Creativity in Science Education: Definition and Constraints

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Abstract

The development of Higher Order Thinking Skill (HOTS) in teaching and learning Science in schools is one of the desired goals by many countries. HOTS including creativity will produce better lifelong learning and it is listed among the four main skills needed to face the challenges of the 21st century world of work by American Management Association (2010). However teaching and learning Science particularly more emphasis on the facts, vocabulary, definitions, algorithms and rote learning which is not geared towards the development of creativity. In Malaysia, teachers still practicing teaching methods that do not encourage creativity and consequently the level of creativity among science students is low. Therefore, this paper discuss about the creativity in science education and constraints related to scientific creativity. All this issues will be discussed based on the literature from previous finding.

Keywords Scientific creativity, creativity in science education

Introduction

One of the important agenda in science education is to improve HOTS among students. School play an active role developing students' creativity (Alfuhaigi, 2014; Zoller, Miri, & David, 2007; Kamisah, Punia, Jizah & Adzliana, 2012). Science teachers in particular are responsible for providing a medium of teaching and learning which allows students to discover things by themselves from various viewpoints so that the learning become more meaningful and contribute towards the progress of the country (Goethals, 2013). Based on a study by the American Management Association (AMA) in 2010, involving 2115 respondents, skills such as critical thinking and problem solving, communication, collaboration, and creativity and innovation will become more important to organizations in the future. While a survey run by Hart Research Associates in 2013 to over 318 employers, find that 95% of respondents said innovation and creativity is the virtue and necessity of workers in future. The importance of creativity has been translated through the declaration of the Year of Creativity and Innovation in the European Union in the year 2009, while in Malaysia itself in 2010 (Azrina, 2011). Clearly, creativity has become a major focus in the development of national education, especially in science (Park, 2011a, 2012; Chumo, 2014). But in the context of Malaysia ongoing studies are more focused on fostering ingenuity rather than fostering creativity (Mohammed Mohsin & Nasruddin, 2008; Toh, 2003).

Creativity in Science Education

Although various definitions have been told about creativity, but according to Lin, Hu, and Zhen (2003) general creativity has to be separated from the creativity in science. This is supported by Liang (2002) who states that "*a person who is creative in chemistry need not be creative in the arts*". This means that the creative person in life may not creative in terms of science. Creativity in science education or scientific creativity is a stand-alone field

(Mukhopadhyay, 2013). Hu and Adey (2002) defines creativity as a scientific intellectual ability to produce certain original products that have a personal or social value, designed with a specific purpose in mind using the information given. Park (2011) stated that scientific creativity consists of three dimensions: creative thinking, scientific knowledge and scientific inquiry skills. According to him, if someone invents a new experimental technique while designing an experiment (scientific inquiry skill) related to Faraday's law (scientific knowledge) by thinking divergently (creative thinking), it is said that her new experimental technique is invented by virtue of scientific creativity. Or, if someone finds novel regularities by convergent thinking (thinking) in the process of analysing experimental data (scientific inquiry skill) related to Ohm's law (scientific knowledge), her finding of new regularities can be viewed as being the product of scientific creativity. Scientific creativity could be regarded as reaching new and unique steps for establishing purposes of science (Aktamış and Ergin, 2007). Scientific creativity is important in order to produce students who will become the scientists and students who will work in an environment that involves how scientists work (Chumo , 2014 ; Hu & Adey , 2002; Mukhopadhyay , 2013) and something needs to be done to improve it (Patel , 2013). In addition, when a student is scientifically creative, the ideas emitted are based on science and not just by common sense which may not comply with the given situation (Chumo, 2014).

Issues and Constraints Related to Scientific Creativity

The study by previous researchers play a number of issues and constraints related to scientific creativity. Among the issues are teaching and learning that less encouraging creativity, type of questions that less encourages thinking and implementation of traditional laboratory.

Teaching and Learning that Less Encourage Creativity

Teaching and learning science in Malaysia is focused on the memorization of facts by stressing repetition and drills (Rashimah, 2012). The task of thinking has been taken over by teachers because teachers tend to give an answer without showing process (Cai & Lester, 2010). The thinking activities regarded as an extension of the learning activities (Roslinda, 2007). In addition, the need to finish the syllabus as well as a greater emphasis on achievement of the tests (Mann, 2005; Neill, 2003; Rashimah, 2012) resulting in the creativity of the students who took the science program is at a low level (Siti Hajar, 2008). According to a study by Chuzairy (2013) on teachers of Chemistry found that only a few teacher encourage scientific creativity during the process of teaching and learning. Teachers prefer lecturing and the students get less opportunities to explore their learning independently. A passive attitude among the students also contributes to less encouraging creativity in teaching and learning (Kamisah *et al.,* 2012).

Type of Questions that Less Encourage Thinking

Questioning is an important element in promoting scientific creativity (Trivic & Tomasevic, 2014). In the process of building scientific creativity, students should be encouraged to ask questions and asked questions that will help them study the phenomenon happening around them. Unfortunately, teachers tend to ask low level questions (Rashimah, 2012) and did not provide opportunities for students to ask questions that more challenging (Supramani, 2006). This should not happen, teachers must act as an agent to encourage students to think creatively so that they can investigate the cause or reason for the occurrence of a phenomenon or problem which can eventually lead to a solution to the phenomenon studied (Trivic & Tomasevic, 2014) and thus increase their scientific creativity.

Implementation of Traditional Laboratory

Laboratory activities are among the important feature of science education. Laboratory activities are aimed at learning more meaningful that students not only learn the concepts but also through data from observations (Millar, 2010). However, the fact is the prevailing majority of laboratory activities carried out are traditional recipes based methods (Fenerlon & Breslin, 2012). Students often follow the guidelines given by the teacher and only confirms concepts learned through laboratory activities and they actually do not understand what they are doing (Beussman, 2007). Laboratory activities traditionally do not encourage them to think critically and creatively. As a result they fail to apply the knowledge and skills they have learned to other situations, not in the recipe book (Fenerlon & Breslin, 2012).

Conclusion

Science is a specialized body of knowledge; knowledge of several facts, phenomenon, theories and at the same time, science is also a way of exploring new areas of knowledge. The next generation must not only learn about science-related knowledge but at the same time pervaded with the skills necessary to face the challenges ahead, including problem solving, innovation and creativity (Beers, 2012). Therefore, the development of scientific creativity among students will be such an effort to help the future generation in order to remain competitive in an increasingly challenging world and future needs.

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