). However, it is of importance what cognitive levels of the students are measured. The teachers should pay more attention on higher-order thinking skills. What amount and what kind of higher-order thinking should be required for a classroom assessment depend on the particular learning goals to be assessed (Brookhart, 2010). This research did not identify what types of the question the participants used. It might be another interesting research question. The findings of this study at least suggested that the teacher preparation programs should foster deeper understanding and knowledge of assessment, particularly formative assessment, probably through professional development.

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