USEJ 7 (1) (2018)

Unnes Science Education Journal

http://journal.unnes.ac.id/sju/index.php/usej

INTERPRETING SCIENTIFIC APPROACH IN NATURAL SCIENCE SUBJECT FOR ELEMENTARY SCHOOL: AN INTEGRATIVE STUDY

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Article Info

Received July 2017
Accepted December 2017
Published February 2018

Keywords:
Scientific approach, natural science subject, Elementary School

Abstract

This research employs conceptual analysis with integrative study (Whittemore & Knafl 2005), using five steps of identifying problems, literature study, evaluation of data, analysis of data, and reporting (Whittemore & Knafl, 2005). The result of this research concludes that the learning process of natural science concerning five essential steps. These five steps emphasize on the processes (competences) which should be done or reached by students, which are 1) observing things and or occasion, 2) asking about things and or occasion which are just observed on its relevance, 3) trying to (gather information) to answer the questions in the step of asking, 4) analyzing the obtained information or taking conclusion based on the analysis of data, and 5) communicating the result of experiences from the previous steps in written or oral regarding.

p-ISSN 2252-6617
e-ISSN 252-6232

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INTRODUCTION

The dynamic changing of curriculum is a real challenge for teachers. The changes in curriculum make teachers should update their knowledge, whether it is related to general understanding, the changes and mastery of content, or the application of learning method in the classroom. It also happens to the learning of Natural Science as one of the compulsory subject in Elementary School. The content, method, and the learning approach of science in the new curriculum should be understood by teachers.

2013 curriculum demands teachers of natural science to provide access for students to construct their own scientific concepts through learning experiences oriented to scientific process. It is important as it becomes the initial step to improve students' critical thinking to elaborate science. From various sequences done by the students' scientifically, they will understand the concept and implement the materials they learn in their daily life. Since, natural science concerns on many things related to nature as well as the natural phenomenon, making it closer to the life of the students.

Various actual natural phenomenon can be observed, such as how living creature breathes. This instance is the part of natural science that makes the learning process does not only rely on its theoretical layer, but more likely to become a sequence of scientific activities. It contains the processing skills which is highly required by students in the classroom.

Doran R. *et al.* (1998) in Susilawati, *et.al* (2015) explains that learning natural science is not only related to group of science; instead, it invites students to acknowledge object, symptom, and natural problems from which they can review and make conclusion or concept through scientific process*".* Liem (2007) states that there are some required condition to make new information able to be stored in students' memory permanently. One of them is using all human senses, including sighting, hearing, touching, smelling, and tasting. Different activities involve these senses in complex way through basic processing skills as the part of scientific process.

Scientific process teaches and train the students to think since they are elementary school students. It is important to train their skills and build their scientific concept to their surrounding. Zimmerman (2007) explains that reasoning skills are formed from the process of investigation, experiment, evaluation of evidence, and conclusion. Good reasoning skills support the formation of concepts and theories regarding the nature and social life. If it is seen from the challenge, learning process, including science learning, should be oriented to an activity which directs the students to grow their reasoning skills, guide their motor skills, and guide their spiritual and religios emotion in the class.

However, the reality shows that many aspects should be recovered in learning process. Based on the direct observation and interview, there are some problems which should be solved, including the learning process which does not prioritize active learning process through direct experience, as the learning process is still dominated by the literature of natural science. In this case, students only obtains the material from lecturing, reading text, pictures, and watching video. This condition does not fulfill the expectation of ideal learning as in the Regulation of Ministry of Education and Culture Number 103 Year 2014 Article 2 section 1 and 7 point (d) regarding The Learning Process of Elementary Education and Middle School which indicates that learning process should be done on the basis of activities providing enough space for the initiative, creativity, and independence of the students. It means, the conventional media of text, picture, video, and story are not wrong; however, it is not complete. Since, science does not only cope the product, but also the process, where the stuents are involved directly in finding and discovering the answer of their problems using scientific process. It is expected that the students will grow a good scientific behavior for themselves.

Secondly; the learning process is still dominated by teachers. Students activities (observing, asking, experimenting, analyzing data, and communicating) has not been built systematically, that the awareness to the correlation of problems is still unformed. Actually, these activities will allow the students to have the ability and creativity to solve their problems independently. Direct activities in learning (Portelli: 2004) are the ability to assign the engagement of the students to the learning process. Students who engages the learning process will feel enjoyed and able to face every challenge in learning activity. The activity of a learning process can show the engagement of the

students to the subject. It can improve their motivation and confidence (Chiang: 2014). Therefore, it can be the indicator of students' learning outcome (Astin: 1984), (De Freitas: 2006), (V. Hancock: 2002).

From the problems above, there are many alternatives to solve them, one of them is learning with scientific approach. Scientific learning is a subject which emphasizes on students where they become the subject of the discovery in the classroom. This implementation is in accordance with the Regulation of Ministry of Education and Culture Number 81A Year 2013. Through the sequences of scientific processes in the learning process, learning will be more meaningful. The activities in scientific learning will focus on scientific work to explore the surrounding environment. Paidi (2012) mentions that environment can enrich the materials and activity of learning as well as allow a more meaningful and functional learning, since students are given the real condition.

Based on the explanation above, this research was conducted under the problems of "how are the essential steps of applying scientific approach for natural science subject to elementary schools, and what are the roles of the teachers and the students in each steps?"

THEORETICAL REVIEW

1. What is Scientific Approach

The Regulation of Ministry of Education and Culture Number 103 year 2014 explains that scientific approach consists of five stages: observing, asking, collecting information, analyzing information, and communicating. Fauziah (2013) describes scientific approach as the process to invite students to experience direct experience in integrating the existing problems in the form of formulation of problems and hypothesis, environmental awareness, curiosity, and keen of reading. Meanwhile, according to merriam-webster.com, scientific approach is a process which demands teacher to think systematically and critically to solve problems which solution is difficult to view.

From the definitions above, the researcher sees that there are some keywords which can be zoomed out regarding scientific approach; (1) scientific approach is a working process (thinking, motor, and emotion), (2) scientific approach is experiencing, (3) scientific approach is related to an event, (4) scientific approach guides students to inference (hypothesizing), (5) scientific approach is the process of finding truth (critical to an event), (6) scientific approach uses systematic and planned pattern, and (7) scientific approach solves problems. Explicitly, scientific approach is defined as a process of guiding students to be directly involved on the aspects of thinking, motor, and emotion, from their observation or experience to things or event systematically and critically to answer certain problem clearly.

2. Learning of Natural Science

According to the Indonesian National Department of Education (2006), natural science is the way to find information about nature systematically. It means, natural science does not only cope the mastery of group of information in the forms of facts, concepts, or principles, it is also the process of discovery instead. Benyamin in Toharudin, *et.al* (2011) defines natural science as the was to investigate and obtain data about nature using observation as well as valid and tested hypothesis. Wisudawati & Sulistiowati (2014) strengthen the definition of natural science as the subject which reviews factual natural phenomena, whether it is a reality or an event, and its causal relation.

Referring to the definitions above, there should be a special way to teach natural science where students should understand the events happening in their surrounding. The learning process should emphasize the provision of direct experience to develop students' competence optimally that they can understand their surrouding nature better. In line to that, Glynn & Duit (1995) mention that learning natural science is the dynamic process in building, organizing, and explaining the science of nature.

METHODS

This research used conceptual analysis method with integrative review to identify the essential meaning of certain concept. This research was conducted in five steps, starting from problem identification, literature discovery, evaluation and analysis of data, and reporting (Whittemore & Knafl, 2005 ; Brady & Asselin 2016).

RESULTS AND DISCUSSION

Based on the analysis of literature studies and objectives, there are some stages of scientific approach. The stages is provided in Table 1.

Table 1. The application of scientific approach in science learning and the indicator of students' cognitive process

Scientific Stage	**Cognitive Process (Students' Learning Experiences)**	**Teachers' Role as the Facilitator**
Observing	Observing surrounding things or event Observing things or events provided through demonstration, video, pictures, and or text Taking notes to important finding from observation	Determining the learning objectives Preparing things and or events to become the sources of learning Preparing things and or events related to the materials, whether in the form of demonstration, video, pictures, and or text Preparing observation sheet (observation note with checklists or rating scale or in other form)
Asking	Making inquiry of relevant questions related to facts/ concept/ principles/ procedures and or hypothesis related to the observation whether in written or oral	Guiding the students to make written or oral questions Providing questions sheet
Collecting Information (Try)	Reading and understanding the guidance Reading and understanding the tools and equipment Observing the media (video, picture, text, practicum, or other events) Taking notes to the observation of working sheet	Determining theme of the activity Making the guidance of activity and explicit in a written or oral working sheet Preparing working sheet (activities) of the students Determining and preparing the tools and equipment Guiding students during the process of practicum (experiment) Guiding the students in facing difficulty of taking note in their working sheet
Analyzing Information	Determining relation between variables (comparing) Determining and formulating meaning/concept/procedure/pattern	Providing working sheet which allows students to write their analysis and conclusion Guiding the students to process the analysis of information

Scientific Stage	Cognitive Process (Students' Learning Experiences)	Teachers' Role as the Facilitator
	Providing result in narrative, description, graphic, table, matrix, and or diagram Synthesizing, evalauating, generalizing, concluding	
Communicating	Telling/presenting the result of the discussion (observation, practicum) in written or oral Concluding the result based on the analysis of information	Providing space/chance to communicate the result Guiding the process of presentation Scoring students' behavior (appreciation/reward) Providing behavior scoring sheet

*Adapted from 2013 Curriculum

Based on Table 1. The execution of scientific approach always put forward the students as the subjects. Teachers only become the facilitator who provides ease of access to students to learn, guide, and direct them from misconception. Scientific learning is relevant to scientific approach. Hosman (2014) says that at least, there should be four characteristics of scientific learning in the classroom; (1) centered to students; (2) involve science processing skills in constructing the concept, formula, or principles; (3) include cognitive processes which are potential in stimulating the intellectual development of students, especially in high order of thinking; and (4) develop the character of the students. These four characteristics is displayed clearly on the cognitive processes of the students (see Table 1 in the column of processing skills).

First; centered to students: from Table 1, teacher obviously becomes the guide and facilitator. In more concrete context, teachers provides students activity sheet or working sheet, guides them, directs them, manage the class, motivate the students, and evaluate the activities. Jufri (2013) mentions that "as the consequence of learning process which is centered to learners, thereby, teachers should be able to play the role as 1) the source of learning, 2) manager of learning environment, 3) facilitator, 4) guide, 5) demonstrator, 6) motivator, and 7) evaluator."

Another important thing is to make students as the subject of the learning process, teacher should provide inquiry based students' working sheet. It can minimize the verbality of teacher in the classroom. In this context, students' worksheet is made with some instructions which should be done by the students referring to science processing skills. It means, students' worksheet is the facility for the students to observe, ask, try (collect information), and take notes to important discovery. It asks the students to write their analysis and provide space (column) to conclude. Thus, it will make the learning process centered to the students.

Second; involving students' science processing skills in constructing concept, law, or principles; the involvement of science processing skills is portrayed clearly here and displayed in the worksheet. As the worksheet adopt the science processing skills where it is not merely a book with a set of questions, it is a guidance to students' activity to understand the materials. The worksheet includes the delivery of problems, the invitation to ask questions, to make hypothesis (temporary answer), direction of activity, column of result notes to record the information, and the invitation to conclude the activity and conclude the result.

Thirds; involving cognitive process which is potential in stimulating students intellectual development, especially to the high order thinking skills; the involvement of cognitive skills in the research is drawn from the observation to communication as seen in Table 1.

Fourth; the development of students' character: Scientific learning process begins from observation to communication. It indirectly draws a guidance for students to have good scientific behavior. For example; in the process of observing picture/vide/environment to the topic of respiratory system, students are not only demanded to find scientific facts, but the hidden competence born from this process, which are focus, hardwork, and carefulness.

Based on the characteristics above, it can be concluded that scientific learning is a learning process which is oriented to students, where students become the subject of the learning process. They are involved in the process of developing science processing skills to think analytically and critically as well as to develop their character.

CONCLUSION

Interpreting learning process with scientific learning to natural science subject for elementary school is done by concerning five essential stages. The stages emphasizes on the processes (competences) which should be objected by the students; 1) observing things and or occasion, 2) asking about things and or occasion which are just observed on its relevance, 3) trying to (gather information) to answer the questions in the step of asking, 4) analyzing the obtained information or taking conclusion based on the analysis of data, and 5) communicating the result of experiences from the previous steps in written or oral regarding.

The recommendation of this research is the application of scientific approach should also involve the effort of the teacher in making and providing students' worksheet which is based on process-activities. It will help the them in realizing the principle of learning which is oriented to students.

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