DEVELOPMENT OF HIGHER ORDER THINKING USING A MODULE BASED ON COGNITIVE APPRENTICESHIP MODEL FOR YEAR FIVE STUDENTS ON THE TOPIC OF MEASUREMENT AND GEOMETRY

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By

NOORASHIKIM BINTI NOOR IBRAHIM

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Higher Order Thinking Skills (HOTS) are recognized as an important goal in Malaysian education. However, there is little empirical evidence to help educators decide how to teach in ways that infuse HOTS in the content knowledge. The aim of this study is twofold; (i) to develop and evaluate a HOTS-based module in the topic of measurement and geometry for year five pupils; and (ii) to investigate the effectiveness of the HOTS-based module among the pupils. This study adopted ADDIE model in three phases. In Phase 1, the study is focused on the analysis of the target group's needs which involved mathematics teachers. Phase 2 include the process in designing, developing the assessments and learning activities, and validation of HOTS-based module. In Phase 3, the aim is to evaluate the effectiveness of the module using pupils' performance tests, problem solving skills, conceptual knowledge, and procedural knowledge. The study had adopted a quasi-experimental design involving two groups of subjects. Two hundred and ninety seven pupils from four schools involved in this intervention. The control group was exposed to the conventional learning strategy, while the experimental group used the HOTS-based Modules framed by CAM. Data was collected using performance test. Analyses on the types of errors committed by the pupils were conducted on the experimental groups. These measurements were presented in comparison between urban and rural schools in Kota Bharu, Kelantan.

In Phase 1, results showed that some teachers have positive perceptions towards HOTS, whereas some of them disagree with the implementation of HOTS due to insufficient of time, inappropriate and not accordance with the student's ability. Due to this, HOTS-based module was designed to support teachers and pupils in the face-to-face classroom sessions. In Phase 2, the validation of instruments and HOTS-based module was done by two experts from Teacher Education Institute and one from District Education Department. In Phase 3, the result showed that the use of HOTS-based module has a

significant effect on pupil's performance in two tests (post-test and post-delayed test), as well as their problem solving skills, conceptual knowledge, and procedural knowledge. Whereas for the error analysis, percentage of different types of errors committed by pupils in rural schools is more than pupils in urban schools. Pupils in the treatment group committed less errors compared to their counterpart. Specifically, the result indicated that pupils from urban school significantly better in the mean scores for performances, problem solving skills, conceptual knowledge and procedural knowledge in learning Measurement and Geometry as compared to the pupils in the rural schools. Furthermore, these results indicated that the teaching and learning process based on CAM has significantly enhanced pupils' performance in this topic. The pupil's interest in HOTS-based module was at high level. Almost all pupils from both urban and rural schools decided that the HOTS-based module increased their interest in mathematics, specifically in the topic of measurement and geometry.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PEMBANGUNAN KEMAHIRAN BERFIKIR ARAS TINGGI (KBAT) MENGGUNAKAN MODUL BERASASKAN *COGNITIVE APPRENTICESHIP MODEL* UNTUK PELAJAR TAHUN LIMA DALAM TOPIK SUKATAN DAN GEOMETRI

Oleh

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Kemahiran Berfikir Aras Tinggi (KBAT) dikenal pasti sebagai matlamat penting dalam pendidikan Malaysia. Namun begitu, terdapat sedikit bukti empirikal bagi membantu para pendidik melaksanakan KBAT dalam pengetahuan isi kandungan. Terdapat dua tujuan kajian ini (i) untuk membangun dan menilai modul berasaskan KBAT dalam topik Sukatan dan Geometri pelajar Tahun Lima; dan (ii) untuk mengkaji keberkesanan modul berasaskan KBAT dalam kalangan pelajar. Kajian ini menggunakan model ADDIE dalam tiga fasa. Dalam Fasa 1, kajian ini memberi tumpuan kepada analisis keperluan kumpulan sasaran yang melibatkan guru matematik. Fasa 2 melibatkan proses merancang, membangunkan penilaian dan aktiviti pembelajaran, serta mengesahkan modul berasaskan KBAT. Dalam Fasa 3, matlamatnya adalah untuk menilai keberkesanan modul dengan menggunakan ujian pencapaian pelajar, kemahiran menyelesaikan masalah, pengetahuan konseptual, dan pengetahuan prosedural. Kajian ini menggunakan reka bentuk kuasi eksperimen yang melibatkan dua kumpulan subjek. Dua ratus sembilan puluh tujuh murid dari empat sekolah terlibat dalam intervensi ini. Kumpulan kawalan didedahkan kepada strategi pembelajaran konvensional, sementara kumpulan eksperimen menggunakan modul berasaskan KBAT yang dirangka oleh *Cognitive Apprenticeship Model* (CAM). Data dikumpul menggunakan ujian pencapaian. Analisis tentang jenis kesilapan yang dilakukan oleh murid-murid telah dijalankan ke atas kumpulan eksperimen. Pengukuran ini dibentangkan dalam bentuk perbandingan antara sekolah bandar dan luar bandar di Kota Bharu, Kelantan.

Dalam Fasa 1, keputusan menunjukkan bahawa sesetengah guru mempunyai persepsi positif terhadap KBAT, manakala sebahagian daripada mereka tidak bersetuju dengan pelaksanaan KBAT kerana tidak cukup masa, tidak sesuai dan tidak selaras dengan kemampuan pelajar. Disebabkan oleh perkara ini, modul berasaskan KBAT dibina untuk memberi sokongan kepada guru dan murid dalam sesi kelas bersemuka. Dalam

Fasa 2, pengesahan instrumen dan modul berasaskan KBAT dilakukan oleh dua pakar dari Institut Pendidikan Guru dan satu dari Jabatan Pendidikan Daerah. Dalam Fasa 3, hasil dapatan menunjukkan bahawa penggunaan modul berasaskan KBAT memberi kesan yang signifikan terhadap pencapaian pelajar dalam dua ujian (ujian pasca dan ujian pasca tertunda), yang merangkumi kemahiran menyelesaikan masalah, pengetahuan konseptual, dan pengetahuan prosedural. Manakala untuk analisis kesilapan, peratusan pelbagai jenis kesilapan yang dilakukan oleh pelajar di sekolah luar bandar adalah lebih tinggi berbanding pelajar di sekolah bandar. Pelajar dalam kumpulan rawatan melakukan kurang kesilapan berbanding dengan rakan mereka. Secara khususnya, keputusan menunjukkan bahawa pelajar dari sekolah bandar jauh lebih baik dalam skor min untuk pencapaian, kemahiran menyelesaikan masalah, pengetahuan konseptual dan pengetahuan prosedural dalam pembelajaran Sukatan dan Geometri berbanding pelajar di sekolah luar bandar. Selain itu, keputusan ini menunjukkan bahawa proses pengajaran dan pembelajaran berasaskan CAM telah meningkatkan pencapaian pelajar dalam topik ini. Minat pelajar terhadap modul berasaskan KBAT berada pada tahap yang tinggi. Hampir semua pelajar dari sekolah bandar dan luar bandar memutuskan bahawa modul berasaskan KBAT dapat meningkatkan minat mereka dalam matematik, khususnya dalam topik Sukatan dan Geometri.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

ADDIE	Analysis, Design, Development, Implementation, Evaluation
ANCOVA	Analysis of Covariance
CA	Cognitive Apprenticeship
CAM	Cognitive Apprenticeship Model
CCTS	Critical and Creative Thinking Skills
HOT	Higher Order Thinking
HOTS	Higher Order Thinking Skills
ID	Instructional Design
INSPEM	Institut Penyelidikan Matematik
KBSR	Kurikulum Baru Sekolah Rendah
KLSR	Kurikulum Lama Sekolah Rendah
KR-20	Kuder-Richardson Formula 20
KSSR	Kurikulum Standard Sekolah Rendah
LOTS	Lower Order Thinking Skills
MGPT	Measurement and Geometry Performance Test
MGPT_CK	Measurement and Geometry Performance Test_Conceptual Knowledge
MGPT_PK	Measurement and Geometry Performance Test_Procedural Knowledge
MGPT_PS	Measurement and Geometry Performance Test_Problem Solving
MOE	Ministry of Education
NCTM	National Council of Teacher of Mathematics
PISA	Program for International Student Assessment
PPD	Pejabat Pendidikan Daerah
SISC+	School Improvement Specialist Coaches Plus
SPM	Sijil Pelajaran Malaysia
SPSS	Statistical Package for Social Sciences
TIMSS	Trends in International Mathematics and Science Study
TPCK	Technological Pedagogical Content Knowledge
UNESCO	United Nation Educational Scientific and Cultural Organization
UPM	Universiti Putra Malaysia
UPSR	Ujian Penilaian Sekolah Rendah
ZPD	Zone of Proximal Development

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

One of the key factors in developing the national and economic growth of a country is education. In Malaysia, education is the key direction of the country and the survival of the nation (Nik Aziz, 2008). Economic growth not only can be viewed from the state budget, but also of the situation in the classroom. People who can improve a country's economy and prosperity is the people who are knowledgeable, thinkable and efficiently. In October 2011, a new "National Education Blueprint" was released in order to raise the standard of Malaysia's education system, in providing young people with the knowledge, skills, and values to contribute to the economic development of the 21st century. When Malaysia first joined Trends in International Mathematics and Science Study (TIMSS) in 1999, the average score for the 8th grade student was higher than the international average in Mathematics. However, in 2007, Malaysian's result had fallen below the international average in Mathematics with a corresponding drop in ranking (Ministry of Education, 2014a). As the TIMSS assessment demonstrated, Malaysian students struggle with Higher Order Thinking Skills (HOTS). Thus, the main objective of the MOE system is no longer just on the importance of knowledge, but also on emerging HOTS and to rise to the top-third of countries in TIMSS in 15 years (Ministry of Education, 2014c).

1.1.1 Standard Based Curriculum for Primary School (KSSR)

Curriculum for the teaching and learning of mathematics in primary schools has experienced many changes in its historical development. Ministry of Education continuously review their curricula to ensure the implementation of the curriculum in schools equip students with the knowledge, skills and values to face current and future challenges. KSSR for Mathematics is reviewed and restructured. The restructuring is taking into account the ongoing sustainability to the next level. The change is appropriate to students who have a wide range of capabilities and background, since it offers the knowledge and skills of mathematics (Ministry of Education, 2013a). The aim of KSSR for Mathematics Education is not only to build students' understanding of number concepts, basic skills in computing, mathematical ideas that are easy to understand and are competent to apply mathematical knowledge and skills in everyday life but also to communicate using mathematical ideas, appreciate the beauty of mathematics and using various mathematical tools including ICT effectively to build understanding of the concepts and applying mathematics (Malaysian Ministry of Education, 2014b). Since 1994, thinking skills were stressed in the curriculum with the introduction of Critical and Creative Thinking Skills (CCTS) (Ministry of Education, 2001). KSSR has emphasized on HOTS. According to Ministry of Education (2014b), the definition of HOTS is the capability to relate knowledge, skills and values,

generating reasoning and reflection in solving problems, making decisions, innovate and try to produce new thing.

1.1.2 Higher Order Thinking Skills (HOTS)

One of the important skills in the 21st century is HOTS which is acknowledged as accelerative skills in this changing era. Individual needs to be not only educated but also hold the important ability; being able to think effectively and to make right decisions as well as creative in many way, in order to live well or even merely exist in this highly competitive world (Huang, 2011). According to Richland and Simms (2015), it means that, education in the 21st century should highlight students' skills for HOTS, transfer, and flexible reasoning over memorizing of facts. Thomas and Thorne (2009) suggest that HOTS is thinking skill that is above the level of memorizing facts or giving back the memorized fact to someone, in the same way it was read or told while, Brookhart (2010) identifies of HOTS as three categories which were transfer, critical thinking, and problem solving.

Teaching higher order thinking

As we all know, Bloom's Taxonomy (1956) is not the only framework for teaching thinking, but it is the best commonly used. Instead of teaching students to recall facts, Bloom's objective was to support higher forms of thinking in education, such as analysing and evaluating. According to Bloom (1956), the cognitive domain comprises of abilities and skills within stated in six groups which are knowledge, comprehension, application, analysis, evaluation and synthesis. Each of the behaviour needs to be learned before the next one can take place. Teacher should use this useful information in planning their lesson. Anderson and Krathwothl (2001), have revised Bloom's taxonomy in order to adequate the more outcome-focused modern education objectives. This was done by changing the names of the groups from nouns to active verbs. They also had inverted the order of the highest two groups; and slightly rearranged them so they became like in Figure 1.1.

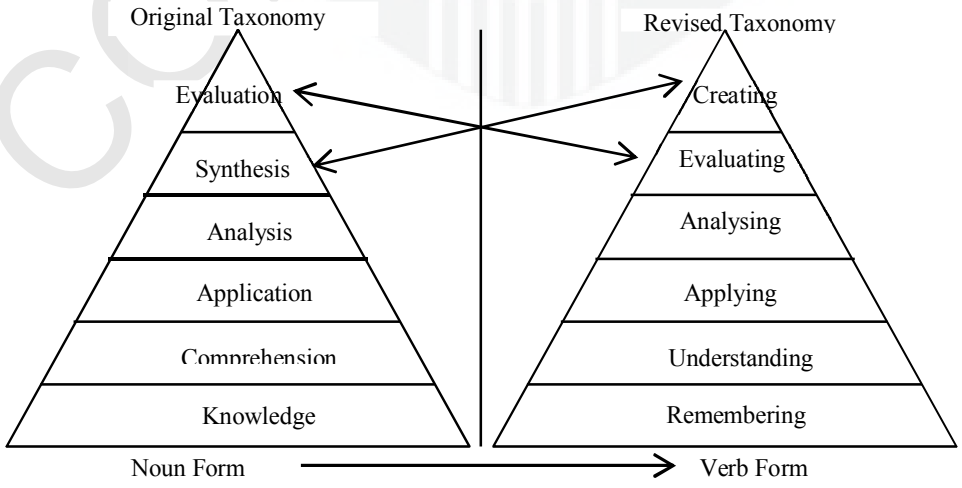

Figure 1.1: Revised Taxonomy Bloom
(Source: Adopted from http://iacbe.org/oa-blooms-taxonomy.asp)

Teachers could scaffold their teaching on thinking skills in a structured way by utilizing the revised taxonomy. In this study, the researcher utilized the revised Taxonomy Bloom as a framework in developing HOTS-based module in order to infuse HOTS within the content knowledge. The revised Taxonomy Bloom which is explicitly structured was able to assist teachers in the teaching and learning process. Furthermore, it is widely used in the new curriculum of primary schools.

1.1.3 Studies related to HOTS

Studies that are related to HOTS had been done worldwide. This section indicates few studies related to HOTS. Sulaiman, Ayub and Sulaiman, (2015) had revised studies on curriculum changes in Malaysian primary schools which HOTS and standard-based assessments were given. They stated that in order to enhance students' HOTS, changes be made in curriculum content, teaching strategies or assessment challenge. Richland and Simms (2015) reviewed collected studies on analogy and disciplinary of HOT. They recommended that relational reasoning could be effectively considered in the cognitive behind HOT. The most significant task in higher education today, is to cultivate its students to be competitive. Teachers were asked to emphasize thinking skill in the teaching processes so that it can be applied from classroom situation to a variety of real-life context. Surya and Syahputra (2017), conduct a study aims to improve the ability of high-level thinking by developing learning models based on mathematics problems in for 11th grade students in North Sumatra. The result showed a significant improvement of student's problem solving ability. In this study, active interaction in the problem based learning had influence in learning and improves students understanding of mathematics concepts in real life which indirectly improved the ability of HOTS among students. Leung (2013) conducted a survey research to 41 secondary school teachers in order to compare the teaching processes and strategies for cultivation students' HOT. The finding has shown a strong influence towards examination-oriented learning. The more experienced ones further agree that examination-oriented strategies were aligned with the development of HOT. Pegg (2010) studied the causes for the problems and challenges that primary and secondary teachers had to face in order to encourage higher order understandings in their students. The findings showed that activities of instruction and assessment need to be closely intertwined by organizing environments for HOTS activities at the suitable times, within the syllabus content which covered in class. He also recommended that teachers should provide students with non-routine questions in order to achieve HOTS as; in general, these questions require at least relational responses. As a conclusion, in order to infuse HOTS in the curriculum, changes in instructions and assessment should be made. Solving non-routine problems which exposed student to the real-life context should be emphasized in the teaching and learning process.

1.1.4 Module Based Learning

The implementation of the individual teaching concept in a classroom can be enhanced if a subject or topics was broken down into several sub-topics so that it can be easily read or used in a systematic way to manage it (Brown & Palincsar, 1989). One way that is considered easier in preparing teaching and learning materials in the form of

successive modules (Shaharom & Yap, 1992). Sharifah Alwiah (1981) stated that almost all existing modules are to facilitate in teaching and learning to become more effective. Klingstedt (1973) also pointed out that the teaching module is not the final say on its effectiveness but it is one of the methods that should be given serious attention. This proves that the teaching modules were considered important and potential tools, materials and resources that bring efficiency to students. The use of the module can also attract students in teaching and learning and to train students to be confident, talented, ability, leadership, and spirit of cooperation. It also help to improve academic achievement and personal development (Noah & Ahmad, 2005).

Through KSSR Mathematics, teachers are provided with teaching and learning mathematics module as a guide and triggering ideas for teaching the subject. The objective is to help teachers realize the demands and wishes of KSSR Mathematics through mathematics education. Salleh Hudin, Saad and Dollah (2015) stated that the use of teaching and learning mathematics number and operation KSSR Module in Year Three has a positive impact on the level of understanding the concept of multiplication. Significant differences in students' achievement through the pre, post and post-delayed tests proved that the use of the module is a good alternative for teaching and learning the topic of Multiplication. As a result, teachers could organize their teaching systematically and diversifying the classroom activities. Hence, the modular approach with teaching kit gave the positive effect on students' mathematics performance. As a conclusion, implementation of modules in teaching and learning process enhanced the learning effectively.

1.1.5 Cognitive Apprenticeship Model (CAM) of Teaching and Learning

Brown, Collins and Duguis (1989) proposed a model called cognitive apprenticeship that gives chances for novices to observe how instructors or experts solve complex problems. In this study, the design of teaching and learning Measurement and Geometry lesson was given to Year Five students intended to provide students with HOTS to deal with real world problems. The students are supervised in a CA environment, where the teacher utilized a range of approaches to align students' thinking with expert thinking (teacher). The model accordingly to Brown et al. (1989) comprises of six steps in a genuine context which are modelling, coaching, scaffolding, articulation, reflection and exploration. There are a few studies reported that the CAM can strengthen the abilities of students' HOTS. For instance, Hwang et al. (2009) indicated that in performing complex science experiments, CAM would be much support to graduate students, especially in the aspect of learning efficiency and effectiveness. Saadati, Tarmizi, Ayub and Bakar (2015) found that a group of students whom using internet-based with CA showed significantly better performance in problem-solving in the subject of statistics compare to the control group students, whereas, Kuo, Hwang, Chen and Chen (2012) found that the combination of the CAM and collaborative learning theory could promote students' HOTS, cognitive skills and oral presentation abilities. In this study, the HOTS-based module framed CAM is being developed and organized with procedures that are easily to understand by both teachers and students. The module utilized an active learning approach and provided with the teaching kit. CAM was chosen to be implemented in this module due to its

effectiveness in promoting HOTS (Ertl, Fisher & Mandl, 2006: Hwang, Yang, Tsai & Yang, 2009).

1.2 Statement of the Problem

In 2015, Malaysian students recorded better results in TIMSS with the highest increase of 25 points among 18 nations that have shown improvements for mathematics (Hazlina, 2016). Even though, Malaysia is now at mid-table in the list of participating countries, the aimed to achieve a score of 500 points in TIMSS 2019 is still continued (TIMSS Study: Science, Maths, 2016). A lot of studies have been conducted on mathematics achievements across the globe, among the factors influencing mathematics achievement among Malaysian eighth graders was lacking of HOTS (Nor'ain & Mohan, 2015; Tajudin, & Chinnappan, 2016) and not familiar with open ended questions (Ministry of Education, 2014g). Hence, various efforts must be continued in promoting of HOTS among students in schools in order to achieve the government's desire for world-class education. In Malaysia, about 58% of teaching and learning process is dominated by explaining, and practicing in mathematics; the rest goes for reviewing homework, re-teaching, taking tests, and participating in activities that are not related to the lesson content (Zabit, 2010). Mullis, Martin, and Foy (2008) claimed that Malaysian mathematics teachers gave more attention to the product of thinking and less emphasize on the outcomes of the learning. Moreover, traditional method of teaching mathematics still exists and will continue to exist in Malaysian classrooms (Zanzali, Abdullah, Ismail, Nordin & Surif, 2011). Research shown that teacher-centered teaching using textbooks and emphasized on procedural understanding in mathematics was related to student's achievement in mathematics (Zanzali et. al., 2011; Bayat & Tarmizi, 2010; Lim, 2007). Thus, the raised concern calls for more effective techniques and alternative teaching and learning approaches in infusing HOTS in mathematics contents. Other factor that influenced student achievement was the learning environment.

According to the TIMSS 2015 report, the average score for Malaysian student in the Measurement and Geometry is low (achievement score is 455 points) compared to other content domains such as Number and Algebra. This means that Malaysian students only have basic knowledge in Measurement and Geometry. Furthermore, analysis of the students' quality of answers in UPSR 2012, 2013 and 2014, (MOE,2014) found that students could not answer correctly in the topic of geometry and measurement. Students were not proficient in the conversion of unit, naming a three dimensional shape, calculating area, and perimeter. They also failed to understand the problem solving questions, transforming the information given in the questions to mathematics sentences (Malaysia Examination Syndicate, 2014). Hence, teachers must find ways to engage students in learning measurement and geometry and acquire HOTS. The learning environment that included school's location, can affect the positive attitude of students toward academic achievement (Schaps, 2013). According to the Ministry of Education (2014a), the percentages of urban students who achieved grade A, B, and C in mathematics *Ujian Penilaian Sekolah Rendah* (UPSR) was higher than rural students (Better 2015 UPSR results, 2015; Aiezat Fadzell, 2016), whereas in *Sijil Pelajaran Malaysia* (SPM) level, the gap widened to 8%. This gap could be motivated by factor such as student who failed in UPSR is not likely to succed in SPM.

Therefore, educators should seek ways to reduce the gap of achievement between urban and rural students. Thus, early intervention is really critical. From what has been discussed above, we can conclude that teachers need to diversify teaching methods to enhance HOTS among students in school. One way to help teachers infused HOTS in the topic of measurement and geometry is to provide teaching and learning module with CAM framed in accordance with the wishes and goals in mathematics KSSR.

1.3 Purpose of Study

The design and development research are often concentrated on the specific product or program. This type of study often looks at an entire design and development process which involved from analysis to evaluation. Hence, the purposes of this study are twofold, to develop and evaluate it. Three specific phases were conducted with research objectives and research questions for each phase.

1.3.1 Research Objectives – Phase 1

In order to determine the needs of the teachers and learners, a need analysis was conducted. This stage is very important to determine the teacher's knowledge about HOTS and distinguish between what the learners already know and what they need to know at the conclusion of the lesson. Hence, the research objectives for this phase are to:

1. Obtain information about primary teachers' knowledge and perception of higher order thinking skills.

2. Get information about the characteristics of systematic HOTS-based Module framed CAM in order to infuse HOTS in the topic of measurement and geometry among year 5 students.

Research Questions – Phase 1

RQ1 What is teachers' knowledge and perception of higher order thinking skills?

RQ2 What are the characteristics of systematic HOTS-based module framed on CAM in order to infuse HOTS in the topic of measurement and geometry among year 5 students?

1.3.2 Research Objectives – Phase 2

Throughout the development of the module, the formative evaluation was carried out and this essential part provided the results which were used to improve the module in order to establish more efficient and effective in teaching and learning. Hence, the research objective for this phase is to:

1. To determine the outline and content of HOTS-based module.

Research Question – Phase 2

RQ3 What is the outline and content of HOTS-based module?

1.3.3 Research Objectives – Phase 3

In the third phase of the study, the effectiveness of the module was examined. The researcher used the refined HOTS-based module and conducted the summative evaluation of the module. The effectiveness was studied based on the performance, problem solving skills, conceptual knowledge, procedural knowledge and errors. The objectives of Phase 3 are to:

1. Evaluate the impact of HOTS-based module framed CAM on students' performance based on the results of two sets (which were carried out before and after the intervention), through pilot test and field trial in urban and rural area.

2. Identify year 5 student's categories of error and misconceptions between rural and urban area schools in the topic of Measurement and Geometry.

3. Investigate students' perspectives about the effect of HOTS-based Module (its features and CAM strategies) on their performance in the topic of Measurement and Geometry.

Research Questions – Phase 3

In addition to determine the effectiveness of HOTS-based module and in line with the above research objectives of the third phase of the study, the following research questions were measured:

RQ4 What is the impact of HOTS-based module framed CAM on students' performance, problem solving skills, conceptual knowledge and procedural knowledge based on the results of two sets (which were carried out before and after the intervention), through pilot test and field trial in urban and rural area?

RQ5 What are the year 5 students' categories of error and misconceptions between rural and urban area schools in the topic of Measurement and Geometry?

RQ6 What are the students' perspectives about the effect of HOTS-Based Module on their performance in the topic of Measurement and Geometry?

Research Hypothesis – Phase 3

Based on the above research objectives for the second phase of the study, the research hypotheses are presented in Appendix A.

1.4 Significance of the Study

The Malaysia Education Blueprint specified that education plays an important role in the development and economic growth of a country. One of the indicators for the development of education is what's happening in the classroom. Thus, teaching and learning process need a paradigm shift in order to align with the country's aspiration. Measurement and Geometry as a branch in mathematics is very important in describing the world using numbers (Battista, 2006). Measurement and Geometry is a perfect topic for students to deal with all types of numbers and numerical operations of all levels, naturally in real-world measurement contexts. Therefore it is very important for students to understand of its foundation in elementary level before continuing it in secondary level. Thus, with the use of HOTS-based module framed CAM, it is hoped that this study can provide different perspectives to educators in applying HOTS in teaching and learning measurement. This study is expected to help students to develop HOTS in measurement and geometry problem solving through the developed teaching and learning modules. The fusion of learning theories such as CAM and contructivist approach produce a theoretical and conceptual framework which gives not only for students, but also for teacher in order to make their process of thinking visible (Collins, Brown, and Holum, 1991). The students are challenge in learning through guided experience on cognitive and metacognitive where tasks provided are not to accomplish on their own but rather it is dependent on assistance from the collaboration with others. In addition, it is also a form of promotion to attract students' interest in improving HOTS in mathematics. Teacher is an agent in forming a higher order thinking community, thus teacher needs to be competent in applying HOTS (Kassim and Zakaria, 2015). It is hoped that teachers will use this findings to improve teaching quality in the classroom through effective module construction. Teachers could help their students to master the problem solving skills and improved their HOTS with the use of HOTS-based module. This study can also support teaching HOTS in terms of curriculum planners, which will be able to determine topics, or concepts that promote the thinking skills among primary school students. The results of this study are expected to provide useful information to curriculum planners at the ministry level in developing future curriculum framework. In addition they are expected to see the weakness of the curriculum being drafted and at the same time improve the quality of teaching and learning of mathematics in schools. Changes in designing a mathematical curriculum may be possible in the effort to diversify teaching resources to enhance HOTS among primary school students.

1.5 Limitations of the Study

Although every attempt is being considered to remove errors in the aspects of design and analytical, there are a few limitations in this study shall be taken into consideration. This study will focus on the effect of HOTS-based module learning instruction to promote HOTS by using the topic of measurement and geometry as an exemplar. In the topic of measurement, the researcher only covered four subtopics (length, mass and volume, shape and space, and angle. Investigating HOTS using other topic will have different result. The study is limited to Year five students in primary school in Kelantan. In this case perhaps different results will be expected with students from other years and locations, different in subject streams and backgrounds. Finally, the

duration of this study is limited to a period of 12 weeks. A longer duration of instruction may provide different result.

1.6 Definition of Terms

In order to understand terms of this study clearly, the following definitions of terminology are presented. These terms will be examined according to their conceptual as well as operational definitions.

High-Order Thinking Skill (HOTS)

Bloom (1956) categorized thinking skills beginning from the concrete and progressing to the abstract: knowledge, comprehension, application, analysis, synthesis, and creative. The last three levels of Bloom's Taxonomy: analysis, synthesis, and creative are considered HOTS (McBain, 2011). In this study HOTS is referred to the last three levels of Bloom's Taxonomy which are analysis, synthesis, and creative

Modular Approach

Module is something that can be an intermediary material especially to students in an organized teaching and learning process (Norijah, 1997). A module is a set of material consist of self-contained instructions, well organized topic which contain specific objectives, teaching/learning activities along with evaluation work. The HOTS-based module framed by Cognitive Apprenticeship Model (CAM) is an alternative material dedicates to help school teachers to use this quality content to improve instruction through higher order thinking skills. In this study, modular approach refers to HOTS-based module developed by the researcher.

Conventional Approach

Conventional approach refers to a teaching approach involving the teacher and the students interacting face-to-face in the classroom, while the students receive the information passively (McCarthy & Anderson, 2000). Teacher emphasize on the use of textbooks and notes (Li, 2016). In this study, conventional approach refers to the teaching approach with the use of textbook and provided module from Curriculum Development Division (*Bahagian Pembangunan Kurikulum, BPK*).

Performance Test

A performance test is a test to measure an individual's performance on a specific task (Fraenkel, Wallen & Hyun, 2012). According to Creswell (2014), performance test is being developed with a 'norm', that is the score of the test will be compared within individual among people who taken the test. In this study, performance test refers to the pre-test, post-test and post-delayed test that are constructed by the researcher in order to measure the achievement obtained by students in the topic of measurement and geometry.

Problem Solving

Nitko and Brookhart (2007), defined problem solving as a required strategy which is non-automatic to reach a goal. Polya, (1945) as cited in Perveen (2010) defined problem-solving as the process used in solving a problem that does not have clear solution. In this study, problem solving is measured based on the heuristic steps of solving a problem which are grounded on Polya's four stage problem solving model.

Conceptual knowledge

Conceptual knowledge is defined as knowledge that comprises of concepts, includes abstract and general principles (Canobi 2009; Rittle-Johnson, Sieglar & Anbali, 2001). Baroody, Feil, and Johnson (2007) suggested that conceptual knowledge should be defined as knowledge about facts and principles. In this study, conceptual knowledge is a students' skill or ability to identify concepts in the of measurement and geometry in the test given.

Procedural knowledge

Procedural knowledge is defined as knowledge that comprises of procedures (Canobi 2009; Rittle-Johnson et al. 2001). According to Rittle-Johnson, Schneider and R. Star (2015), procedural knowledge is steps in sequence, or actions taken to achieve an objective. In this study, procedural knowledge is a students' skill to solve or ability to identify strategies in the of measurement and geometry in the test given.

Error Analysis

Errors could occurs as the result of carelessness; misunderstanding of symbols or text; lack of relevant skill or knowledge connected to that mathematical topic/learning objective/concept; lack of consciousness or incapability to check the answer given; or the result of a misconception (Hansen et al., 2005). In this study, errors refer to student's solution in the performance test. The result indicate that there are signs of carelessness; misunderstanding of symbols or text; lack of relevant skill or knowledge connected to that mathematical topic/learning objective/concept; lack of consciousness or incapability to check the answer given; or the result of a misconception in the individual's answer/solutions.

1.7 Summary

This chapter presented perspective on teaching and learning of mathematics for year five students in primary school level. The research objectives, research questions and research hypotheses are presented. A problem statement is derived from the existence of poor performance among Malaysian students in the international assessment such as TIMSS 2011. The proposed module (HOTS-based module) integrated with learning theory of Cognitive Apprenticeship Model (CAM), was expected to help teachers in infusing higher order thinking skills which is a very important skill in the 21st century learning. Limitations and the conceptual and operational definitions of the key terms are also discussed in this study.

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