HIGHER ORDER THINKING SKILLS (HOTS) AMONG HIGH, MODERATE AND LOW ACHIEVING LEARNERS IN LEARNING THE PERIODIC TABLE OF ELEMENTS

Si Hui Ling

Master of Science (Learning Sciences) 2015
UNIVERSITI MALAYSIA SARAWAK

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KML 6066 Research Paper
Master of Science (Learning Sciences)

Faculty of Cognitive Sciences and Human Development

UNIVERSITI MALAYSIA SARAWAK

2015
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It is hereby confirmed that the student has done all necessary amendments for examination and acceptance.

(\text{Dr. Philip Nuli Anding})

Date: 05 June 2015
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ABSTRACT

HIGHER ORDER THINKING SKILLS (HOTS) AMONG HIGH, MODERATE AND LOW ACHIEVING LEARNERS IN LEARNING THE PERIODIC TABLE OF ELEMENTS

Si Hui Ling

Enhancing student’s thinking ability is one of the objectives of the national education system. In order to accomplish the goal, the priority should be placed on thinking skills in the teaching and learning processes in order to develop the 21st century thinkers that our world needs. A thoughtful learning foundation emphasises thinking skills in teaching and learning. Additionally, the content in Chemistry learning is replete with various abstract concepts and therefore it requires intellectual thought and understanding. The purpose of this study is to explore the higher order thinking skills (HOTS) among high, moderate, and low achieving learners in learning the Periodic Table of Elements. The study adopts a qualitative approach to achieve its purpose. The think aloud method and semi-structured interviews are used to get an in-depth understanding of HOTS among the three categories of learners. A total of 14 Form 4 pure science students from SMK Tinggi Kuching, Sarawak participated in this study. In order to explore HOTS among the three categories of learners, the students are asked to answer the questions (Structured type) which encompass the six categories of cognitive processes based on the revised Bloom’s taxonomy. The result of the study, found that the high achieving learners possess all the higher order skills that are analysing, evaluating and creating. The moderate achieving learners possess the analysing and evaluating skills, whereas the low achieving learners, at least possess one of the higher order skills of analysing. The findings suggest that teachers should teach HOTS to the students of different academic levels. The findings of the study hopefully could also provide insights to educators to come out with various practical tools for helping students to accomplish tasks requiring higher order thinking.
ABSTRAK

KEMAHIRAN BERFIKIR ARAS TINGGI (KBA T) DI KALANGAN PELAJAR BERPENCAPAIAN TINGGI, SEDERHANA DAN RENDAH DALAM PEMBELAJARAN JADUAL BERKALA UNSUR

Si Hui Ling

CHAPTER ONE
INTRODUCTION

1.0 Introduction

This study aimed to investigate the higher order thinking skills (HOTS) among high, moderate, and low achieving learners in learning the Periodic Table of Elements. This chapter starts with discussion of background of the study, followed by the problem statement, research objectives and research questions. The chapter also presents the significance of the study, limitation of the study and clarifies the definition of the important terms used in the study.

1.1 Background of the Study

Education in Malaysia is an ongoing effort to produce generations who are competent in science and technology. As a result, the curriculum is formulated based on the needs of the nation as well as global scientific requirements. The science curriculum comprises of Biology, Physics, Chemistry, General and Additional Mathematics. Each of the science subjects has its own curriculum specifications.

The Integrated Chemistry Curriculum for Secondary Schools (ICSS, 2006) aims to provide students with knowledge and skills which enable them to do problem solving and make everyday decision by teaching them the theory, concepts, and applications of Chemistry in their lives (Curriculum Development Centre, 2005). In line with the
teaching scenario in Malaysian Education System, science stream students are the ones who take up Chemistry.

Enhancing student's thinking ability is one of the objectives of the national education system. In order to accomplish the goal, the priority should be placed on thinking skills in the teaching and learning processes in order to develop the 21st century thinkers that our world needs. In the Malaysian Education Blueprint 2013-2025 (Ministry of Education, 2012) states that:

"Education plays a central role in any country's pursuits of economic growth and national development. There is no better predictor of a nation's future that what is currently happening in its classroom" (p. E-1).

Therefore, in today's worldwide economy, a country's success depends basically on the knowledge, aptitudes and capabilities of its people.

A thoughtful learning foundation emphasises thinking skills in teaching and learning. Additionally, the content in Chemistry learning is replete with various abstract concepts and therefore it requires intellectual thought and understanding. Over the years, different teaching methods and principles have been used for instruction in the teaching of Chemistry in senior secondary school level for students to learn scientific methods, chemical content and to understand the nature of science (Owoyemi, Toyin E. & Olowofela, Taiwo A., 2013).

Moreover, the Ministry of Education has put in a lot of endeavor to develop higher order thinking skills. One of the eleven shifts to transform education system highlighted in the Malaysian Education Blueprint 2013-2025 (Ministry of Education, 2012), in which to provide equal access to quality education of an international standard (Shift 1), the
Ministry of Education has revamped the national examinations and school-based assessments to gradually increase percentage of questions that test higher order thinking.

i-THINK programme, the joint venture between the Ministry and the Agensi Inovasi Malaysia (AIM) is developed to help schools impart thinking skills to students, and to enable them to be lifelong learners. In this programme, teachers and students will use the eight thinking tools in the teaching and learning processes. Through this programme, it is hope that to promote and develop higher order thinking skills among students towards producing innovative student. Hence, this study aims to investigate the higher order thinking skills (HOTS) among high, moderate, and low achieving learners in learning one of the topics in Form 4 Chemistry, the Periodic Table of Elements.

1.2 Problem Statement

Chemistry is perceived by students as a challenging subject. This is due to the abstract nature of the Chemistry concept (Ahmad Nur Jahan & Lah Yahya Che, 2013). The abstract concepts of Chemistry require students to think on several levels. According to Sirhan (2007), students need to learn the sub-microscopic, macroscopic and symbolic levels of chemical knowledge. While the macroscopic level deals with what the eyes can see and the sub-microscopic level deals with fundamental particles, the symbolic level involves chemical formulas and equations (Aksela, 2005). These three levels must be linked in order to understand the application of chemical knowledge in everyday life. Consequently, if at one of these levels, students possess difficulties, it affects the other levels.

Higher order thinking skills (HOTS) is currently the main priority in education, and also incorporated into the revised science curriculum. Instead of the usual practical work or inquiry skills, HOTS is now applied to facts, vocabulary, definitions, calculation,
and fundamental skills in genuine scientific explorations (Aksela, 2005). Additionally, Domin (1999) claimed that main emphasis was placed on lower order thinking skills of students in most activities found in laboratory manuals rather than on higher order thinking skills.

Moreover, where higher education is concerned (Yee, Jailani, Razali, Widad, & Tee, 2011), HOTS is a tool in teaching and learning where it helps students to solve problem and improve their achievement. Therefore, if they are trained with HOTS activities, they become good thinkers.

Studies indicate that HOTS can be taught. Yee, Widad, Jailani, Tee, Razali and Mimi Mohaffyza (2011) identified the level of Marzano Higher Order Thinking Skills among technical education students in the Faculty of Technical Education (FPTek), Universiti Tun Hussein Onn Malaysia. The findings showed that investigation, inquiry based experiment, comparing, deductive reasoning, and support in a constructive manner, inductive reasoning, and invention developed the HOTS of 13 Marzano students at a moderate level. On the other hand, low level of HOTS was demonstrated for these skills: decision making, problem solving, analysis of errors, abstraction, analysis of perspectives, and classification.

Another study by Murray (2011) examined the influence of reflective teaching cycles on the teachers' selection and implementation of mathematics tasks that had the potential to facilitate higher order thinking. Murray showed that the students' achievement had increased. In addition, other research on mathematics curriculum where thinking skills is given emphasis show that student's achievements increased together with their ability in solving problems and thinking critically (Boaler & Staples, 2008; Gutierrez, 2000).
Previous researches (Barathimalar, 2014; Rajendran, 2001) conducted the study mainly focused on teacher's acceptance and problems faced in conducting HOTS in school base assessment; and teachers' perceptions of their subject matter knowledge and pedagogical skills as well as the teachers' attitude towards teaching Malay or English language respectively. Besides, study by Adawati (2014) was to explore teachers' experiences on integration of HOTS in teaching of Science.

Many studies have proved that it is essential to incorporate HOTS in science education (Boaler & Staples, 2008; Fensham & Bellocchi, 2013; Gutierrez, 2000; Murray, 2011; Zohar & Dori, 2003). The respondents involved in the previous studies mainly were the primary and secondary schools teachers, and also teachers in the Teacher Education Colleges.

Furthermore, many studies conducted showed the HOTS in the teaching and learning of science at the higher education. Therefore, to fulfill the gap, the aim of this study is to investigate the higher order thinking skills (HOTS) among high, moderate, and low achieving learners in learning the Periodic Table of Elements at the secondary school level.

1.3 Research Objectives

Based on statement of the problem, specifically the purpose of this study is:

1.3.1 To identify the higher order thinking skills (HOTS) among the high achieving learners;

1.3.2 To identify the higher order thinking skills (HOTS) among the moderate achieving learners;

1.3.3 To identify the higher order thinking skills (HOTS) among the low achieving learners;
1.3.4 To develop a model that represents the higher order thinking skills (HOTS) for high, moderate, and low achieving learners in learning the Periodic Table of Elements

1.4 Research Questions

The four research questions that guide this study were as follows:

1.4.1 What are the higher order thinking skills (HOTS) among the high achieving learners?

1.4.2 What are the higher order thinking skills (HOTS) among the moderate achieving learners?

1.4.3 What are the higher order thinking skills (HOTS) among the low achieving learners?

1.4.4 What is the suitable model that represents the higher order thinking skills (HOTS) for high, moderate, and low achieving learners in learning the Periodic Table of Elements?

1.5 Significance of the Study

The study is a research to identify the higher order thinking skills (HOTS) among the high, moderate, and low achieving learners in learning the Periodic Table of Elements in SMK Tinggi Kuching, Sarawak. The result from this study provides practical implication for teachers and also for the students. The teachers could refer to the findings of this study to redesign and adopt better teaching styles to enhance students' thinking especially on integrating higher order thinking skills (HOTS) in teaching of Chemistry. Moreover, the result will provide information for teachers on how the knowledge organisation of high-achievers, moderate-achievers, and low-achievers differ.
The findings from this study could also provide guidelines for students in learning Chemistry. Students could understand the problems faced when their teachers are trying to teach them higher order thinking skills (HOTS).

Besides, the research could also be a reference for the other researchers who would like to further their research in other fields of study. It could be a suitable platform to refer on a wide range of structures in learning Chemistry in the secondary school level.

1.6 Limitation of the Study

This study only focused on identifying the higher order thinking skills (HOTS) among the high, moderate, and low achieving learners in learning one of the topics in Form 4 Chemistry syllabus that entitled "Periodic Table of Elements". In addition, the sample of this study had been restricted to Form 4 pure science students of SMK Tinggi Kuching, Sarawak. Therefore, the sample may not be representative of the entire population of secondary school pure science students in Malaysia.

Other limitation of this study is that the researcher uses only think aloud method and semi-structured interviews as the instruments to identify the HOTS among the high, moderate, and low achieving learners in learning the Periodic Table of Elements.

1.7 Definition of Terms

1.7.1 Higher Order Thinking Skills (HOTS)

Higher order thinking can be regarded as a complex non-algorithmic thinking which generates various solutions which involves the application of criteria, reflection, and self-regulation (Resnick, 1987). Higher order thinking processes are cognitive processes (skills) that can be categorised as remember, understand, apply, analyse, evaluate, and create (Anderson & Krathwohl, 2001).
The last four categories are usually designated as higher order thinking skills. The operational definition of HOTS for this study is referred to the high, moderate, and low achieving learners ability to demonstrate HOTS regarding the ideas of chemical reaction of Group 1 elements (alkali metals) with water.

1.7.2 High Achieving Learners

Mary (1997) in her study use the term "high-achievers" which refer to subjects who attained scores of more than 75% in the post-treatment science achievement test. Furthermore, Zohar et al. (2001) use the term high achieving (HA) students which refer to students who generally do well in school and have high academic achievement. The operational definition of high achieving learners for this study is referred to students who attained an average scores of 80% and above in a few tests for Chemistry subject.

1.7.3 Moderate Achieving Learners

The moderate achieving learners for this study is referred to students who attained an average scores of 50% to 79% in a few tests for Chemistry subject.

1.7.4 Low Achieving Learners

Mary (1997) in her study use the term "low-achievers" which refer to subjects who attained scores of less than 40% in the post-treatment science achievement test. Furthermore, Zohar et al. (2001) use the term low achieving (LA) students which refer to students who generally do not do well in school and have low academic achievement. The operational definition of low achieving
learners for this study is referred to students who attained an average scores of less than 50% in a few tests for Chemistry subject.

1.7.5 Learning

Learning is a process of acquiring knowledge or a skill through instruction or experiences (Dictionary.com). The operational definition of learning for this study is referred to the activity of obtaining knowledge by the high, moderate, and low achieving learners in the topic entitled "Periodic Table of Elements".

1.8 Summary

This chapter has discussed the background of the study and the need to conduct the study. It also establishes four research objectives which are then plotted into research questions that guide the development of the study. Furthermore, this chapter provides a clear and precise definition of terms. The findings of the study would provide a better understanding on the higher order thinking skills (HOTS) among the high, moderate, and low achieving learners in learning the Periodic Table of Elements. The next chapter would discuss on literature relating to HOTS among the high and low achieving learners in learning Chemistry and other related research studies that have been done on HOTS.