THE EFFECT OF PROBLEM-BASED LEARNING WITH COOPERATIVE LEARNING 'NUMBERED HEAD TOGETHER' ON SCIENTIFIC CREATIVITY OF PRESCHOOLERS

CHIN MUI KEN

THESIS SUBMITTED IN FULFILLMENT FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

FAKULTI PSIKOLOGI DAN PENDIDIKAN
UNIVERSITI MALAYSIA SABAH
2017

UNIVERSITI MALAYSIA SABAH

BORANG PENGESAHAN STATUS TESIS

JUDUL: **THE EFFECT OF PROBLEM-BASED LEARNING WITH COOPERATIVE LEARNING 'NUMBERED HEAD TOGETHER' ON SCIENTIFIC CREATIVITY OF PRESCHOOLES**

IJAZAH: **DOCTOR OF PHILISOPHY (CURRICULUM AND INSTRUCTION)**

Saya **CHIN MUI KEN**, Sesi 2012-2013, mengaku membenarkan tesis Doktor Falsafah ini disimpan di Perpustakaan Universiti Malaysia Sabah dengan syarat-syarat kegunaan seperti berikut:

1. Tesis ini adalah hak milik Universiti Malaysia Sabah.
2. Perpustakaan Universiti Malaysia Sabah dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (/):

[ ]	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA 1972)
[ ]	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
[/]	TIDAK TERHAD	

Disahkan Oleh,

CHIN MUI KEN
DT1221034T

(Tandatangan Pustakawan)

Tarikh: 4 September 2017

Dr. Siew Nyet Moi @Sopiah Abdullah
Penyelia

DECLARATION

I hereby declare that the material in this thesis is my own except for quotations, excepts, equations, summaries and references, which have been duly acknowledged.

19 July 2017

Chin Mui Ken
DT1221034T

CERTIFICATION

NAME : **CHIN MUI KEN**

MATRIC NO : **DT1221034T**

TITLE : **THE EFFECT OF PROBLEM-BASED LEARNING WITH COOPERATIVE LEARNING 'NUMBERED HEAD TOGETHER' ON SCIENTIFIC CREATIVITY OF PRESCHOOLERS**

DEGREE : **DOCTOR OF PHILOSOPHY (CURRICULUM AND INSTRUCTION)**

DATE OF VIVA : **19 JULY 2017**

CERTIFIED BY

1. **SUPERVISOR** Signature
SIEW NYET MOI @SOPIAH ABDULLAH

ACKNOWLEDGEMENT

As I reach the end of this journey, I am most humbled by the fact that it could not have been traveled alone. Without the unquestionable support and enduring encouragement by my supervisor, friends, and family, my destination could not have been finished. So many people have helped me and supported me along the way, and I know I will never be able to express my gratitude or thank every person who has assisted me in my journey.

First, I must thank my family. To my husband, Tony Liew, who has been a rod of support and a wall of encouragement through the times that challenged me the most. I so appreciate your willingness to allow me the time and resources necessary to complete this journey. To my children, Alex, Edward, Bryan, Brendon and Aaron, thank you for your understanding and encouragement.

I would also like to deeply thank my supervisor, Dr. Siew Nyet Moi @Sopiah Abdullah, for consistently guided me in the right direction and insisted I keep going. I will never be able to fully express my most sincere gratitude for her time, dedication, and belief in my abilities.

To my colleagues and friends, a thank you is not sufficient for all the encouragement, support, and resources each of you provided to me. Your faith in my ability to be successful has been so meaningful to me.

Chin Mui Ken
July 2017

ABSTRACT

Problem-based learning (PBL) and cooperative learning (CL) have become one of the important instructional approaches in primary, secondary and higher learning institutions in Malaysia. However, very few studies have examined the integration of PBL with CL 'Numbered Head Together' (NHT) to foster scientific creativity in preschool level. The research aims to determine the effects of PBL-CL 'NHT' on five trait dimensions of preschooler' scientific creativity: fluency (F), originality (O), elaboration (E), abstractness of title (A), and resistance to premature closure (R). A PBL-CL 'NHT' module was developed as a guideline for preschool teacher to foster preschooler's scientific creativity. The Figural Scientific Creativity Test (FSCT) Form A and B were also developed to assess the five trait dimensions of scientific creativity. A quasi-experimental pre-post control groups design was employed and a total of 216 six-year-old preschoolers from three preschools participated in three intervention groups: PBL-CL 'NHT', PBL and hands-on activities. Multivariate Analysis of Covariance (MANCOVA) was utilized for the analysis of data to determine if a significant difference existed on mean scores across the three groups. The findings revealed statistically significant difference (F (6, 202) = .485, $P < .01$) across the three groups. Follow-up ANCOVA results indicated that there were statistical significant differences across the three groups in fluency (F (2, 212) = 23.530, $P < .01$), originality (F (2, 212) = 16.229, $P < .01$), elaboration (F (2, 212) = 24.130, $P < .01$), abstractness of title (F (2, 212) = 18.084, $P < .01$), resistance to premature closure (F (2, 212) = 17.005, $P < .01$), and scientific creativity (F (2, 212) = 22.183, $P < .01$). Medium and large effect sizes were obtained for comparing PBL-CL 'NHT' with PBL and TG method. This study indicates that the PBL-CL 'NHT' method has a positive impact in fostering preschoolers' five trait dimensions of scientific creativity. Thus, educators and preschool teachers are recommended to employ PBL-CL 'NHT' module in the classroom practices. Teaching preschoolers the various ways to acquire new knowledge and applying what has been learned are able to enhance scientific creativity and prepare preschoolers for life beyond their education.

ABSTRAK

KESAN PEMBELAJARAN BERASASKAN MASALAH DENGAN PEMBELAJARAN KOOPERATIF 'NUMBERED HEAD TOGETHER' TERHADAP KREATIVITI SAINTIFIK KANAK-KANAK PRASEKOLAH

Pembelajaran berasaskan masalah (PBL) dan pembelajaran kooperatif (CL) merupakan satu pendekatan pengajaran yang penting di sekolah rendah, menengah dan institut pengajian tinggi di Malaysia. Namun demikian, kajian yang melibatkan integrasi PBL dengan CL 'Numbered Head Together' (NHT) untuk membantu perkembangan kreativiti saintifik di peringkat prasekolah adalah sangat kurang. Kajian ini bertujuan untuk menentukan kesan PBL-CL 'NHT' terhadap lima dimensi sifat kreativiti saintifik murid prasekolah: kelancaran (F), keaslian (O), penghuraian (E), keabstrakan tajuk (A), dan rintangan terhadap penutupan pra-matang (R). Sebuah modul PBL-CL 'NHT' telah dibangunkan sebagai panduan kepada guru prasekolah untuk memupuk kreativiti saintifik kanak-kanak prasekolah. Instrumen Kreativiti Saintifik Bergambar (KSB) Borang A dan B juga dibangunkan untuk mentaksir lima dimensi tret kreativiti saintifik. Reka bentuk kuasi-eksperimen ujian pra pasca telah digunakan dalam kajian ini. Seramai 216 kanak-kanak prasekolah yang berumur enam tahun daripada tiga buah prasekolah telah terlibat dalam tiga kumpulan intervensi: PBL-CL 'NHT', PBL dan 'hands-on' aktiviti. Multivariate Analisis of Covariance (MANCOVA) telah digunakan dalam analisis data untuk menentukan sama ada terdapat perbezaan yang signifikan pada skor min dalam ketiga-tiga kumpulan. Dapatan kajian menunjukkan terdapat perbezaan yang signifikan ($F(6, 202) = 0{,}485$, $P < 0{,}01$) dalam ketiga-tiga kumpulan. Keputusan ANCOVA juga menunjukkan terdapat perbezaan yang signifikan dalam ketiga-tiga kumpulan terhadap kelancaran ($F(2, 212) = 23{,}530$, $P < 0{,}01$), keaslian ($F(2, 212) = 16{,}229$, $P < 0{,}01$), penghuraian ($F(2, 212) = 24{,}130$, $P < 0{,}01$), keabstrakan tajuk ($F(2, 212) = 18{,}084$, $P < .01$), rintangan terhadap penutupan pra-matang ($F(2, 212) = 17{,}005$, $P < .01$), dan kreativiti saintifik ($F(2, 212) = 22{,}183$, $P < .01$). Saiz kesan yang sederhana dan besar diperolehi dalam perbandingan PBL-CL 'NHT' dengan kaedah PBL dan TG. Kajian ini menunjukkan bahawa kaedah PBL-CL 'NHT' memberi kesan positif dalam membantu perkembangan lima dimensi sifat kreativiti saintifik kanak-kanak prasekolah. Oleh itu, para pendidik dan guru prasekolah adalah disarankan menggunakan modul PBL-CL 'NHT' dalam amalan bilik darjah mereka. Dengan mengajar kanak-kanak prasekolah pelbagai cara untuk memperoleh pengetahuan baru dan menerapkan ilmu yang telah dipelajari dapat meningkatkan kreativiti saintifik serta menyediakan mereka dengan kehidupan diluar pendidikan.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CL	Cooperative Learning
FSCT	Figural Scientific Creativity Test
MANOVA	Multivariate Analysis of Variance
MANCOVA	Multivariate Analysis of Covariance
MOE	Ministry of Education
NHT	Numbered Head Together
NPCS	National Preschool Curriculum Standard
PBL	Problem-Based Learning
SCSM	Scientific Creativity Structure Model
TG	Traditional Method
TTCT	Torrance Test of Creative Thinking
ZPD	Zone of Proximal Development

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Young children are natural scientists. Starting in early infancy, the young child acquires and organizes information, forms categories, and constructs mental representation and naive theories to explain the world (Venville, 2008). Children have innate curiosity and as soon as children realize that they can discover things for themselves, their first encounter with science has occurred. According to Conezio and French (2002), children's everyday experience is the foundation for science. Experiences in science provide opportunities for young children to develop an appreciation and awareness of the world around them (Eshach, 2006; French, 2004).

Science education is necessary in the preschool period for the pre-schoolers to improve their creativity and learn about different perspectives. Moreover, science education in preschool level forms the basis for the science education at primary school (Özbey and Alisinanoğlu, 2008). The pre-schoolers who enjoy science activities are expected to develop a positive attitude towards science in their future lives (Çamlıbel Çakmak, 2006 cited in Abdullah Mirzaie, Hamidi and Anaraki, 2009).

Unfortunately, lack of research on science education and developing perceptions toward science during early childhood prevents researcher from tracing the formation of science views in general (Fleer and Hardy, 1993; Zembylas, 2008). In Malaysia, research in the field of early childhood science education, especially with children in preschool, is limited in scope and volume. One major reason for the lack of research is the characteristics of the early childhood population. Specifically, young children have limited expressive language, and only partially developed reading, writing, and drawing skills. In addition, young children have a short attention span and may bot fully engage in the task or provide reliable answers (Fleer and Hardy, 1993).

Furthermore, difficulties in methodology design for studying young children, researchers' expertise, and preconceptions about young children's capabilities also contribute to the lacuna in early childhood science education research (Fleer and Hardy, 1993; Charlton, 2003; Ravanis and Bagakis 1998). Hence, there is a clear need for more research focusing on science education during the early years.

As the world is entering a new era, creativity is not just becoming increasingly important (Pink, 2005), but it seems that "our future is now closely tied to human creativity" (Csikszentmihalyi, 1996). Gardner (2010), in his Five Minds for the Future, has argued for the crucial role of creativity, as one of the five cognitive abilities that leaders of the future should seek to cultivate. In order to prepare for the future, the Ministry of Education (MOE) has introduced a new plan in 2012 called 'The Education Development Plan'. This plan outlines the directions for the education system in Malaysia for 2013 until 2025. Through this plan, there are six key attributes in the student aspirations that needed by every student to be globally competitive and one of the attribute is able to think critically and creatively.

Tracing back, the efforts of the MOE to develop creative thinking skills among pre-schoolers started with the implementation of National Preschool Curriculum since 2001 (PPK, 2001) and the newly-implemented National Preschool Curriculum Standard (NPCS) which was introduced in 2010 (BPK, 2010a). In these preschool curriculums, science is one of the disciplines that can make a contribution to the achievement of these goals. Knowing the great importance to enhance creativity in science education, several European countries in the world have conducted the Creative Little Scientists project, aiming to foster creativity in early childhood, is an evidence of the priority given to creativity in general and creativity through science in particular, especially in early years education (www.creative-little-scientists.eu).

In Malaysia, several studies have been done to examine the creativity of Malaysia pupils. The earliest academic study was pioneered by Yong (1984) and was followed by Palaniappan (1993). These studies focused much on adolescents and undergraduates and were mainly conducted on creativity as a general ability or process (Yong, 1984; Yong 1993; Kalliappan, 1998; Palaniappan, 1993; Segumpan, 2001; Palaniappan, 2005). Hu, Adey, Shen and Lin (2004) stated that it is a general consensus that domain-specific knowledge and skills are major components of creativity. Other researchers (Albert, 1983; Gardner, 1983; Feldman, 1986; Han, 2003; Kaufman and Baer, 2008) have also concluded that creativity is domain-specific. Nickerson (1999) stressed the importance of domain-specific knowledge as a determinant of creativity and felt it was generally underestimated. According to Hu and Adey (2002), a domain specific creativity such as scientific creativity was worth attention as scientific research requires creativity and went beyond what was already known. Furthermore, during science activities, pupils are required to solve problems by producing several possible methods. Thus, Aktams and Ergin (2006) pointed out that science lesson was one of the most important lessons in which pupils could be nurtured with all the dimensions of the scientific creativity.

The fact that scientific creativity is attaining increasingly widespread popularity, with researches carries out in Malaysia as well as other countries. Malaysian researchers such as Siew, Chong and Lee (2015) have conducted research on fostering scientific creativity among the fifth graders through problem-based learning (PBL). Students' scientific creativity was investigated in the product dimensions of (a) solving scientific problems, (b) understanding scientific phenomena, (c) advancement in scientific knowledge, and (d) improvisation skills with a technical product. The fifth graders demonstrated improved creative traits of being fluent, flexible, and original in their solutions for a scientific problem, improvising a technical product, and advancing scientific knowledge. This shows scientific creativity could be fostered among early learners and more creative traits such as elaboration, abstractness of title, and resistance to premature closure need to be assessed in order to nurture and understand the creative traits of the learners particularly in the preschool level.

Other researchers, Jo (2009) claimed that creative competence and scientific proficiency play a role of partial mediators among scientific creativity, general creativity and scientific proficiency. Rawat (2010), focused on the fluency component of scientific creative talent of elementary stage students of Himachal Pradesh with respect to area, type of school and gender. Secondary school students in Hu and Adey (2002) research found that scientific creativity increases with increase in age, and science ability was a necessary but not sufficient condition for scientific creativity. Meanwhile, Ceran, Güngören and Boyacıoğlu (2014) stated that middle school's students have "mid-level" of scientific creativity. They have abilities to think up a lot of ideas, however, they cannot approach a case from different standpoint and their original thinking is lesser.

Although many researches have been done, there are still some limitations of the research on scientific creativity. Most of the researchers chose to measure students' creativity in specific domains such as biology (Carson, 2011) and chemistry (Cox and Jones, 2011), rather than to assess students' scientific creativity in general. Moreover, most of the respondents in the scientific creativity research were elementary (Mohamad, 2006), secondary (Hu and Adey, 2002; Liang, 2002; Kiliç and Tezel, 2012; Ceran *et al.*, 2014) and high school students (Silva, Fadel and Wechsler, 2013). Ignoring preschooler's scientific creativity in the preschool can be detrimental for these children in subsequent grade levels. Therefore, more attention is needed to shift the focus of researchers from the discussion of scientific creativity toward preschool level. Identifying scientific creativity in preschool can help preschoolers make the best use of their potential. Thus, educators can better serve the preschooler's needs through providing appropriate teaching methods and learning opportunities that promote scientific creativity.

Creative thinking is related to divergent thinking, which emphasizes on four subscales; fluency, flexibility, originality, and elaboration (Guilford, 1956, 1959, 1960, 1986). However, Torrance, Ball and Safter (2008) have eliminated flexibility and added another two subscales in creative thinking as abstractness of title and resistance to premature closure. The rationale for addition of abstractness of title is based on idea where creativity requires a person to sense the essence of a problem, to know what is truly essential, and then to reflect on the level of abstraction given to the title of the drawn figure or picture. Meanwhile, resistance to premature closure requires an individual to 'keep open' in processing information and consider a variety of information (Torrance *et al.,* 2008). According to Torrance (1979), each subscale of creative thinking should interpret separately to nurture and understand the creative ability of a person. Similarly, Chronopoulou and Riga (2012) stressed that the creative ability of an individual can be generalized by assessing the subscales of creative thinking. The level of each subscale is able to indicate the effectiveness of certain interventions or programs for the development of creative ability (Awamleh, Al-Farah and El-Zraigat, 2012; Rossa, 1996). In order to address these issues, the present study has focused on these five subscales as trait dimensions of scientific creativity.

Recently, there has been growing interest in exploring these five subscales of creative thinking in preschool level. Shawareb (2011) claimed that the effect of early computer experience among Jordanian kindergarten children show no significant differences between gender in all the subscales of creative thinking. Chronopoulou and Riga (2012) focused on the effect of music and movement activities to fluency, flexibility, originality and elaboration of five year old children. The findings showed the growth rate of these four subscales upon completion of the educational programme. Garaigordobil and Berrueco (2011) found that play program of preschool children showed increased the graphic creativity of fluency, originality and elaboration.

Unfortunately, many researchers have tended to focus the subscales on general creativity rather than on domain specific as scientific creativity. Therefore, Figural Scientific Creativity Test (FSCT) Form A and B was developed in the present study to assess the five trait dimensions of scientific creativity among preschoolers: fluency, originality, elaboration, abstractness of title and resistance to premature closure. Identifying of these trait dimensions of scientific creativity can help science educators to assess the creative ability of the preschoolers during the teaching and learning process or intervention program. Furthermore, the characteristics (trait) of the creative person can be obtained (Hu and Adey, 2002).

1.2 Problem Statement

Creative and critical thinking are one of the main elements emphasized in the NPCS. Fostering creative thinking in preschool level is important to develop the preschoolers as independent thinkers after the formal schooling (Abdullah Mirzaie *et al.*, 2009). According to Craft (2000), educating children in ways that foster creative development is able to offer them the right to express their own feelings, have inner world of dreams, fantasies, and imagination to make their own engagement in life. Introducing children the creative thought and expression in early education is able to nurture and affirm their creative potential as creative thinking can be taught and learnt (Dziedziewicz, Oledzka and Karwowski, 2012).

Scientific Creativity has been identified as one of the key domains of specific creativity which has contributed to the advancement of human civilization (Hu, Shi, Han, Wang, and Adey, 2010). Individuals who possess scientific creativity are considered to be more capable of producing a certain product that is original and has social or personal value (Hu and Adey, 2002). Children are naturally creative and curious thus fostering scientific creativity in preschools can help them make the best use of their potential.

Despite the increased emphasis on fostering children's creativity in the recently revised NPCS (BPK, 2010a), there is a little evidence to demonstrate researches done on scientific creativity among preschoolers in Malaysia. A review carried out by Chew and Madar (in press) (2016) entailing the most recent studies from multiple disciplines and educational levels between the years 1979 to 2015 showed that research about creativity mostly focused on 'general-content-based creativity'. An affiliated research conducted outside Malaysia showed improvement in creativity among 30 preschool boys' fluency, flexibility, originality and elaboration (Mirzaie, Hamidi and Anaraki, 2009). However, no details were given as to which domain specific creativity was evaluated.

Many recent studies have focused on correlation between PBL and creativity (Plucker and Nowak, 2000; Tan, 2009). PBL has been substantiated by research that demonstrates the effectiveness in promoting high cognitive level (Santos, Alonso, Eloy and Arnaltes, 2012), knowledge construction, collaborative learning, and independent learning (Tan, 2009). One of the outcomes that PBL can potentially produce is the capability for creative thought, which has recently drawn much attention from educators (Barak, 2006; Kwon, Park and Park 2006; Semerci, 2006; Tan, 2000). In preschool context, the preschoolers who are exposed with PBL environment learn to reflect on their experiences as they construct and develop new knowledge. According to Torp and Sage (2002), preschool is a place of experiential learning, the implementation of PBL will encourages experiencing learning and investigation appears to be a practical method of teaching and learning in this setting.

Despite claims about the positive effect of PBL on students' creativity, empirical evidence of the advantages of PBL in Malaysian preschools is scarce. Meta-analysis on PBL was conducted from 2009-2014 (Mustaff and Ismail, 2014), but its primary focus was on research carried out in Malaysian secondary and primary schools level. Several other research studies investigated the effects of PBL on learning achievement in subjects such as chemistry, biology, and primary science (Tarhan and Acar-Sesen, 2013; Osman and Kaur, 2014; Etherington, 2011), whereas others look at the effects of PBL on learning skills and affective properties of students. For example, self-directed learning skills, attitude, and beliefs among high school and university students (Malan, Ndlovu and Engelbrecht, 2014; Demirel and Dagyar, 2016; Tarhan and Acar-Sesen, 2013). There is relatively little research done on the effects of PBL on children's creativity at the preschool level.

Another well researched topic in educational circles for more than a decade is cooperative learning (CL). CL has created a lot of interest amongst researchers and is acknowledged as a set of pedagogical practices which students are grouped and encouraged to work together to facilitate active participation in discussing different perspectives on a common topic (Hirst and Slavik, 2005; Johnson and

Johnson, 1999; Slavin, 1995). Recently, researchers and practitioners have found that small cooperative groups can develop the type of intellectual exchange that fosters creative thinking and productive problem–solving (Davoudi and Mahinpo, 2012). Kim and Song (2012) state that CL is an effective teaching method for students to acquire creativity, critical thinking skills, and problem-solving skills instead of fragmentary knowledge acquisition.

Numbered Heads Together (NHT) is a CL strategy that combines the components of teacher-directed and peer-mediated instruction while using a distinct teacher questioning strategy that encourages active student participation (Maheady, Michielli-Pendl, Harper, and Mallette, 2006). NHT is known as a set of procedures for cooperative structures and is well researched in group work. This structure is beneficial in science as well as in social studies, general knowledge, and retention of learned content (Maheady, Mallette, Harper and Sacca, 1991; Maheady, Michielli-Pendl, Mallette and Harper, 2002; Haydon, Maheady and Hunter, 2010). Kagan (1989) stressed that NHT includes teams, positive interdependence and individual accountability, which lead to cooperative interaction among the students. The use of NHT has been proven to increase students' scientific creativity (Maulana, 2014) and effective in increasing class participation among all students within a classroom (Hunter, 2011).

Although NHT has gained interest in research especially in secondary and primary school classrooms, research on preschoolers' creativity is lacking. Kyndt, Raes, Lismont, Timmers, Cascallar, and Dochy (2013) performed a meta-analysis from 1995 onwards on the effects of different methods of cooperative learning on achievement, attitudes and perception yet did not mention NHT. The meta-analysis focused on primary, secondary or tertiary education conducted in real life classrooms. Evidently, the meta-analysis showed that studying the effects of cooperative learning strategy that is, the NHT, on students' creativity at the preschool level, is worthy of receiving attention.

The increasing interest in PBL has heightened some researchers to integrate CL in PBL. Shared activities with peers provide children with opportunities to learn,