DEVELOPMENT AND EVALUATION OF DoCtor WoRM'S MODULE IN IMPROVING MULTIPLICATION SKILLS AMONG YEAR FOUR LOW ACHIEVERS

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ABSTRACT

The purpose of this study is to develop and evaluate the effectiveness of DoCtor WoRM's Module in improving multiplication skills among Year Four low achievers in National-Type Chinese Primary School (SJKC). DoCtor WoRM's Module had been designed based on Constructivist Theory, mastery learning, and game-based learning. The module was developed based on Sidek's Module Development Model. Quantitative approaches with quasi-experimental design were used for this study. A number of 60 Year Four low achievers from Manjung District were selected using random sampling. The sample was divided into the treatment and control groups. The former went through a teaching and learning process using DoCtor WoRM's Module, while the latter learnt through traditional teaching. After the pre-test, three months of intervention was carried out to both groups of sample, followed by a post-test. Data was analysed using descriptive and inferential statistics. Dependent *t*-test showed that there was a significant increase in the achievement of treatment group from pre-test ($M = 59.47$, $SD = 27.242$) to post-test ($M = 91.53$, $SD = 12.566$), $t(29) = 6.254$, $p < .001$. The independent *t*-test had shown that the achievement of multiplication skills in post-test of treatment group ($M = 91.53$, $SD = 12.566$) is higher than the post-test of control group ($M = 79.17$, $SD = 22.588$), $t(58) = 2.621$, $p < .012$. As a conclusion, DoCtor WoRM's Module has improved the multiplication skills among Year Four low achievers in SJKC. This study implicates that DoCtor WoRM's Module should be applied to the low achievers in Malaysia in order to improve their Mathematics achievement particularly in multiplication skills.

PEMBANGUNAN DAN PENILAIAN MODUL DoCtor WoRM UNTUK MENINGKATKAN KEMAHIRAN MENDARAB DALAM KALANGAN MURID BERPENCAPAIAN RENDAH TAHUN EMPAT

ABSTRAK

Tujuan kajian ini adalah untuk membina dan menilai keberkesanan Modul DoCtor WoRM bagi meningkatkan kemahiran mendarab dalam kalangan murid berpencapaian rendah Tahun Empat di Sekolah Jenis Kebangsaan Cina (SJKC). Modul DoCtor WoRM telah direka berdasarkan Teori Konstruktivisme, pembelajaran penguasaan dan pembelajaran berasaskan permainan. Modul ini telah dibina berpandukan Model Pembinaan Modul Sidek. Kajian kuantitatif iaitu kuasi-eksperimen telah digunakan dalam kajian ini. Seramai 60 orang murid berpencapaian rendah Tahun Empat di daerah Manjung telah dipilih melalui kaedah pensampelan rawak. Sampel telah dibahagikan kepada kumpulan rawatan dan kumpulan kawalan. Kumpulan rawatan telah melalui proses pengajaran dan pembelajaran menggunakan Modul DoCtor WoRM manakala kumpulan kawalan belajar dengan kaedah tradisional. Selepas ujian pra, intervensi selama tiga bulan telah dilaksanakan terhadap kedua-dua kumpulan, diikuti dengan ujian pasca. Data telah dianalisis menggunakan statistik deskriptif dan inferens. Ujian-*t* bersandar menunjukkan bahawa terdapat peningkatan yang signifikan dalam pencapaian kumpulan rawatan daripada ujian pra ($M = 59.47$, $SD = 27.242$) kepada ujian pasca ($M = 91.53$, $SD = 12.566$), $t(29) = 6.254$, $p < .001$. Ujian-*t* tidak bersandar menunjukkan bahawa pencapaian kemahiran mendarab dalam ujian pasca bagi kumpulan rawatan ($M = 91.53$, $SD = 12.566$) adalah lebih tinggi daripada ujian pasca bagi kumpulan kawalan ($M = 79.19$, $SD = 22.588$), $t(58) = 2.621$, $p < .012$. Kesimpulannya, Modul DoCtor WoRM adalah berkesan bagi meningkatkan kemahiran mendarab dalam kalangan murid berpencapaian rendah Tahun Empat di SJKC. Implikasi kajian menunjukkan bahawa Modul DoCtor WoRM seharusnya diaplikasikan terhadap semua murid berpencapaian rendah di Malaysia supaya dapat meningkatkan pencapaian Matematik terutamanya dalam kemahiran mendarab.

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LIST OF ABBREVIATIONS

ANCOVA	Analysis of Covariate
FPK	National Philosophy of Education
HOTS	Higher Order Thinking Skills
JPN	State Education Department
KBSR	Integrated Curriculum for Primary School
KPM	Ministry of Education Malaysia
KSSR	Primary School Standard Curriculum
LINUS	Literacy and Numeracy Screening
NKRA	National Key Result Areas
OECD	Organisation for Economic Co-operation and Development
PISA	Programme for International Student Assessment
PPD	District Education Office
PPPM	Malaysia Education Blueprint
SJKC	National-Type Chinese Primary School
SJKT	National-Type Tamil Primary School
SK	Malay-Medium National Schools
SPSS	Statistical Packages for the Social Science
UPSI	Sultan Idris Education University
UPSR	Primary School Evaluation Test

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter will explain briefly about the study in eight sections, which are background of the study, problem statement, conceptual framework, purpose of the study, hypothesis, significance and limitations of the study, and operational definitions.

1.2 Background of the Study

The first shift in Malaysia Education Blueprint (PPPM) 2013-2025 is providing an equal access to quality education of an international standard. In this case, government had increased the investment in physical and teaching resources for pupils with specific needs. Besides being provided with the facilities and equipment needed to create a conducive and supportive learning environment, these pupils would

be also taught by teachers who have received additional training to help them understand their pupils' specific contexts and challenges, and the teaching strategies required to address them.

In the year of 2009, Malaysia first participated in the Programme for International Student Assessment (PISA). Based on the mean score for year 2012, Malaysia is still placed in the bottom third, ranking 52 out of 65 countries and 55 out of 74 countries in the year 2009 survey (Kang, S.C., 2013). The average Malaysia pupil performance in all three areas was well below both the international and the Organisation for Economic Co-operation and Development (OECD) averages. This statistic indicated that we have to put harder effort in Mathematics education as it is one of the major skills to be mastered by our generation.

Through the Educational Transformation, Literacy and Numeracy Screening (LINUS) was introduced in August 2009. LINUS programme as an educational part of National Key Result Areas (NKRA) in Government Transformation Programme (GTP) is continuity from the existing programmes to overcome the challenges in mastering basic skills of reading, writing, and arithmetic (3M) systematically. The implementation of LINUS programme targeted 100% of Year Three pupils to master in literacy and numeracy before enter Year Four starting in year 2013, except for pupils with special needs.

Mathematics is a compulsory subject in primary and secondary school curriculum in Malaysia. Even though it is important and needed in our everyday life, yet there are many pupils who are afraid of this subject, especially during tests and

examination. This happened among the Mathematics low achievers, as they have not mastered the basic arithmetic skills as required. Thus, actions have to be taken by the educators so that the low achievers are able to improve their basic arithmetic skills in classroom and their daily life.

1.3 Problem Statement

Mathematics is the mother of Science and is also often applied in our daily lives. However, many pupils always have difficulties in studying it and are little interested in it (Chang, R.C. & Yang, C.Y., 2016). Research found that many pupils failed to master Mathematics beyond the primary grades because they never master mathematical facts (Johnson & Street, 2013). Furthermore, declines in Mathematics enrolments at high school are worldwide and extend beyond cultural and national borders. Educator must develop strategies that are underpinned by theories that address the obstacles imposed by the global declines in numeracy skills (Everingham, Gyuris, & Conolly, 2017).

As one of the four basic mathematical operations, multiplication is an important skill learnt in primary education. Especially mastery of the single-digit multiplication table is an important aim of primary education, as it forms the basis for other operations such as division and multi-digit multiplication (van der Ven, Straatemeier, Jansen, Klinkenberg, & van der Maas, 2015). The teaching of multiplication provides some particular challenges for teachers in order to help pupils develop a conceptual understanding of these operations (Bicknell, Young-Loveridge

& Nguyen, 2016). Pupils' problem in learning Mathematics especially in the operation of the basic multiplication facts started since they were in Year Two where they need to learn the multiplication tables from one to five and the tables from six to nine when they were in Year Three (Norhayati Ahmat, Nurul Huda Mohamed, Nor Afzalina Azmee, & Sarah Mohd Adham, 2017).

Chinese fourth and fifth grade pupils were likely to treat multiplication facts as language-based tasks because they had received systematic instruction of multiplication through their Mathematics curriculum. Over practice and emphasis on drills in Chinese Mathematics curriculum might train these children to rely more on phonological codes for retrieval (Liu, R.D., Ding, Y., Xu, L., & Wang, J., 2016). Self-guided learning and teamwork with an appropriate tool and minimalist instruction increased pupils' intrinsic motivation towards learning Mathematics, whereas the traditional Mathematics lessons, in which the motivation is more extrinsic due to the teacher's active role, were less appealing to them (Eronen & Karna, 2017). According to which pupils recognize that they know less about multiplication and division than addition and subtraction, and therefore are less confident in their multiplication and division judgement (Lortie-Forgues & Siegler, 2016).

The traditional method of teaching multiplication used to be memorization methods. The traditional Mathematics teaching interprets logic training by forcedly memorizing formulas and definition composed by abstract symbols. This cramming way of learning has led to a result that pupils lack of interest in learning Mathematics (Chang, R.C. & Yang, C.Y., 2016). It is undeniable that memorization method is good for multiplication learning. However, the concept of multiplication should be

understood by the pupils before memorization occurred (Yoong, S.M. & Noor Aini Ahmad, 2018).

In twenty first century, digital game-based learning has become a form of new teaching and learning activity yet it has not been practiced in the formal education system in Malaysia (Sayed Yusoff Syed Hussain, Tan, W.H., & Muhammad Zaffwan Idris, 2014). The design and development of a computer game could be utilized as an adaptable tool for the educational process (Katmada, Mavridis, & Tsiatsos, 2014). Meantime, combination of computer and video games with a variety of educational content may also achieve as good or better results as though traditional learning methods in the process (Prensky, 2007).

In Malaysia, teachers use remedial modules supplied by the Ministry of Education in teaching and learning activity for pupils who are recognized as weak in Mathematics. However, the previous research showed that the time delay in distributing the LINUS module to schools had become a challenge faced by LINUS teachers (Mohd Razak Mohd Nordin, Shaharuddin Shaari, & Normah Kamarodzan, 2014). The implementation of LINUS programme targeted 100% of Year Three pupils to master in literacy and numeracy before enter Year Four. Since LINUS targeted pupils from Year One to Year Three, so the Year Four low achievers are often left out. The researchers also found out that most SJKC schools in Manjung district did not provide LINUS programme or remedial class for the Year Four low achievers.

Based on the source from Manjung District Education Office (PPD), the pass rate of Mathematics subject results in year 2017 are Year One (81.22%), Year Two (89.4%), Year Three (83.19%), Year Four (65.47%), Year Five (65.93%), and Year Six (91.34%), whereas their Grade Point Averages are 2.73, 2.03, 2.58, 3.35, 3.23, and 2.43 respectively. This data showed that Year Four obtained the lowest pass rate (65.47%) and the highest Grade Point Average (3.35) among all.

Therefore, it is clear that researches on identifying effective teaching and learning strategies are needed in Malaysia especially for the Year Four low achievers who have not mastered in multiplication skills. Once the low achievers enter Year Four, they might be left out as the teacher will focus on teaching of operational facts instead of basic facts. Hence, this study will be carried out to develop and evaluate the effectiveness of DoCtor WoRM's Module in multiplication skills among Year Four low achievers.

1.4 Theoretical Framework

Figure 1.1 shows the theoretical framework of this study. This study is experimental in nature, so the variables that could affect the study outcome have to be determined. Two types of variables identified are independent variable and dependent variable. The independent variable is controlled and manipulated by the researcher and does not depend on another variable. In this study, the independent variable refers to DoCtor WoRM's Module. This module used /D/, /C/, /W/, /R/, and /M/ as the

acronym for Draw, Count, Write, Read, and Memorize. It is expected that this variable will have some effect on the dependent variables.

Meanwhile, the dependent variable is the factor measured in a research. It depends on the independent variables. In this study, the dependent variable is achievement of Year Four low achievers in multiplication skills. The achievement of the pupils will be measured by pre-test and post-test. The researcher will measure the pupils' improvement by comparing the results between pre-test and post-test.

The theoretical underpinning of the module is based on Bruner's Constructivist Theory. Bruner's Theory of Constructivism was influenced by the earlier theoretical research of Vygotsky and Piaget. His theoretical framework supports the belief that learners construct new ideas or concepts based upon existing knowledge (Cherry & Overbaugh, 2004). The theory described by Piaget and Vygotsky is very important because knowledge is increased based on construction of learning and learners, instead of something that is fed from the others (Hayati, Fauzan, Iswari, & Khairdir, 2018).

Regarding to this, teachers should help the pupils to build their basic concepts from concrete thinking to the utilization of more conceptually adequate modes of thought (Bruner, 2006). The process of learning is an active construction. This means that students construct their knowledge through the selective experience to create a conceptual structure that forms the basis of their knowledge (Matanluk, Baharom Mohammad, Kiflee, & Imbug, 2013).

On the other hand, the learning models used in designing this module are game-based learning and mastery learning. Game-based learning is a type of learning by playing game and has defined learning outcomes. Generally, game-based learning is designed to balance the subject with game play and the ability of player to apply the learning into the real world. Games offer a unique structure to complement traditional teaching strategies and infuse teaching with energy, spark innovative thinking, and provide diversity in teaching methods (Boyle, 2011). Games are also a unique activity to implement existing learning models, and playfulness adds a dimension to these existing models. This creates a learning experience that can make games a preferable activity compared to other traditional activities (Plass, Homer, & Kinzer, 2015).

Mastery learning is a method of instruction where the focus is on the role of feedback in learning (Motamedi, 2001). In mastery learning, pupils must master the content of a unit before moving on to the next unit. The model is being applied into DoCtor WoRM's Module by which the pupils are required to master multiplication facts for a certain single-digit before they can proceed to the next multiplication facts. This module has also offer enrichment activities in form of digital games for the pupils that have mastered a certain multiplication facts. The integration of mastery learning strategies with game-based learning provides greater benefits for pupils when learning Mathematics (Lin, C.H. et al., 2013).

Mathematics is the foundation of Science, technology, intellectual development, and an index of civilization evolution (Chang, R.C. & Yang, C.Y., 2016). Mathematics contains of few domains, which include whole numbers, fractions, decimals, percentages, and ratios. Meanwhile in primary school, arithmetic becomes

one of the most important skills as it contains four basic skills in Mathematics subject. Arithmetic skills refer to the ability to combine numbers. Simple arithmetic refers to operations of addition, subtraction, multiplication, and division with smaller values of number (Andin, Ronnberg, & Rudner, 2013). In this study, the researcher focused on multiplication skills.

This study had evaluated the effectiveness of DoCtor WoRM's Module towards the achievement of Year Four low achievers in multiplication skills. After three months of intervention, the pupils in the treatment group are able to improve in their achievement. The researcher had evaluated the effectiveness of this module by using pre-test and post-test. The differences between the results of pre-test and post-test showed that there is an improvement on the pupils' achievement in multiplication skills.

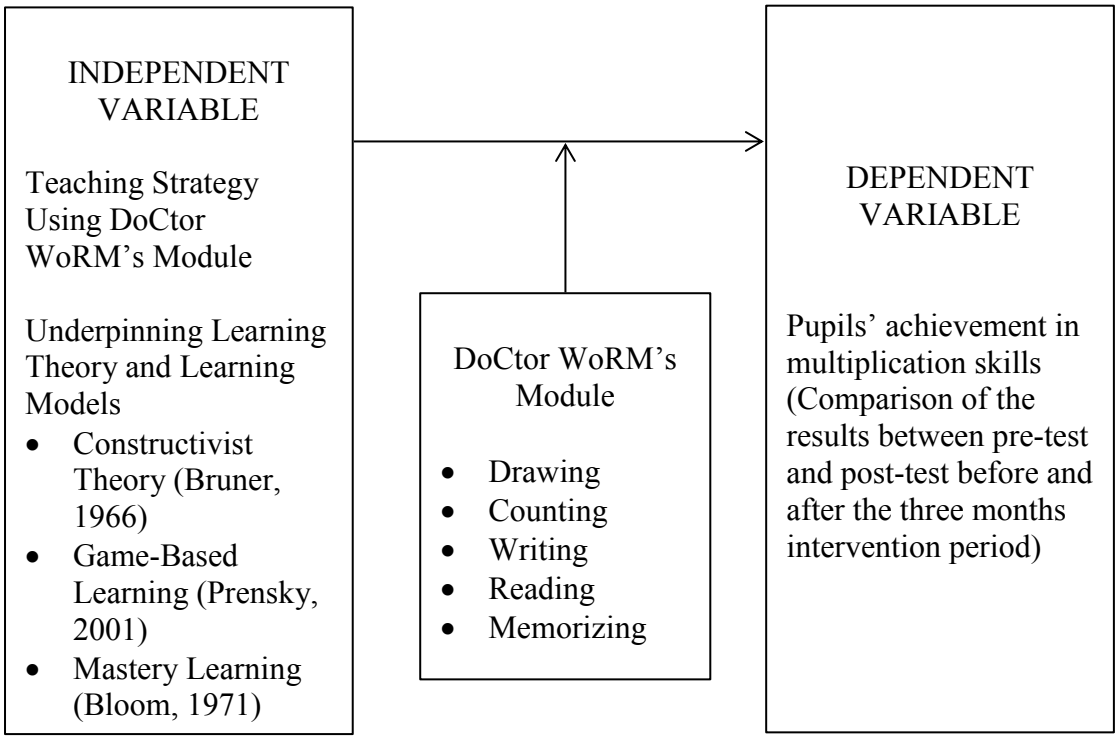

Figure 1.1 Theoretical Framework

1.5 Conceptual Framework

Figure 1.2 shows the conceptual framework in this study. There are two phases in this study, which are Module Developmental Phase and Module Evaluation Phase. During Module Developmental Phase, the researcher had designed DoCtor WoRM's Module based on Constructivist Theory, game-based learning, and mastery learning.

Bruner's three modes of representation are enactive, iconic, and symbolic. Firstly, enactive mode involves encoding action based on information and storing it in our memory. Secondly, iconic mode is where information stored visually in the form of images as a mental picture in the mind's eye. Thirdly, symbolic mode is where information stored in the form of a code or symbol, such as language (McLeod, 2008).

The activities in DoCtor WoRM's Module are in line with Bruner's three modes of representation. During enactive mode, the pupils are exposed to a story as an introduction. Story is used in the beginning of this module as it is easier for pupils to comprehend and store in the memory. Next, during iconic mode, the pupils need to draw and count the intersection points of the caterpillars. These activities enable pupils to visualize and form a mental image in their mind. Lastly, it comes to symbolic mode. During this mode, the pupils need to write and read, and memorize the multiplication sentences, so the information is stored in the form of language.

During Module Evaluation Phase, the samples are selected from the population of Year Four low achievers. Then, the pupils in the treatment group will learn multiplication skills by using DoCtor WoRM's Module. Five important steps in

DoCtor WoRM's Module are /D/ drawing, /C/ counting, /W/ writing, /R/ reading, and /M/ memorizing. After the three months intervention, the pupils are able to master in single-digit multiplication.

Computer and videogames are potentially the most engaging pastime in the history of mankind. This is due to a combination of twelve elements; (1) games are a form of fun; (2) games are form of play; (3) games have rules; (4) games have goals; (5) games are interactive; (6) games are adaptive; (7) games have outcomes and feedback; (8) games have win states; (9) games have challenge; (10) games have problem solving; (11) games have interaction; and (12) games have representation and story (Prensky, 2001).

Bloom taxonomy is associated with mastery learning, because it is the same Benjamin Bloom who is famous for both. The taxonomy, edited by Bloom, was developed by a committee and published in 1956 to expand teaching and testing beyond the lowest levels of rote learning that were considered to dominate teaching in those days. By 1968, Bloom had launched his version of mastery learning, based on John Carroll's model of school learning (Bloom, 1971 in Gentile & Lalley, 2003). In mastery learning, teachers set an objective based on pupils' level. The pupils went through learning process so that they can achieve the first objective. Formative assessment is given to the pupils in every lesson. This is to see whether the pupils acquired the knowledge along the intervention taking place. Next, enrichment activity is carried out. If the pupils does not show mastery in the skill, then correction need to be done until the pupils solve at least 80% of the items correctly. After the pupils achieved the unit, then they will proceed to the next unit with the second objective.

Module Evaluation Phase begins after DoCtor WoRM's Module is completed. The researcher had selected Year Four low achievers using purposive sampling. The researcher had also divided these low achievers into control group and treatment group. The treatment group went through an intervention using DoCtor WoRM's Module. After three months period, the pupils in the treatment group are able to master in single-digit multiplication.

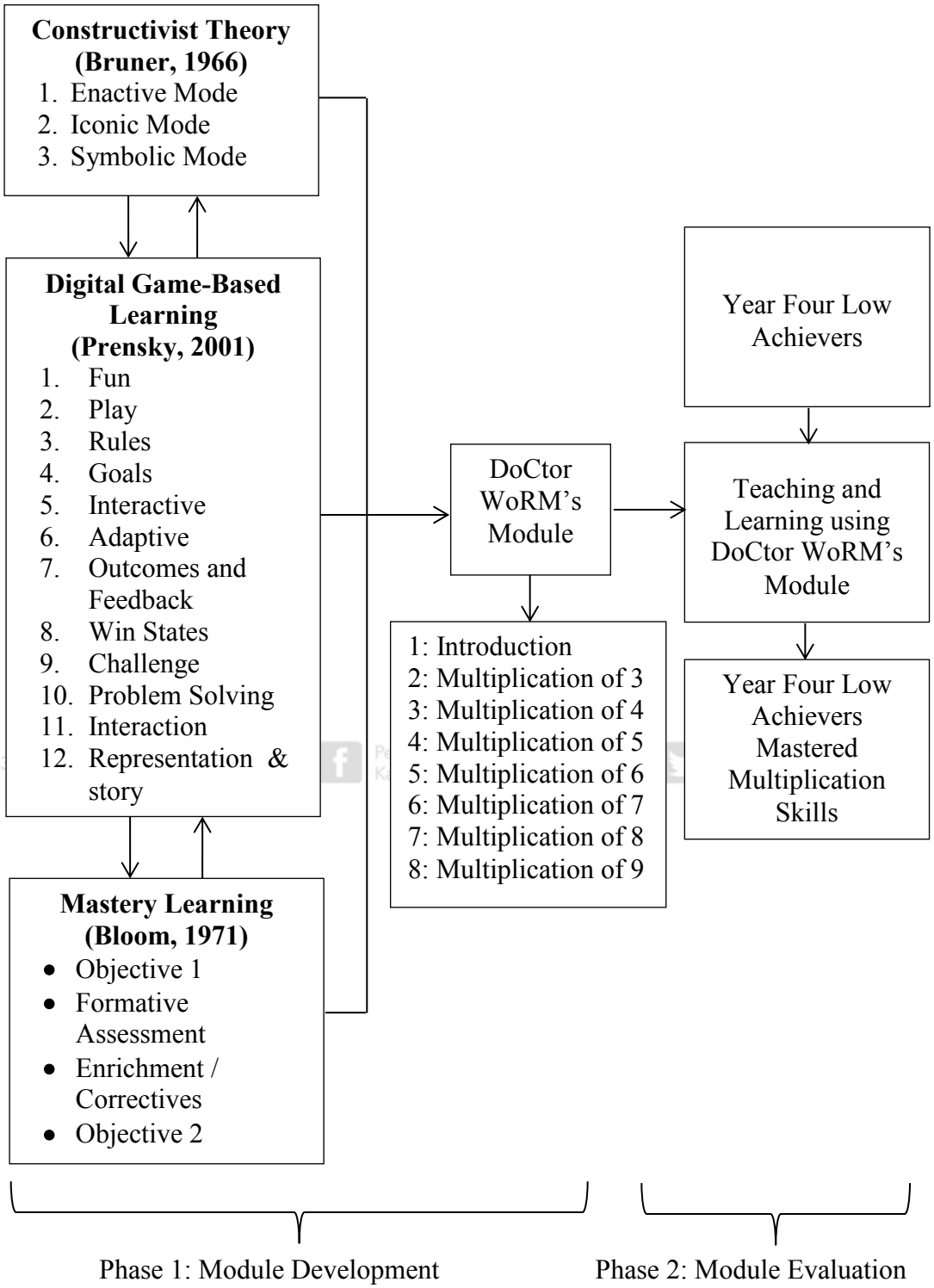

Figure 1.2 Conceptual Framework

1.6 Purpose of the Study

The purpose of the study is to develop and evaluate the effectiveness of DoCtor WoRM's Module in the teaching of multiplication skills among Year Four low achievers.

1.6.1 Objectives

The five objectives to achieve the main purpose are identified as follow:

1. To identify the module needs in multiplication skills for Year Four low achievers in SJKC.

2. To measure the content validity of DoCtor WoRM's Module among Year Four low achievers in multiplication skills.

3. To measure the reliability of DoCtor WoRM's Module among Year Four low achievers in multiplication skills.

4. To measure the improvement in multiplication skills among Year Four low achievers after using DoCtor WoRM's Module.

5. To measure the effectiveness of DoCtor WoRM's Module in improving multiplication skills among Year Four low achievers.

1.6.2 Research Questions

According to the objectives, five research questions are listed below:

1. Is there a need for module in multiplication skills among Year Four low achievers in SJKC?

2. What is the content validity of DoCtor WoRM's Module among Year Four low achievers in multiplication skills?

3. What is the reliability of DoCtor WoRM's Module among Year Four low achievers in multiplication skills?

4. Is there any improvement in multiplication skills among Year Four low achievers after using DoCtor WoRM's Module?

5. Is DoCtor WoRM's Module effective in improving multiplication skills among Year Four low achievers?

1.7 Hypothesis

Hypothesis is the temporary conclusion for problem statements to be tested and depended on the researcher's understanding towards the previous researches that had been made on the research title (Raja, Noraini Mohamed Hassan, & Chong, W.L., 2016). A null hypothesis states that the test mean score of students taught by discussion method is equal to the test mean score of students taught by lecture method (Lay, Y.F. & Khoo, C.H., 2016). In this study, the researcher states null hypothesis instead of alternative hypothesis because null hypothesis is the focus of hypothesis testing since the null hypothesis will be tested directly, not the alternative hypothesis. Two null hypotheses in this study are:

H_{o1} : There is no significant difference between the means of the pre-test and the post-test for the treatment group.

H_{o2} : There is no significant difference between the means of the post-test for the treatment and control groups.

1.8 Significance of the Study

There are four basic skills in the arithmetic, which are addition, subtraction, multiplication, and division. Multiplication became one of the toughest skills to be mastered and it is also very important in our daily lives. It is important to carry out the study and the significance for the study can be viewed from different perspectives.

The introduction of DoCtor WoRM is a modification from the line multiplication. It could be placed in the syllabus as a fun way to learn multiplication. The visualisation of the abstract arithmetic skills could raise the pupils' interest in the learning activities. Traditional memorization method on multiplication can be helpful but above all, the pupils must understand the concept of multiplication and this can be explained by the lines' intersection points. Hence, the construction of this module is believed to give a helping hand for the teachers in order to help the low achievers to understand the concept of multiplication in an easier way.

For the policy makers, the findings could give some suggestions in revising the syllabus by adding alternative method on multiplication in the textbooks. Refer to Primary School Standard Curriculum (KSSR) Mathematics textbook, pupils are encouraged to used creative and critical thinking when solving the problems. The pupils can obtain the solution not by only one method, but more than one method can be accepted. Additionally, findings on the contribution of DoCtor WoRM's Module from this study can be utilised by the Curriculum Development Division, Ministry of Education in helping them to objectively select the right and suitable technology tools as critical enablers to improve the delivery of the Mathematics curriculum.

On the other hand, the syllabus of Mathematics in KSSR is also claimed to be tougher if compare to the syllabus of Mathematics in Integrated Curriculum for Primary School (KBSR). This is due to the integrating of secondary school elements into the primary school syllabus. Higher order thinking skills (HOTS) are highlighted in the curriculum caused the low achievers to lost their interest in this subject. In order

to prevent the consequences as mentioned, educators should implement the basic arithmetic skills among the pupils at the same time fulfil their desire and motivation to learn in an interesting way. In this case, DoCtor WoRM's Module provides a step-by-step learning to make sure pupils are able to understand about the abstract concept of multiplication skills.

1.9 Limitations of the Study

Limitations are matters and occurrences that arise in a study which are out of the researcher's control (Simon & Goes, 2013). In this research, limitations of the study are made to ensure its validity. There are 11 National-Type Chinese Primary Schools (SJKC) in Manjung district involved in this study. As such, the results obtained do not generalise the population of the Malaysian pupils especially in other districts or states, nor can the results be a fair representation of pupils from other school types.

The SJKC schools in Manjung district are chosen, instead of all other districts available in Malaysia. The reason for choosing the sample from this certain schools is because there are pupils who meet the criteria for the research. The researcher targeted Year Four low achievers which had failed in the previous Mathematics assessment, and have not mastered in single-digit multiplication. Hence, the researcher had done a needs survey in Manjung district and found that there are a need to carry out the research in this district in order to enhance the multiplication skills among the Year Four low achievers.

The sample is confined to Year Four low achievers, thus the small sample size of the purposive sampling does not generalize the population of the Malaysian pupils. In Malaysia, the learning of multiplication skills begins since pre-school level or in Year One. According to KSSR syllabus, pupils are required to understand and learn multiplication facts of two, five, ten, four, one, and zero since Year Two. In Year Three syllabus, the pupils continue to learn about the multiplication facts of three, six, seven, eight, and nine. During these two years period, the pupils learn multiplication skills with some different methods, one of them is memorization of multiplication table. In other words, the pupils need to master in multiplication facts from one to nine by Year Four, or else they will be left out. Thus, the researcher limited the sample of this study to Year Four low achievers to help these pupils to master the basic skills of multiplication facts.

The scope of the module contents is limited to the multiplication facts of three to nine. Single-digit multiplication facts are being chosen because they are the basic facts for all the other multiplication facts with any larger multiplicand. For example 9 x 12, if pupils have the basic knowledge as in the scope of this module, they are able to do the algorithms by separating it into two steps, which are 9 x 2 and 9 x 10. Then, the pupils have to add 18 and 90 to get the final answer of 108. This has shown that the single-digit multiplication facts are vital for the pupils in order to solve the multiplication facts with any larger multiplicands.

The intervention in this study requires pupils to draw the intersecting lines, count the intersection points, then write the multiplication sentences. The researcher chose Mathematics sentence instead of vertical algorithm because it is an easier form

for the pupils to read and memorize the multiplication facts. Pupils in primary school are taught to memorize the multiplication facts until the task become automatic. In this case, Mathematics sentences are more suitable instead of the vertical algorithms.

Last but not least, the research targeted SJKC in this study, despite of Malay-Medium National Schools (SK), National-Type Tamil Primary School (SJKT), and other school types. The researcher is teaching in SJKC and encounter the problems in this school type, hence it urge the researcher to find out the solution. Besides, the researcher also has more understanding about the culture and background of SJKC compare to the other school types, which is useful in designing the module suitable for the target group. Thus, the findings of this study do not generalise the population of Malaysian pupils especially in the other school types.

1.10 Operational Definitions

An operational definition outlines a metric for quantifying something of interest (Church, 2004). There were variety definitions of the terms from the experts. However, the key terms used in this study are most appropriate for the content of this study were listed out. The operational definitions of the five key terms to be listed out in this study are Mathematics as a subject, arithmetic skills, multiplication skills, low achievers, and traditional teaching.

1.10.1 Mathematics as a Subject

Mathematics has always been among the pre-requisites for the many technical courses (Rohaiza Ramli, 2015). In education, Mathematics has become one of the most important subjects to be learnt in school. If the pupils do not learn Mathematics, then they will struggle to calculate and to solve problems in everyday life. Due of the reasons, the researcher thought it is crucial that innovative ways should be explored in the teaching of Mathematics. Memorization of multiplication facts without the understanding of the concept caused the pupils to face difficulties when applying the knowledge in the different problem context. Another reason for choosing this skill is the fact that pupils need to master the skill in order to get a better result in Mathematics examination, especially in the Primary School Evaluation Test (UPSR) that they will soon facing in Year Six.

In the context of this study, Mathematics as a subject indicates that it is one of the core subjects in SJKC. Considering that the KSSR syllabus had been introduced since year 2011, the emphasis on HOTS questions had caused many pupils to obtain low marks in the examinations, especially the low achievers. In this case, four basic arithmetic skills must be mastered by the pupils in order for them to solve the higher level problems in Mathematics subject. Hence, the researcher had selected Mathematics in this study as to improve the Year Four low achievers' achievement in the subject.

1.10.2 Arithmetic Skills

Interval arithmetic operations included addition, subtraction, multiplication, and division. Thus, it can be concluded that the Mathematics subject that are being taught in primary school are mainly arithmetic skills (Hickey, Ju, & Van Emden, 2001). Arithmetic skills can be trained by means of game play, especially with young children (Castellar, All, Marez, & Looy, 2015). More training time may be needed to master subtraction and division than to master addition and multiplication. Follow-up research on the specificity of children's arithmetic learning is needed to further evaluate these possibilities (Walker, Bajic, Mickes, Kwak, & Rickard, 2013).

In the context of this study, arithmetic is a branch of Mathematics that consists of four basic skills, which are addition, subtraction, multiplication, and division. The researcher had selected arithmetic skills because these four operations are the basic mathematical operations for the pupils in primary school, in order to solve the complex problems in the other topics or real life problems. Besides, the pupils in primary school are learning the same arithmetic skills in their every year Mathematics syllabus. In KSSR, pupils learn about addition and subtraction skills since Year One. Consequently in Year Two, the pupils learn about simple multiplication and division skills. The contents of arithmetic skills are continually integrated in Year Three until Year Six syllabus, with the gradually increase of difficulty levels. In this study, the researcher focused only in multiplication skills, which will be discussed in the next section.

1.10.3 Multiplication Skills

Multiplication is a mathematical operation of adding an integer to a specific number of times, solving problems about equal groups, or making an arrangement of objects, pictures or numbers in columns and rows which is called array. Multiplication is an abstract concept. It is hardly interpreted by the learners, especially low achievers. Regard to this, the researcher thinks it is better to visualize the concept by using some teaching methods and animations to make the concept easier for the pupils. Hence, the researcher designed DoCtor WoRM's Module using five systematic steps to assist the low achievers. In short, the five steps are /D/ drawing, /C/ counting, /W/ writing, /R/ reading, and /M/ memorizing.

In the context of this study, multiplication skills are an ability to solve an equation by following the five steps in DoCtor WoRM's Module. After completing the module, the pupils should be able to obtain the correct answers for multiplication items by drawing intersecting lines, counting the intersection points, writing the multiplication sentences, reading the multiplication sentences, and memorize the multiplication facts. In short, multiplication skills in this study contains five important steps, which are drawing, counting, writing, reading, and memorizing, that represented by the alphabets of /D/, /C/, /W/, /R/, and /M/ in DoCtor WoRM's Module.

In fact, this method is a modification of Japanese Multiplication, which is an interesting method to visualize multiplication that reduces it to simple counting. According to Hale (2015), kids in Japan learn how to multiply completely differently

to how they do in the West. Without the stress of memorizing multiplication table, all this method requires the pupils to do is counting lines and dots. To modify the Japanese Multiplication into a more interesting and attractive way, the researcher designed DoCtor WoRM's Module by creating Betty Butterfly and Dr. Worm as the main characters. By counting the intersection points of the intersecting caterpillars, it became a simpler way for the low achievers to master the abstract multiplication skills.

In this module, teachers carried out the teaching and learning activities based on the lesson plans in Teacher's Manual. The pupils are given a Pupil's Activity Book so they can do the activities on multiplication facts during every lesson. Then, they are also given time to play with the interactive game so that they can learn multiplication skills through the animation and multimedia. Overall, these activities led the pupils with a sequence of drawing the intersecting lines, counting the intersection points, writing the multiplication sentence, reading the multiplication sentence, and memorizing the multiplication facts.

1.10.4 Low Achievers

Low achievers are pupils who have difficulty in meeting educational standards. These pupils failed in their learning subjects and meets difficulty to understand the content in the normal classrooms. However, the low achievers are yet not qualified for special education services, so the regular teachers are responsible for teaching them in the mainstream classrooms. In the context of this study, the researcher targeted low achievers in Mathematics subject only. Besides, the Mathematics low achievers in this

study are the Year Four pupils in SJKC. These pupils failed in their Mathematics assessment, in which they obtained the marks below 40.

Since the focus of this study is on multiplication skills, the researcher needs to specify these Year Four Mathematics low achievers into those who have not mastered multiplication skills even though they have been taught during Year Two and Year Three using other methods. Therefore, the pupils are screened through a pre-test, to ensure that they have not acquired the skills of single-digit multiplication. As a result, these low achievers needed guidance from the teachers by using an alternative method, technique or materials which are more suitable with their learning level. Hence, the researcher had designed a module to increase the achievement of these Year Four low achievers in multiplication skills.

1.10.5 Traditional Teaching

In experimental research, the researcher could perform a new teaching approach with one group of participants and perform the traditional teaching approach with another group of participants (Johnson & Christensen, 2014). The traditional teaching is teacher-centered instead of pupils-centered. The pupils in traditional teaching classroom are usually passive as the teachers are using one-way communication. Hence, in Information and Communication Technology era, traditional teaching and learning methods are less attractive to the young generation as they have been exposed to all kinds of technologies (Muhamad Hafizhuddin Abdul Rahman, 2016).

In the context of this study, traditional teaching for control group is the teaching of multiplication skills using a traditional method. The method used in teaching single-digit multiplication for control group is by grouping method. For example, the item of 3 x 4 = 12 is explained by three groups of four equal to twelve. The teachers in the control group demonstrated the solution by drawing three big circles and four objects in each circle. Then, the pupils are required to count the objects and the sum of the objects is the answer for the question. All the teachers involved in control group were reminded to teach the same content of single-digit multiplication, which are multiplication facts from three until nine in the given time. In short, this is to control the extraneous variables and to ensure that both treatment and control groups had learnt the same content within the three months intervention period.

1.11 Summary

Teachers have to encounter with different challenges and problems in everyday life. In Mathematics subject, pupils may undergo difficulties if they have not mastered the four basic arithmetic skills in their learning. The teachers must find or develop a new strategy or method in order to improve the abilities and skills of the pupils. This study targeted the Year Four Mathematics low achievers because this category of pupils is often being left out. In the school, these pupils are usually being labelled as stupid or lazy as they cannot perform as the normal children at the same age and class.

Mathematics has become one of the most important subjects as it helps us to solve our daily problems. A good achievement in Mathematics is a requirement for every pupil in the schools. In this case, pupils need to master the four basic arithmetic skills during primary education. The researcher designed DoCtor WoRM's Module in order to help the Year Four low achievers in learning multiplication skills in a systematic way. The pupils will be divided into treatment group and control group. Traditional teaching is conducted towards the control group. Meanwhile, intervention using DoCtor WoRM's Module is conducted towards the treatment group. After the intervention using this module, the pupils should be able to master in multiplication skills involving single-digit multiplication facts.