EFFECTS OF DIVERGENT PRODUCTION INSTRUCTIONS ON CREATIVE THINKING AND LEARNING OF MATHEMATICS

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This study looks at an instructional approach in assisting learning mathematics in primary school. Specifically, the divergent production instruction was delivered as an activity using the single subject experimental research design at S.J.K. Chung Hua Sg. Jernang, Kota Samarahan, Sarawak. This study involved five Primary Four students. In particular, this study is interested in the students' mathematics performance on the three dependent variables of think aloud, mathematics inquiry and problem solving as a result of the divergent production instruction, the students' creativity based on the Torrance Test of Creative Thinking (TTCT), and the students' mathematics achievement. In this research, five students sat for a pretest of TTCT Figural A. After the pretest, they underwent a baseline phase which provided information about the students' current level of the behaviour (strategies in solving problems) measured by Divergent Production Scales. Thereafter, the students participated in the intervention phase comprising of three types of instructions namely think aloud, mathematics inquiry and problem solving. Follow-up phase and posttest of TTCT Figural B were carried out for these students. Findings of this study show that students' mathematics performance on the three dependent variables have shown an improvement as a result of the divergent production instructions. For the creative thinking test, there was a significant difference for "title" dimension of creativity but there were no statistical significant differences for the "fluency",
“originality”, “elaboration” and “closure” dimensions. Students tended to be more creative in giving a title for their drawings in TTCT Figural B compared to TTCT Figural A. This is an indication that they had improved in this aspect of creativity after the divergent production instructions. Furthermore, there are increments in mathematics achievements for these five students after the divergent production instructions. The results indicated that divergent production instruction can be an effective approach in assisting learning in primary school mathematics especially strategies such as think aloud, mathematics inquiry and problem solving. It also implicated that students tended to be more creative after the divergent production instruction.
tetapi tiada perbezaan untuk dimensi "kelancaran", "keaslian", "elaborasi" dan "penutup". Murid-murid cenderung dalam memberi tajuk untuk lukisan mereka dalam TTCT "Figural B" berbanding dengan TTCT "Figural A". Ini menunjukkan selepas pengajaran "divergent production", terdapat kemajuan dalam aspek kreativiti murid-murid. Selanjutnya, juga terdapat kemajuan dalam pencapaian Matematik bagi kelima-lima orang murid-murid dalam kajian ini selepas pengajaran "divergent production". Keputusan menunjukkan pengajaran "divergent production" boleh dijadikan sebagai satu pendekatan dalam membantu pembelajaran matematik di sekolah rendah terutamanya strategi-strategi seperti "think aloud", inkuiri matematik dan penyelesaian masalah. Selain itu, keputusan juga memberi implikasi bahawa kreativiti murid bertambah selepas pengajaran "divergent production".
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CHAPTER ONE

INTRODUCTION

1.0 Introduction

New knowledge, tools and ways of doing and communicating mathematics continue to emerge and evolve. The need to understand and be able to use mathematics in everyday life and in the workplace has never been greater and will continue to increase (Knuth & Jones, 1991). According to Arnold (2003), mathematics is the way to understand all sorts of things around us.

Mathematics has a beauty of its own and there is, for the mathematician, an aesthetic joy that comes from solving an important problem, no matter what value society may place on this activity. In this sense, mathematics has constantly sought to free itself from its practical origins (Peat, 1990).

Mathematics literacy is one of the most important keys to quality life now and in the future, and for ensuring access and equity for all students (Knuth & Jones, 1991). Changes in the global economy and in technology require mathematical literacy. Without excellence in mathematics, world's economic productivity will be affected (Knuth & Jones, 1991).
Yet, learning mathematics can be a traumatic experience and could be highly emotional especially for students with past failure in the mathematics classrooms (Newman, 1998). Furthermore, some students have difficulties in learning mathematics, but could perform in other academic subjects (Newman, 1998). This group of students could have high IQs, are excellent readers, creative writers and could learn quickly (Newman, 1998). They show superior performance in thinking, verbal, reading and writing skills, and in every subject where these skills are the predominant modes of learning and assessment. But yet when it comes to any subject that requires understanding and application of the language of mathematics, they fail miserably (Newman, 1998). Varied mathematics instructions should be used to alleviate the problems of these students with mathematics difficulty. Mathematics education is experiencing a rapid change of direction (Noraini Idris, 2006). Studies on mathematics teaching and learning can contribute towards improving mathematics teaching and learning and promoting creative thinking in mathematics (Newman, 1998). Positive classroom climate assists in the learning and teaching of mathematical creativity (Noraini Idris, 2006). Creativity needs time to develop and thrives on experience (Noraini Idris, 2006).

1.1 Background of the Study

In this rapidly changing world, those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their future (Arnold, 2003). Mathematics is a prerequisite in understanding many things in the world around us.
Fiori (2004) states that mathematics has important implications for the real and practical world. Mathematics is used among others in the fields of science, engineering, surveying, medicine, and economics. These fields both and make use of new discoveries in mathematics.

Regardless of the purpose for learning mathematics, it is a fascinating and demanding creative endeavor and to engage meaningfully in the subject requires energy and enthusiasm (Fiori, 2004). Mathematics transfixes people with its aesthetic power, its philosophical ramifications, and its unearthly qualities.

According to Hyde and Bizar (1989), a very heartening situation in the state of mathematics education today is a shift toward problem solving. Mathematics education in Malaysia has undergone several changes since independence. Other than modification to the content of the mathematics content, in tandem with changes world wide, more emphasize was put on attaining a balance between understanding concepts and computational skills (Curriculum Development Center 2006).

Mathematics education in the primary school aims to build and develop pupils’ understanding of number concepts and their basic skills in computation that they can apply in their daily routines effectively and responsibly in keeping with the aspirations of a developed society and nation, and at the same time to use this knowledge to further their studies

(Curriculum Development Center, 2006, p.viii)
Furthermore, the curriculum places emphasis on problem solving as indicated by the following quote from the primary school mathematics syllabus, “Our nation’s vision can be achieved through a society that is educated and competent in the application of mathematical knowledge. To achieve this vision, society must be inclined towards mathematics. Therefore, problem solving and communicational skills in mathematics have to be nurtured so that decisions can be made effectively.” (Curriculum Development Center, 2006, p.viii). Problem solving in real contexts are considered essential in helping students to appreciate mathematics. In short, problem solving becomes the focus in the curriculum and the hub of mathematics teaching and learning. Students must be confident in their ability to do problem solving in order to be successful in learning mathematics and completing real life activities.

According to Noor Azlan Ahmad Zanzali (n.d.), to achieve the aims of the mathematics curriculum in the Malaysian education system, several factors should be emphasized. Students’ should be actively involved in the learning process. The learning activities, the types of questions asked and the guides given to students should be geared towards improving students’ thinking ability, and assist them in learning through real-life experiences. The learning experiences should involve activities that encourage inquiry and provide opportunities for students to reach certain conclusions or solve problem independently. These experiences must also include the use of mathematics in situations that are meaningful to students.
Creativity is not the ability to create out of nothing, but the ability to generate new ideas by combining, changing or reapplying existing ideas (Edgar, Faulkner, Franklin, Knobloch, & Morgan, 2008). Van and Tegano (2002, cited in Edgar et al., 2008) defined creativity as a significant products are developed genuinely by an interpersonal and intrapersonal process by means of which original, high quality. Creativity also includes a wide range of interpretations and beliefs based on an individual's personal style and experiences (Edgar et al., 2008).

Encouraging creative expression is an equally important educational goal that has largely been ignored in traditional instructional models (Isaksen, Murdock, Firestien, & Treffinger, 1993). Creativity may be especially important for diverse populations who are acculturating into a new environment and need to quickly adapt to a cultural changes in society (Coleman & Cross, 2001).

There is a need to cultivate creativity in education so as to cultivate the fullest development of all positive aspects of the personality of children, acknowledging and accepting a diversity of abilities and talents (Cropley, 2001). At a more everyday level, many teachers and parents are uneasy about emphasizing creativity in school because this might result in unruly, disobedient, careless, imprecise, or just plain naughty behaviour. Others see the call for creativity in the classroom as abandoning of basic skills and standards or even fundamental principles such as correct-incorrect. However, this is a humanistic goal that has been given great prominence in the educational philosophy for
hundreds of years (Cropley, 2001). Cropley (2001) also pointed out that research has shown that teachers play a key role in the emergence of widely acclaimed creative talents.

Creativity is often seen as the key to rapid economic and social development, especially modernization and its hoped-for benefits of improved education (Cropley, 2001). The world is changing rapidly and creative responding is a useful skill for living and adapting to the demands of a highly complex and changing society (Young, 2004). The need for creative problem solving in modern society has resulted in a general awareness and interest in creativity education (Isaken et al., 1993).

Creative thinking involves creating something new or original (Edgar et al., 2008). It involves the skills of flexibility, originality, fluency, imagery, associative thinking, attribute listing, metaphorical thinking and forced relationships (Edgar et al., 2008). They also added that the aim of creative thinking is to simulate curiosity and promote divergence. Divergent thinking helps students to be more resourceful in their analyses of questions, answers are not based on rote memorization and students develop their own solutions to problems (Edgar et al., 2008).

1.2. Problem Statement

Generally, the learning of mathematics, especially those involving mathematics problem solving can cause mathematics anxiety among primary school students (Godbey, 1997).
Majority of students have difficulty developing their mathematical problem solving skills and have difficulty accepting alternative approaches to solve a problem. To these students, a mathematics problem should have only one correct answer which is generally not the case with real life problem solving.

As envisaged in the Integrated Curriculum for Primary Schools Curriculum Specifications for Mathematics Year Five (2006), the teaching and learning of mathematics should not only stress on achievement in the subject but also to look at promoting creativity in the mathematics classroom. However, studies in Malaysia such as Noor Azlan Ahmad Zanzali and Lui (n.d.) has shown that Malaysia’s students are weak in creative problem solving, especially in mathematics.

According to Park (2004), divergent production instruction with mathematics inquiry skills and think aloud strategies can be a way to improve students’ mathematics performance and eventually develop their creativity potential. Curriculum Development Center (2006) also stated that problem solving skills in mathematics has to be nurtured so that decisions can be made effectively.

Torrance (1981) also noted several signs that indicate when creative learning occurs, such as improved motivation, alertness, curiosity, concentration, and achievement. Thus, creative teaching can enhance learning.
Therefore, this study aims at investigating the students' creativity and divergent thinking especially in think aloud, mathematics inquiry, problem solving through the divergent production instruction.

1.3. Research Objectives

Specifically, this study have the following research objectives:

1. To determine if the divergent production instruction has improved students’ mathematics performance in think aloud, mathematics inquiry and mathematics problem solving.

2. To investigate the effects of divergent production instruction on students’ creativity level using the Torrance Test of Creative Thinking.

3. To determine the effects of divergent production instruction on students’ mathematics achievement.

1.4. Research Framework

Referring to Figure 1.1, the dependent variables for this study were frequencies of using: think aloud, mathematics inquiry and problem solving; levels of creative thinking which consisted of fluency, originality, elaboration, titles and closure; and students’ achievement in a mathematics test. The independent variable of the study was the divergent production
instructional method, which consists instructional activities adapted from Park (2004) and modified by the researcher to suit the local classroom situations.

<table>
<thead>
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<th>Independent Variable</th>
<th>Dependent Variable</th>
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| Divergent Production Instructional Method | 1. Frequencies / ways of using  
  • Mathematics Inquiry  
  • Think Aloud  
  • Problem Solving  
  2. Creative Thinking  
  • Fluency  
  • Originality  
  • Elaboration  
  • Titles  
  • Closure  
  3. Achievement in Mathematics test |

Figure 1.1 Research Framework