AN INVESTIGATION OF CREATIVITY AND CONCEPTUAL UNDERSTANDING IN STATE OF MATTER USING DIRECTED CREATIVE PROCESS BASED SCIENCE PROJECT AMONG YEAR 5 PRIMARY SCHOOL STUDENTS

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ABSTRACT

The growing interest and concern about creativity elements in our education system has prompted much research been done on creativity assessment. This research explores the application of directed creative process in primary science project as an instructional strategy for fostering and assessing creativity and conceptual understanding of State of Matter in science subject among primary school students. The respondents consist of 32 students from a Chinese Primary School located in Tenom, Sabah. This research employed experimental design research where the data was analysed quantitatively. A single pre test-post test group was given an intervention of directed creative process based science project during their science lesson in duration of three weeks. There are two instruments used in this study, namely pre-test and post-test of science conceptual understanding test and Torrance's Figural test of Creative Thinking (TTCT) adapted from Torrance (1966). Five dimensions of creative thinking skills among students which comprise of Fluency, Originality, Elaboration, Abstractness of Title and Resistance to Premature Closure were evaluated based on TTCT test. The data obtained were anaylised by using *Statistical Package for the Social Science* (SPSS) 16.0 for Paired-sample t-test while the percentages of students in different category of creativity levels were computed in Microsoft Excel. The research finding revealed that there was positive effect of the intervention, as there were significant difference in mean scores between pre-test and post test in conceptual understanding in science (P= 0.000) as well as in mean score between TTCT pre-test and post-test total scores (P=0.000). while there were significant difference in mean scores between pre test and post test in the "Elaboration:, "abstractness of title" and "Resistance to Premature Closure" dimensions of TCTT test, however, the results reveal that there is no significant difference in mean score between pre-test and post-test in the "Fluency" and "Originality" dimension of TTCT Test. At the end of the intervention, it was found that majority of the students (62.50%) have a moderate level of creative thinking and the rest of them were found creative (31.25%) and less creative (6.25%). The study recommends the application of directed creative process in project-based learning model for repeated uses on any educational institution especially primary and secondary schools to enhance students' creative thinking skills and conceptual understanding in their learning.

Key Words

Creativity, Conceptual Understanding, Directed Creative Process, Project-Based Learning, Torrance Tests of Creative Thinking.

ABSTRAK

Minat yang semakin meningkat dan keprihatinan mengenai unsur-unsur kreativiti dalam sistem pendidikan kita telah mendorong kepada banyak penyelidikan telah dilakukan ke atas penilaian kreativiti. Kajian ini meneroka penggunaan proses kreatif terarah dalam projek sains sekolah rendah sebagai satu strategi pengajaran bagi memupuk dan menilai kreativiti dan pemahaman konsep dalam topik "Keadaan Jirim" dalam mata pelajaran sains di kalangan murid sekolah rendah. Responden terdiri daripada 32 orang murid dari Sekolah Rendah Jenis Kebangsaan Cina di Tenom, Sabah. Penyelidikan ini menggunakan reka bentuk penyelidikan eksperimen di mana data dianalisis secara kuantitatif. Satu kumpulan ujian pra-pasca tunggal telah diberi intervensi proses kreatif terarah dalam pembelajaran berasaskan projek sains selama tiga minggu. Terdapat dua instrumen yang digunakan dalam kajian ini, iaitu ujian pra dan pasca untuk pemahaman konsep sains dan ujian Pemikiran Kreatif Torrance -Figural (TTCT) yang diadaptasi daripada Torrance (1966). Lima dimensi kemahiran pemikiran kreatif di kalangan murid yang terdiri daripada kefasihan, Ketulenan, penjelasan, Keabstrakan Tajuk dan Tentangan terhadap Penutupan matang telah dinilai berdasarkan ujian TTCT. Data yang diperolehi telah dianalisis dengan menggunakan perisian SPSS 16.0 untuk ujian-t iaitu pair-sample t-test manakala peratusan murid dalam tahap kreativiti yang berbeza telah dikira menggunakan perisian Microsoft Excel. Hasil kajian ini menunjukkan bahawa terdapat kesan positif intervensi yang dijalankan, di mana terdapat perbezaan yang signifikan dalam skor min antara ujian pra dan ujian pasca dalam pemahaman konsep sains (P = 0.000) dan juga dalam skor min antara ujian pra dan pasca TTCT-Figural (P = 0.000). Terdapat perbezaan yang signifikan dalam skor min antara ujian pra dan ujian pasca dalam dimensi "penjelasan", "keabstrakan tajuk" dan "Tentangan terhadap penutupan matang" dalam ujian TCTT. Bagaimanapun, dapatan kajian menunjukkan bahawa tiada perbezaan yang signifikan dalam min skor antara ujian pra dan ujian pasca dalam dimensi "Kelancaran" dan "Ketulenan" dalam Ujian TTCT. di penghujung intervensi, kajian mendapati bahawa majority murid (62.50%) mempunyai tahap pemikiran kreatif yang sederhana manakala murid selebihnya didapati kreatif (31.25%) dan kurang kreatif (6.25%). Kajian itu mengesyorkan penggunaan proses kreatif terarah dalam model pembelajaran berasaskan projek di mana-mana institusi pendidikan terutamanya sekolah rendah dan menengah untuk meningkatkan kemahiran pemikiran kreatif dan pemahaman konsep murid dalam pembelajaran mereka.

Kata Kunci

Kreativiti, pemahaman konsep, Proses Kreatif Terarah, Pembelajaran Berasaskan Projek, Ujian Kemahiran Berfikir Torrance

CONTENT

LIST OF TABLE

LIST OF ABBREVIATION

A	Abstractness of Title
E	Elaboration
F	Fluency
H_0	Null Hypothesis
KBKK	Critical and Creative Thinking Skills
KSSR	Primary School Standard Curriculum
O	Originality
PC	Resistance to premature Closure
PBL	Project-Based Learning
SPSS	Statistical Package of Social Science
TTCT	Torrance Tests of Creative Thinking

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Science subject is one of the important disciplines that taught in all level of schools. The school should teach students basic knowledge of the sciences as well as fundamental principles of scientific thinking and problem solving. In this regard, primary school education is especially important. Students need to have good conceptual understanding and critical and creative thinking skills in order to master scientific knowledge. Thus, the aspect of conceptual understanding and thinking skills among students should be emphasized and concerned by the educators.

As we tracing back, the efforts of the Ministry of Education Malaysia to develop creativity among students started with the implementation of Critical and Creative Thinking Skills (KBKK) across the curriculum since the 1990's. This effort was continued with the introduction of the Invention subject, in addition to it being components of Life Skills subject in primary schools. In secondary schools level, technical and vocational subjects indeed have creativity features through project-based learning and problem solving. However, the development of creativity should be implemented in line with the globalization era, the age of the information explosion and the borderless world of the present and the future

time. Thus, the role of education has become more challenging, not only to educators but also to students nowadays (Ministry of Education Malaysia, 2010).

According to Siew (2013), the cultivation of creativity in students is crucial to prepare the generation to meet the challenges of this ever-changing society. Creativity is one of the core skills for success not just for an individual but also for a society.

In order to achieve Malaysia aspiration as a developed, competitive and robust country status in 2020, our country needed human capital that capable in critical and creative thinking, problem-solving skills, the ability to create new opportunities, have the resilience and ability to cope with the changing global environment. Therefore, in order to ensure that the school curriculum can develop students' creativity, learning objectives related to creativity should be developed. Activities that can increase interest and creativity should be provided and students should be provided with the knowledge, skills and tools that enable them to develop their creativity as well as develop attitudes and creative individual personalities.

As the science curriculum have been revised, the new Malaysian Science Curriculum for Primary Schools was introduced in stages beginning 2011 starting with Year 1, Year 2 in 2012 and Year 3 in 2013. The new implementation of Primary School Standard Curriculum (KSSR) focuses on a more fun way of learning science. According to Ministry of Education Malaysia (2011), the KSSR

was an improvement as one of its purposes is to inculcate the interest and to promote student's creativity through experience and investigation in order to master science knowledge, scientific skills, thinking skills and noble values. Therefore, promoting creative thinking abilities is a value-added skill to be achieved in KSSR (Siew, 2013).

In this new curriculum, school-based assessment has become a crucial assessment in assessing students' achievement and performance in school. School-based assessment can be carried out during the teaching-learning process. The teaching-learning process can be conducted in or outside the classroom. Some of the examples of assessment tools which can be carried out both in and outside the classroom are observation, test, checklist, creative works such as portfolios, invention, project works, props and other creative productions produced during the science lessons can also be assessed using those tools. One of the education emphases in Malaysia education is creativity and innovation. Creativity and innovation is the ability to produce something new in an imaginative and fun-filled way. Pupils display interest, confidence and self-esteem through performance and producing simple creative works.

Creativity, as a gift from God is the potential possessed by everyone. However, not everyone can be creative individuals. Creative and innovative thinking must be developed and expanded among students during the teaching and learning process. (Ministry of Education Malaysia, 2012). School curriculum should provide opportunities for students to make them love to ask questions

and find the answer, a relationship, anticipating events that will occur, to speculate about the possibilities, explore ideas, think literally, and always to reflect critically on ideas, actions and outcomes. According to Erdogan et. al (2009), creative thinking can be learned and improved and this is fulfilled through education in schools and with the help of teachers. The influence of the educational settings on improving creative thinking skills is quite a lot.

In our country, the goal of the development of creativity among students aimed at producing human capital through the implementation of creative and innovative school curriculum. Creative and innovative students have to be developed to the optimum level so that they are able to produce creative and quality ideas and inventions, and thus it can become the practice and culture in the lives of Malaysia citizens in the future. Creative and innovative individuals are the important assets that can contribute to the development of society, community, nation and religion. The objective of the development of creativity and innovation in the school curriculum is to enable students to have the skills and personality of the creative individual, to acquire skills in the creative process, to produce creative and innovative ideas. Mastering communication skills, apply the knowledge and skills critically and creatively, as well as solve problems, make decisions and manage daily life in a creative and innovative way.

As creativity is becoming one of the crucial aspects in our education system, a trustable and reliable creativity assessment should be applied to assess student's level of creativity in the classroom. Among the creativity assessment

used across the world, one of the most widely used creativity assessment instrument is the Torrance Test of Creative Thinking (TTCT) which developed by E.P. Torrance (1966). Even though creativity seems to be composed of several factors that make its evaluation difficult and elusive, it is commonly accepted that the TTCT, which have been used internationally, is one of the best forms of creativity measurement (Almeida et al., 2008). The TTCT test includes figural and verbal subtests. The TTCT-Figural consists of two parallel forms with three subtests, which compose a drawing, finish a drawing and compose a different drawing parting from parallel lines (Torrance, 1974). The TTCT-Figural forms are oriented to assess five principal cognitive processes of creativity. There are five mental characteristics or factors of creative thinking ability measured in the Torrance Test of Creative Thinking (TTCT), namely fluency, originality, abstractness of title, elaboration and resistance to premature closure.

On the other hand, in the aspect of science conceptual understanding, Mazur (1997) noted that despite being to solve advanced problems, student often fail to comprehend the basic concepts. This may due to science is perceived as a difficult subject to learn. One of the key factors in facilitating an effective learning environment in the science class is the teaching strategies used by teachers. As early as 1910, John Dewey criticized science teaching of the day as giving too much emphasis to the accumulation of information rather than to an effective method of inquiry (Bybee, Trowbridge & Powell, 2008). Nowadays, teachers often use the excuse of overloaded science curriculum to explain their reliance on strictly didactic methods of teaching instead of using students-centred

approach in assisting student's learning. Though these claims may have some merit, these teaching strategies may in effect, portray the subject as difficult to many students. Behar and Polat (2007) alluded to this when they identified the passive roles of students in the classroom and their perception of the teacher as the only source of knowledge, as contributing to the perceived difficulty of science topics. Thus, a more effective teaching strategy should be applied in order to help students master the conceptual understanding in science subject.

1.2 Problem Statement

There are several problem highlighted in this research. The first problem faced by most of the primary science teacher in our country is to foster students' creativity throughout the teaching and learning process. According to Ministry of Education (2012), Creativity needs to be developed among the students since the early stages of schooling. It aims to enable them to know the potential and tendency possessed by them and unleashes the hidden potential within them. Creativity is crucial for students as it can accustom students' mind to find the abnormal and unconventional answer, to digest the idea to produce writing for completing tasks more efficiently, to evaluate the quality of the work done and make improvements, to encourage students to think out of the box and finding a solution based on reasoning, imagination and visualization, and also highlight the personality of a creative individual (Ministry of Education Malaysia, 2012).

The Malaysian science curriculum seek to develop creative thinking among students, however some of the research finding revealed that most Malaysian primary and secondary school as well as undergraduate students have low or moderate level of creativity. The research study done by Chen (1999) has revealed that the Year Six students' level of critical and creative thinking skills in science were below satisfactory. Ravi (1999) in his study on the teaching of critical and creative thinking skills in the primary level found that the Year Six students in Tamil National Type Primary School had a fair level of critical and creative thinking skills. Apart from that, Fipriyani (1997) found that there was a wide range of creativity among Form Six students, the highest is Fluency while the lowest being in originality. Meanwhile, Siti Zakiah (2011) in her study about creative thinking ability of Primary School children in Kuching, Sarawak has found that the creative thinking ability of the upper primary pupils was high whereas the creativity thinking ability of the lower primary pupils was only average. Muhammad Yusof *et. al* (2011) in his finding of the study also showed that as a whole, the level of creativity among Science Social and Living Skills students in Education Faculty of University Technology Malaysia was only moderate, whereby 52% of them are in creative level.

On the other hand, some previous research finding has revealed that the teacher in school has not use effective instructional strategy to develop creative thinking among students. Siew (2013) in her research has found that the primary science teachers who participated in her creativity study were mostly moderate creative and only few of them were deemed to be creative. The finding of her

study could imply that teachers have not implemented the creative elements on primary science curriculum effectively. Romesh (2003) in his study posited that the teacher's role is essential in shaping the creativity of the students. A creative teacher should conduct a significant activity in the right situation with accordance of the abilities and needs of the students. The creative ability of the students in the class and creative ideas of the students should be used to build a community of excellence. Creative people have the ability to adapt new ideas and able to evaluate views of others effectively. On top of that creative people are always engaged with activities that benefit the community in whole. Hence, the intellectuality of the teachers to assess the ability of the students will help the students to build their creativity in the school. In order to engage students in creative behaviour, a science teacher could think of a variety of approaches to foster their interest in science and get them thinking of how knowledge from science is developed and contributes to the real worlds (Johnson & Kendrick, 2005). In a nutshell, it is important for teacher at school to understand creative thinking ability among students. An understanding of the existing level or characteristics of creative thinking ability of the students and the factors that could affect the differences among them could serve as a guide for the design and development of learning opportunities that benefit not just the students but also the nation in the long run (Siti Zakiah, 2011).

In this new era, a new teaching approach should be introduced to primary students in order to enhance their creativity level. In this research, the researcher chooses the directed creative process model in science project-based

learning, which was introduced by the ministry of education since the year of 2012. This model focuses on providing a rich learning experience among students in problem solving, investigation and other meaningful task. Students can construct their own knowledge and also create their own realistic product that is relevant to the topic taught. Generally, there are four phase involved in the teaching and learning process, which are preparation phase, imagination phase, development phase and action phase. It is hope that students creativity can be fostered through the implementation of several stages that included in the model.

Beside the creativity aspect, the researcher has also focuses on the problem of science conceptual understanding among students. In order to master scientific knowledge, student are ought to master their conceptual understanding in science subject. Selection of suitable teaching method in fostering students' conceptual understanding in science has become problem among primary science teacher. Devetak *et. al* (2010) had noted that students have difficulty in identifying and understanding the concepts that are unique to particular science phenomena. For example, the science topic chosen for this study is "State of Matter" in Primary Year 5 Science syllabus. Studying about the matter helps pupils to understand the physical world around them. This topic should not only enrich pupils' knowledge and understanding but also promote interest towards careers such as chemists, meteorologists, pharmacists and environmentalists (Sopia et. al, 2006). Based on previous experience, the researcher found that most students were difficult to understand concept regarding how the states can

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