THE EFFECTIVENESS OF HANDS-ON INVESTIGATION ON STUDENTS' CONCEPTUAL UNDERSTANDING AND CURIOSITY TOWARDS SCIENCE

TAY SHENG JOO

THIS DISSERTATION IS PRESENTED TO FULLFIL PART OF THE CONDITIONS REQUIRED FOR MASTER OF EDUCATION IN SCIENCE

FACULTY OF PSYCHOLOGY AND EDUCATION
UNIVERSITI MALAYSIA SABAH
2014

DECLARATION

I, Tay Sheng Joo, hereby declare that the work contained in this dissertation entitled THE EFFECTIVENESS OF HANDS-ON INVESTIGATION ON STUDENTS' CONCEPTUAL UNDERSTANDING AND CURIOSITY TOWARDS SCIENCE is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person, except where due acknowledgement and citations has been made in the text.

Signature : 

Name : TAY SHENG JOO

Matrix Number : MT1212073T

Date : 17 JUNE 2014

ACKNOWLEDGEMENTS

I would like to express my greatest appreciation and deepest gratitude to Dr. Sopiah Abbdullah, my supervisor of this dissertation, for her encouragement, guidance and support throughout the study. Without her guidance and patient, I could not complete this study.

In addition, I would like to express my heartily thankful to my MES course mates and my colleagues, as they had given me support, advises and assistance for me to continue this study.

Las but not least, I would like to express my sincere thanks to my beloved family, especially my sister who had been struggle with me throughout this study. Thank you for the understanding that supports me to carry out and complete this study.

ABSTRACT

THE EFFECTIVENESS OF HANDS-ON INVESTIGATION ON STUDENTS' CONCEPTUAL UNDERSTANDING AND CURIOSITY TOWARDS SCIENCE

The purpose of this study was to determine the effectiveness of hands-on investigation on students' conceptual understanding and curiosity towards science. There were 70 samples of Primary Year 5 students selected from two schools located in Tenom, Sabah. Samples were divided into two groups, which 35 of them included in the treatment group that underwent hands-on investigation and the other 35 samples in the control group. The instruments used in this study were the pre- and post- test to examine the effects of hands-on investigation on students' conceptual understanding; and the pre- and post- questionnaire to examine the effects of hands-on investigation on students' curiosity towards science. Data collected was analysed in both way: descriptively and inferentially. The findings indicated that hands-on investigation had showed no significance difference in the post-test between treatment group and control group; nevertheless, researcher found that treatment group students had better improvement than those who are not. Besides that, findings also proved that hands-on investigation had positive effect on students' curiosity towards science.

Key Words: hands-on investigation, conceptual understanding, curiosity.

ABSTRAK

KEBERKESANAN PENYIASATAN HANDS-ON KE ATAS PEMAHAMAN KONSEPTUAL MURID DAN PERASAAN INGIN TAHU MEREKA TERHADAP SUBJEK SAINS

Kajian ini bertujuan untuk mengkaji keberkesanan penyiasatan hands-on ke atas pemahaman konseptual murid dan perasaan ingin tahu mereka terhadap subjek sains. Seramai 70 murid Tahun 5 dipilih dari dua buah sekolah yang terletak di Tenom. Sample diasingkan kepada dua kumpulan, iaitu 35 orna gmurid dikategorikan sebagai kumpulan intervensi yang menjalani penyiasatan hands-on, manakala 35 orna gmurid lagi sebagai kumpulan kawalan. Instrument yang digunakan dalam kajian ini adalah ujuan pra-pasca untuk menguji keberkesanan penyiasatan hands-on ke atas pemahaman konseptual murid, dan soal selisik pra-pasca untuk menguji keberkesanan penyiasatan hands-on ke atas perasaan ingin tahu murid terhadap subjek sains. Data yang dikumpul dianalisi decara deskriptif dan statistic. Dapatan menunjukkan bahawa penyiasatan hands-on tidak menunjukkan perbezaan signifikan antara ujuan pasca antara kumpulan intervensi dan kumpulan kawalan. Namun demikian, pengkaji mendapati bahawa murid dalam kumpulan intervensi menunjukkan peningkatan yang lebih baik daripada kumpulan kawalan. Selain itu, dapatan juga menunjukkan terdapat kesan positif antara penyiasatan hands-on dengan perasaan ingin tahu murid terhadap subjek sains.

Kata Kunci: penyiasatan hands-on, pemahaman konseptual, perasaan ingin tahu.

TABLE OF CONTENT

LIST OF DIAGRAM

LIST OF TABLE

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Science is crucial for the development of a country. A scientific, progressive and innovative society is always looking forward for an advance life. Noticed by the important of science in contributing to the advanced growth, Malaysia Minister of Education had implemented various curricula since the independence of Malaysia which aimed to produce scientific and technological civilization. Nevertheless, challenges discovered when the society produced was not only required to be scientific knowledgeable, advance on technology, but at the same time capable to complete with other. On the other hand, Malaysia current science curriculum had been framed as a trend of exam-oriented, in which the score is always on the top of quality of learning. Students reserve prior attention on the test score and their ranking in the class, and neglect the important of learning science to solve problem and the master of certain science conceptual understanding instead. As these issues are oppose the aim of Malaysia Minister of Education, actions shall be taken to ensure the greatest advantages on science learning in school in coherent with the aim.

Society had to admit that the students had been trained to answer test's question rather than to understand the answer. According to Janettha (2013), learning by merely reading science books and memorizing every single science contents is not qualified for students to master science concepts. Students' habits to memorise as to reach an answer or conclusion will have zero contribution to produce scientific knowledgeable individuals. As a result, various learning methods and approaches should be

implemented in school to enhance students' science concepts. Each student should be given the opportunity to observe, experiment, collect and interpret data, make inferences and draw conclusions about which they obtained (MOSTI, 2012).

There are many activities started with students' daily knowledge, and attempt to extend to a formal conceptual domain (Stears, 2009), however, the ability for students to relate between the daily knowledge and the new concept build are still in low level. Eventhough students obtained high scores in their test, however there is no guarantee that the students able to apply the knowledge in their daily life, as stated by Stears (2009) that crossing between school learning and out of school learning is one of the more difficult borders to cross for most of these learners, but if they see the use of their everyday experiences as more than just a device for learning science, they are more inclined to bring their home experiences to school. Nevertheless, previous science curriculum did not showed much succeeded results in overcoming these problems.

In fact, Malaysia's learning culture is yet depending on traditional-oriented method (Zelkepli, 2010). Teachers mostly make excuses on the constraints of large size number of students, lacking of time, insufficient school facilities, inadequate knowledge on teaching methods, burdened by school duty, and so on, consequently causing the lesson to be conducted in passive learning lesson, most likely teacher-centered, whilst the importance of carry out hands-on activities to develop conceptual understanding are neglected. In fact, learning of science should be started best in primary school through manipulating with objects. According to Ates and Eryilmaz (2011), children start to learn science once they realize that their actions and experiences lead to the construction of events interpretation which can help them learn about the world. If students do not have well science conceptual understanding in their elementary stage of learning, it will be harder to strengthen their knowledge on science in future.

By the other hand, research shown that Malaysian students showed moderate level of curiosity towards science subject, and some believed that students' curiosity fall in sleep as they enter primary school system (Rahim, 2013), while the intention to learn are built upon score ranking purposes. According to Hee and Siti Liyana (2008), students' motivation on learning emerged from their interest and curiosity to learn. Students become curious as the subjects enable them to think critically, and challenge them to have deeper understanding on that particular area. It is said that students with higher level of curiosity will put more efforts to learn and master a concept. Whereas Mohamad Mohsin and Nasruddin (2008) stated that motivational aspects should emphasize on teachers' efforts to foster curiosity, as well as their willingness to take risks in learning. Hence it is concluded that teacher take an important role to enhance students' scientific knowledge as well as to stimulate their curiosity and motivation to learn on science.

1.2 Problem Statement

The Ministry of Education aims to produce students with high intention of learning science, and to promote creativity among students through experience and investigation, by the same time enhance the mastery of conceptual understanding, scientific skills and noble values. Since the Ministry of Education had placed high expectation on the science lesson, consequently bring to greater responsibilities for teachers to carry out more effective science lesson. Nonetheless, teachers often claimed that the lacking of time provided to accomplish syllabus, together with enhancing conceptual understanding through activities as the main problem encountered to the curriculum's needs. Eventually, students learn a concept based on what teacher taught, rather than gaining knowledge based on their understanding on the lesson instead. According to Ateș and Eryilmaz (2011), students need both practical opportunities to apply knowledge and the opportunities to integrate and exchange the knowledge gained in order to truly master a science concept.

Evidence shows that Malaysia's students used to memorise a fact rather than to think and analyse the reason of the fact to happen (Khamisah et al., 2007). In other words, the students are lack of mastering in conceptual understanding. They are able to recall the concepts learnt, but most of them failed to understand the exact meaning behind the words. The Minister of Welfare, Women and Family Development Datuk Fatimah Abdullah pointed out that learning should beyond merely reading, writing and counting (Heng, 2013).

Pernafes (2005) claims that understanding a new concept, either it is scientifically or spontaneously, they both need to converge ultimately, otherwise, scientific concepts will have no grounding and relevance in the students' reality, and spontaneous concepts would achieve zero systematicity. Basically, students need to have strong conceptual knowledge before they have the ability to relate it with real life's problems. Teachers hereby need to emphasis on the content taught as well as the conceptual understanding generated among students. Thus, a more effective approach should be used as to enhance students' conceptual understanding.

As an alternative to the above problem, the researcher chooses hands-on investigation as it could be one of the active engagement methods to solve the problem stated. Learning through playing had been proved to help in the development of students learning progress (Azizi, 2010). The activities involve can be either based on direct experience with natural phenomena or any educational experience heard, seen or leant before. In the context of investigative learning process as required by the Malaysia Ministry of Education, teachers should offer students with opportunities to conduct various experiments with different levels of difficulty, and then followed by discussion among their peers to find out whether the finding reach the objectives of lesson or not (Osman and Sukor, 2013).

Hands-on investigation is not only promotes learning by doing, but also claimed to enhance students' knowledge. Students are no longer satisfied with spoon feeding method; they prefer to have direct interaction with the objects to learn on a new concept. The ability to manipulate with the objects became more crucial in the learning of science than other subjects. It can increase students' ability to digest and produce original ideas and be generatively can be tested by students themselves (Cakir, 2008). New ideas or inspiration arises through a combination of existing ideas and thus help in develop effective ways to resolve problematic situation (Karagiorgi and Symeou, 2005). Promote hands-on investigation can certainly help students to understand and explain a concept they are studying during learning (Nurzatulshima and Lilia, 2013).

Review on the efforts of Malaysia Ministry of Education to develop students' conceptual understanding towards science subject, science curriculum were designed to produce active learners, in which the students are provided with the opportunities to observe, ask questions, formulate and test hypotheses, analyse, interpret data, report and evaluate findings (Kementerian Pelajaran Malaysia, 2003). As hands-on investigation provides students with opportunities to learn and mastery science concepts through manipulating objects, teachers are encouraged to conduct learning in investigative process as to develop students' science conceptual understanding. Students hereby develop their scientific knowledge by their own hands.

1.3 Research Objectives

The objectives in this study are:

i. To investigate the effect of the hands-on investigation on students' conceptual understanding in the topic of light.

ii. To investigate the effect of the hands-on investigation on students' curiosity toward science.

1.4 Research Questions

i. Is there any significance difference in the pret-test mean scores between the treatment group and the control group?

ii. Is there any significance difference in the post-test mean scores between the treatment group and the control group?

iii. Is there any significance difference in mean scores between pre-test and post-test in students' conceptual understanding for the treatment group?

iv. Is there any significance difference in mean scores between pre-test and post-test in students' conceptual understanding for the control group?

v. Is there any significance difference in the pre-curiosity mean scores between the treatment group and the control group?

vi. Is there any significance difference in the post-curiosity mean scores between the treatment group and the control group?

vii. Is there any significance difference in the pre-curiosity mean scores and the post-curiosity mean scores for the treatment group in their curiosity towards science?

viii. Is there any significance difference in the pre-curiosity mean scores and the post-curiosity mean scores for the control group in their curiosity towards science?

1.5 Research Hypotheses

The NULL hypotheses generated based on the research questions above are shown as following:

H_{01}: There is no significant difference in the pre-test mean scores between the treatment group and the control group.

H_{02}: There is no significant difference in the post-test mean scores between the treatment group and the control group.

H_{03}: There is no significant difference in mean scores between pre-test and post-test in students' conceptual understanding for the treatment group.

H_{04}: There is no significant difference in mean scores between pre-test and post-test in students' conceptual understanding for the control group.

H_{05}: There is no significant difference in the pre-curiosity mean scores between the treatment group and the control group.

H_{06}: There is no significant difference in the post-curiosity mean scores between the treatment group and the control group.

H_{07}: There is no significant difference in the pre-curiosity mean scores and the post-curiosity mean scores for the treatment group in their curiosity towards science.

H_{08}: There is no significant difference in the pre-curiosity mean scores and the post-curiosity mean scores for the control group in their curiosity towards science.

1.6 Significance of Study

Basically, this study is one of the requirements for completing the course of Master of Education in Science. The researcher hopes that this study can contribute to the field of education, particularly to primary science teacher whereby to promote the use of hands-on investigation for the benefits of both teachers and students.

1.6.1 Significance to Teachers

The Ministry of Education had been promote pupils-centered learning since the implementation of Primary School Integrated Curriculum in 1994, however there are many teachers yet conducting teaching and learning lesson based on teacher-centered, and even they do so, eventually the lesson will lead to teacher-centered, in which the teachers define, demonstrate and explain a lesson, while the students listen and copy the answers. In this study, hands-on investigation is an approach fully in charge by students, whereas the teachers only act as materials provider and instruction deliverer. The process of the activity will be conducted by students, while the teachers are not supposed to involve in the activity, but to facilitate their progress, by the same time monitor the students' safety. Through hands-on investigation, teachers are able to see the progress and the skills mastered by each student, whether they conduct the activity by group or individually, it is therefore suitable to be used as active learning as proposed by the Malaysia Ministry of Education that students learning through experience and investigation is one of the important factors to master science knowledge (KPM, 2011), which means that hands-on investigation can be used as an alternative towards pupils-centered learning.

1.6.2 Significance to Primary Students

Primary students are ought to learn and master the science conceptual understanding through their own hands, which means that the students are encouraged to carry out the activity mostly by themselves, and the teachers are act as facilitator only. Since the aim of the Malaysian Philosophy of Education is to produce students that are balance from the aspects of physical, emotion, spiritual, intellectual and social, by the same time are capable to compete internationally as a global player, hence they are no longer suitable to be taught in conventional approaches, which in tend to teacher-centered methods. Teachers are responsible to inculcate self-learning habits among students starting from elementary stage, to encourage students participating actively in learning, to let them explore the reason of a phenomenon happen, as well as define the concepts found in an occurrence. The researcher hopes that the implementation of hands-on investigation will benefits students where students can instill hands-on investigation in their learning, by the same time understand that they way they learn through their own hands are eventually help in improve their conceptual understanding in the subject learnt.

1.7 Operational Definition of Terms

There were three terms used in this study, which were hands-on investigation, conceptual understanding and curiosity.

1.7.1 Hands-on Investigation

According to Haury and Rillero (1994), hands-on activities are any instructional approach that needed students to actively involve in manipulating objects as to gain knowledge or understanding. However, the researcher chose to use the term hands-on investigation since the activities

which will be implemented in this study is beyond the concepts of manipulating objects. Hands-on investigation in this study refer to activities that fully conducted by students, including the arrangement of apparatus and materials, the progress of activities or experiments, brainstorming and group discussion to gain ideas, as well as the way the students record and perform their findings, and lastly a brief conclusion. The teachers are only responsible to provide the apparatus or materials needed, give an instruction card on the task to be carry out, distribute worksheets, and lastly to ensure the safety of each students throughout the investigation.

1.7.2 Conceptual Understanding

Conceptual understanding refers to the generalisations about the nature or properties that a learner can develop from the concept (Australia Ministry of Education, 2013). It is all about what students know and understand in the process of learning. In this study, the conceptual understanding will be refers to knowledge gain through the hands-on investigation in the topic of "Light" in Primary Year 5 syllabus. Throughout the implementation of hands-on study, there will be two sets of pre-test and post-test administered to each respondent as to test their mastering of conceptual understanding in the topic taught. The test was constructed based on Bloom Taxonomy, which comprised of the level of Knowledge, Comprehension, Application, Analysis and Synthesis. At the end of this study, students that considered as improved in their conceptual understanding must had shown an average increment above 10 in their mean test score for the level of Comprehension and above. The data analysed will be used to compare the mean score of treatment group and control group as to examine the effects of hands-on investigation on students' conceptual understanding.

1.7.3 Curiosity

Curiosity refers to how deep a person's interest on certain domain. It is a need, thirst or desire to find out new concepts and ideas (Edelman, 1997). In this study, the curiosity of students toward science subject will be tested through a set of pre-questionnaire and post-questionnaire , modified from the Children's Science Curiosity Scale (Harty and Beall 1984) which is said to be included only the desire for information in science domains. There are three subscales designed to measure children science interest, attitudes towards science, and scientific curiosity in similar items but phrased differently depend on the specific measure. Students that considered as improved in their level of curiosity should at least showed increment in the dimension of Scientific Curiosity and or more in the other two dimensions at the end of this study.

1.8 Research Limitation

To generalize a study's result to a larger population, the sample size of the study supposedly in large amounts from different population, however, in this study, all of the respondents selected are come from one of the Chinese Primary School in Tenom, Sabah. By the same time, due to the same amount of students, the researcher can only conduct the study in single pre-post-test group. Therefore, the findings of this study can only be generalised in the same situation faced by the selected school located in Tenom, Sabah.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss on the literature review related to the study, basically will focus on the definition of concepts which are hands-on investigation, conceptual understanding, curiosity; the theory and model involved; several research studies related, and also the theoretical framework used in the study.

2.2 Conceptual Definition

2.2.1 Hands-on Investigation of Science Lesson

Malaysia science education referred hands-on activities as practical work, experiments, experimental or laboratory work, which are usually carried out in a student-oriented laboratory (Ministry of Education, Ministry of Education 2002). Learning by doing can promote reflective thinking that help students to solve the problems which may seem to go beyond their current capability but in fact in a domain which there are familiar with, consequently lead to the construction of additional knowledge (Lesgold, 2004).

Nonetheless, students have less opportunity to conduct hands-on activity, especially experiment, but have to observe passively in the demonstration conducted by teacher (Taylor, 1999, Johan, 2005). They are often asked to carry out thought experiment, which means to conduct the