DEVELOPMENT OF A TEACHING FRAMEWORK FOR PRE-SERVICE MATHEMATICS TEACHERS

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ABSTRACT

The main purpose of this study is to develop a teaching framework for pre-service mathematics teachers. Specifically, this study validates the items that measure the constructs of the Teaching Framework for Pre-service Mathematics Teachers (TF@Maths) and examines whether mathematics content knowledge (MCK), mathematical pedagogical knowledge (MPK), general pedagogical knowledge (GPK), classroom management skills (CMS), and mathematical disposition (MDP) significantly relate to quality mathematics teacher (QMT). This study employed a quantitative approach to look at the constructs of a quality mathematics teacher from the perspective of the pre-service teachers. Data were collected using a questionnaire from a sample of 400 students which were randomly selected from three Public Universities (PUs) and seven Institutes of Teacher Education (ITEs). Structural Equation Modelling (SEM) was applied to analyse the data. The results reveal an acceptable fit of the TF@Maths framework with satisfactory convergent validity, discriminant validity and reliability. All confirmatory factor analysis (CFA) models achieved convergent validity with Average Variance Extracted above 0.50 and the value of construct reliability exceeded 0.70. These indicated that all items of each constructs could measure the same traits. The Structural Equation Modeling analysis indicated significant overall fit of the model and the discriminant validity showed that all correlation coefficient values were less than 0.90 which indicated that all constructs were different significantly. The results also showed that MCK, MPK, GPK, CMS, and MDP are significant predictors of QMT. In conclusion, this study showed that TF@Maths is well fitted and can be accepted as a valid and reliable instrument to determine a quality mathematics teacher. The study implicates that the TF@Maths framework and findings could provide a new instrument to help stakeholders in designing mathematics curriculum.

PEMBINAAN RANGKA KERJA PENGAJARAN UNTUK BAKAL GURU MATEMATIK

ABSTRAK

Tujuan utama kajian ini adalah untuk membina satu rangka kerja pengajaran untuk bakal guru matematik. Secara spesifik, kajian ini mengesahkan item-item yang mengukur konstruk-konstruk Rangka Kerja Pengajaran untuk Bakal Guru Matematik (RKP@Maths) dan mengkaji sama ada pengetahuan kandungan matematik (PKM), pengetahuan pedagogi matematik (PPM), pengetahuan pedagogi umum (PPU), kemahiran pengurusan kelas (KPK), dan kecenderungan matematik (KCM) mempunyai hubugan yang signifikan dengan guru matematik berkualiti (GMB). Kajian ini menggunakan pendekatan kuantitatif untuk melihat konstruk-konstruk guru matematik yang berkualiti dari perspektif bakal guru. Data dikumpul dengan menggunakan soal selidik daripada satu sampel 400 orang pelajar yang dipilih secara rawak dari tiga buah Universiti Awam (UA) dan tujuh buah Institut Pendidikan Guru (IPG). Pemodelan Persamaan Berstruktur digunakan untuk menganalisis data. Dapatan kajian menunjukkan kesepadanan RKP@Maths yang boleh diterima dengan kesahihan memusat, kesahihan diskriminasi dan kebolehpercayaan yang memuaskan. Semua model analisis pengesahan faktor (APF) mencapai kesahihan memusat dengan *Average Variance Extracted* melebihi 0.50 dan nilai kebolehpercayaan konstruk melebihi 0.70. Ini menunjukkan bahawa semua item bagi setiap konstruk dapat mengukur ciri-ciri yang sama. Analisis Pemodelan Persamaan Berstruktur menunjukkan kesepadanan model adalah signifikan dan kesahihan diskriminasi menunjukkan semua pekali korelasi adalah kurang daripada 0.90 yang menunjukkan bahawa setiap konstruk adalah berbeza secara signifikan. Dapatan kajian juga menunjukkan PKM, PPM, PPU, KPK dan KCM adalah peramal yang signifikan terhadap GMB. Kesimpulannya, kajian menunjukkan bahawa RKP@Maths mencapai kesepadanan yang baik dan boleh diterima sebagai instrumen yang sah dan boleh dipercayai untuk menentukan guru matematik yang berkualiti. Implikasinya, rangka kerja RKP@Maths dan hasil dapatan dapat memberikan instrumen baru untuk membantu pihak berkaitan dalam merancang kurikulum matematik.

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LIST OF ABBREVIATIONS

AAMT	Australian Association of Mathematics Teachers
AMOS	Analysis of Moment Structure
AVE	Average Variance Extracted
CB-SEM	Covariance-Based Structural Equation Modeling
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CMS	Classroom Management Skills
CR	Construct Reliability
df	Degree of Freedom
EFA	Exploratory Factor Analysis
EPRD	Educational Planning and Research Division
GOF	Goodness-of-Fit
GPK	General Pedagogical Knowledge
IGS	Institute of Graduate Studies
ITE	Institute of Teacher Education
KDPM	Kursus Diploma Pendidikan Malaysia
KPLI	Kursus Perguruan Lepasan Ijazah
MATHED&SEI	Mathematics Teacher Education & Science Education Institute
MCK	Mathematics Content Knowledge

MDP	Mathematical Disposition
MMTQS	Malaysian Mathematics Teacher Quality Standards
MOE	Ministry of Education Malaysia
MOHE	Ministry of Higher Education
MPK	Mathematical Pedagogical Knowledge
MTEP	Mathematics Teacher Education Programme
MTS	Malaysian Teacher Standards
NCTM	National Council Teacher of Mathematics
OECD	Organisation for Economic Co-operation and Development
PCA	Principal Component Analysis
PIHE	Public Institute of Higher Education
PISA	Programme for International Student Assessment
PLS-SEM	Partial Least Squares Structural Equation Modeling
QMT	Quality Mathematics Teacher
RMSEA	Root Mean Square Error of Approximation
SEAMEO RECSAM	Southeast Asian Ministers of Education Organisation Regional Centre for Education in Science and Mathematics
SEM	Structural Equation Modelling
SET@MATHS	Standards for Excellence in Teaching and Learning of Mathematics
SIQA	School Inspectorate and Quality Assurance
SPSS	Statistical Package for the Social Sciences

SRMR	Standardized Root Mean Square Residual
TF@Maths	Teaching Framework for Pre-service Mathematics Teachers
TLI	Tucker-Lewis Index
UiTM	Universiti Teknologi MARA
UPM	Universiti Putra Malaysia
UPSI	Universiti Pendidikan Sultan Idris

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CHAPTER 1

INTRODUCTION

1.1 Introduction

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The strong influence of globalization along with the critical demands for economic and social development has accelerated the momentums to strengthen the educational system in many countries (Tam & Cheng, 2007). High quality educational provision is therefore necessary. To achieve this, the most widely recognized factor that influences student achievement become imperative is teacher's quality (P. S. C. Goh, 2012).

Malaysia has made major inroads into providing educational quality and accessibility to all. However there are still areas for improvements in particular mathematics. In Malaysian context, the focus of mathematics teacher's quality has grown due to the challenge to improve the student achievement in international largescale assessment. The current release of Programme for International Student

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Programme for International Student Assessment (PISA) 2015 has indicated that Malaysian students recorded an average score of 446 in mathematics, an improvement from the 421 they scored in the PISA 2012, but still below the 490-mean score for Organisation for Economic Co-operation and Development (OECD) countries (Malaysia Ministry of Education, 2016). Our students in age 15 failed to meet the minimum benchmarks in Mathematics, that is the basic proficiency required for students to participate productively and efficiently in life.

As such, there is a dire need to develop Malaysian mathematics teaching framework that would facilitate student mathematics learning outcomes and in turn, informs pedagogical and educational policy. In relation to this, the Malaysian Teacher Standard (MTS) 2009 which consists of three main content standards: (1) Professional values within the teaching profession, (2) Knowledge and understanding of education, subject matter, curriculum and co-curriculum, and (3) Skills of teaching and learning. It was found that the MTS not specific to mathematics subject (SEAMEO RECSAM, 2016a).

Therefore, this study attempts to develop a teaching framework for pre-service mathematics teachers to ensure that appropriate and effective pedagogies are used in curriculum, with the aim to equip teachers with the teaching strategies needed for

effective classroom instruction. The Teaching Framework for Pre-service Mathematics teachers or TF@Maths was developed. TF@Maths consists of five attributes of mathematics teacher's quality: (1) mathematics content knowledge, (2) mathematical pedagogical knowledge, (3) general pedagogical knowledge, (4) classroom management skills, and (5) mathematical disposition.

This study was about an evaluate the goodness of fit of teaching framework for pre-service mathematics teachers (TF@Maths) constructs and .examine convergent validity, discriminant validity and construct reliability of TF@Maths constructs in CFA. In addition, mathematical content knowledge (MCK), mathematical pedagogical knowledge (MPK), general pedagogical knowledge (GPK), classroom management skills (CMS), mathematical disposition (MDP) are whether significantly related to quality mathematics teacher (QMT) was also examined.

Following the introduction, section 1.2 presents the background of the study while section 1.3 specifies the research problem. Further, sections 1.4, 1.5 and 1.6 outline the research objectives, research questions and hypotheses, while section 1.7 and section 1.8 describe the conceptual framework and the significance of the study, respectively. Finally, section 1.9 describes the limitations of the study, while section 1.10 provides the definition of the constructs used in this study.

1.2 Background of The Study

Achieving excellence in mathematics teaching is the first step towards professionalizing mathematics teachers. To do this, mathematics teachers should aim to pursue a high-quality education. Teacher skills and pedagogical skills should be assessed and improved to achieve the quality and standards that have been set so the teacher's instructions will be more efficient and effective teaching can be established (MATHTED & SEI, 2011).

Today's mathematics teachers in Malaysia are undergoing major changes not only in the mathematics content they teach but also in the techniques they use when teaching. Almost all of these teachers came through school when mathematics consisted of a collection of skills and facts to be learned by rote or mastered by a relatively homogeneous group of students taught using a lecture method. Now teachers are called on to teach innovative, more challenging mathematics to a very diverse audience using dynamic learning approaches designed to develop an understanding (Malaysia Education Blueprint, 2013; Noraini, 2006). Effectiveness of positive and comprehensible input is the prime concern of teachers in the learning process. For this reason, teachers should be equipped with optimum pedagogical skills. Teacher should be skillful, use a variety of innovative and challenging methods to enhance their teaching.

Philippines Councils of Mathematics Teacher Education & Science Education Institute (MATHTED & SEI, 2011) found that the mathematics teachers have been tested by the depth of the mathematics content that is available for them to study so they can teach mathematics in good and correct way to students; uncertainty context and behavior of students these days need to be armed with a variety of ideas for teachers to manage student behavior and classroom resources; cognitive background of varying student needs a variety of pedagogical approaches learning of mathematics; the perceived disconnect between school mathematics and everyday life; the existence of a wide variety of technologies and their rapid progress; their role as model positive values and attitudes, which will bring these students in their lives and careers, and the need to continue to progress themselves in the teaching profession. Such challenges hamper mathematics teachers' creative abilities and self-efficacy. Mathematics teachers clearly need all the extra help that they can get to achieve excellence in the teaching of mathematics.

Besides that, the current discussion on teaching and learning in mathematics all around the world are demanding the adoption of the learner centred approach rather than the traditional teacher centred approaches. In these modern approaches to teach mathematics, one distinction is very important. The more active a student is in the

learning situation, the more student-centred the teaching orientation is likely to be. Researcher believe that student-centred environment will encourage the student more independent and the teacher enables to deal with all types of students effectively. One focus in the teaching and learning of mathematics in the 21st century is to have an effective lesson that engages students actively in the classroom (Anthony & Walshaw, 2009). In order to develop an effective mathematics lesson, pre-service mathematics teachers need to have adequate pedagogical knowledge for teaching mathematics.

Teaching and learning are inextricably and elaborately linked. Good mathematics teaching involves continuously trying to learn about students' understanding and the effects of teaching on it. Noraini (2006), based on a survey conducted between 1995 and 1996 of pre-service teachers' view of mathematics, concluded that this group of pre-service teachers possessed a formal view of mathematics. They viewed mathematics as being abstract and static and involved the manipulation of symbols according to rules. As such, mathematics can only be understood by a small portion of student population.

Reports from Hong Kong, Lucas (2000) and Japan, Kinoshita (2000) have shown that students rely on rote learning in mathematics, and concerns have been expressed about the need to implement changes in teaching methods in both of these countries.

In Western countries, it is generally believed that such rote learning and memorization do not enhance mathematical understanding. Noor Shah and Sazelli, (2010) indicated that some of the students learn algebra through memorising all the rules and manipulating symbols but do not really understand how some algebraic techniques work. As an example, $(x + y)^2 = x^2 + y^2$; $a + b/a = b$ and $x^2 + y^2 = x + y$ seem to be reasonable statements to some of the students, although mathematically untrue. Lim and Chan (1993) describe that the learning style in Malaysia classroom, where drills, attention to content and not the process of learning, emphasis on examinations, technical questions and proofs rather than applications, and learning by memorization are all same features. As a result, the novice teachers are not well prepared in teaching (P. S. C. Goh, 2013).

On top of that, a framework on teaching in Mathematics for Teacher Education Programme in Malaysia is needed to guide higher education institutions, professional organization of mathematics teachers and school administrators in assessing and improving the performance and career development of mathematics teachers based on a set of standards. The Teaching Framework is designed to support teachers in the delivery of high quality teaching and learning practices which ultimately aim to improve the students' ability to learn and understand the material that they are being taught.

Other countries, especially the developed ones, have a well-established teaching and learning framework or standard in mathematics to guide the teacher development centers to produce highest quality and standard of pre-service teacher and meet the needs of stakeholders in education. Hence, a framework of teaching and learning in mathematics for Teacher Education Programme is needed to assist teacher educators to prepare their student to teach.

One of the teaching and learning framework that may guide the development of a framework on teaching and learning for mathematics teacher education programme in Malaysia is the Cox's discipline-specific professional development framework. In Cox (2004) framework, he proposes four areas that mathematics teachers in higher education should develop basic knowledge and skill of curriculum design, delivery method and assessment, practical skills in managing the teaching process, deeper understanding of the underlying principles and theories of teaching and learning and attitudes, self-awareness and self-development in relation to the teaching and learning process and interaction with students.

Framework for Philippine Mathematics Teacher Education by Philippine Council of Mathematics Teacher Education and Science Education Institute (MATHTED & SEI, 2011) emphasises five components for developing highly component

mathematics teacher namely mathematics content knowledge, mathematics pedagogical knowledge, general pedagogical knowledge, classroom management skills, mathematical disposition and professional development. This framework explained about the attributes of effective mathematics teachers in term of what they need to know (content knowledge), what they should do to achieve quality learning outcomes (pedagogical knowledge) and what they should possess to be able to manage the different aspects of the teaching and learning process (management skills). All these are based on the objective of improving the quality of mathematics education.

Mathematics Framework Singapore by National Institute of Education (2007) emphasizes understanding of concepts, skill proficiencies and thinking skills in the teaching and learning of mathematics. These components are essential to the development of ability to solve mathematical problem. Emphasis is also given to reasoning, applications, and use of technology. Advances in technology have changed the way they teach and learn mathematics. There are four interrelated components namely the concepts and skills (which are foundational), proficiency in processes, metacognition (monitoring one's own thinking), and attitudes toward mathematics, which address the affective domain.

In addition, there are a variety of mathematics teaching standards enacted abroad. For example, in Australia known as "Standard for Excellent in Teaching Mathematics in Australian School" (Australian Association of Mathematics Teacher, 2006). This standard provides guidance on the qualities needed to be an effective teacher, how to carry out their duties and responsibilities as well as the philosophy of self-regarding teaching and learning mathematics in the classroom.

National Council of Teachers of Mathematics (1991, 2000) also introduced a standard for the teaching of mathematics in the United States through the "The Professional Standards for Teachers Mathematics". National Council of Teaching of Mathematics (NCTM, 1991) that suggest about the role of teachers and students in the teaching and learning of mathematics in classroom, the teaching and learning of mathematics is designed to enable students to understand the subject being studied. More specifically, the NCTM proposal was intended to give guidance on how teaching and learning should be practiced in classrooms across the United States. It also clarified two standard types of content standards for specific titles and standard mathematical process involving pedagogy and teaching methods. This was described by the statement, "*Teachers need to know and use mathematics for teaching that combines mathematical knowledge and pedagogical knowledge*" (NCTM, 2000, p. 370). There are six standards for the teaching of mathematics; i) Standard 1: The

learning environment, ii) Standard 2: Meaningful mathematical discourse, iii) Standard 3: Tools to improve the discourse or teaching, iv) Standard 4: The role of the teacher during lessons (discourse), v) Standard 5: The role of student during lessons, and vi) Standard 6: Analysis of teaching and learning.

Standards for Excellence in Teaching and Learning of Mathematics (SET@MATHS) was developed by Noor Shah, Nor'ain, Zulkifley, Muzirah and Lim (2009), SET@MATH refers to the quality of professional knowledge, professional attributes, professional practice and professional teaching and learning process that must be owned by mathematics teachers and be able to transform and implement this standard in teaching and learning process. The standards are intended to serve at least four major purposes which are i) Identify of component related to Malaysian mathematics teaching standards to be adapted, ii) as a framework for mathematics teachers in raising the quality of mathematics teaching in Malaysia, iii) indicator of teaching standard for mathematics teacher in Malaysia based on SET@MATHS and iv) theoretical knowledge and teaching and learning practices based on SET@MATHS to be adopted in mathematics teachers' training in all institutional related to mathematics education programme.

Psychology and Learning Theories in Mathematics Education

The effective mathematics teachers should not only have an excellent grasp of subject content but should also have the knowledge on how mathematics should be learned, theories of mathematical learning and instruction, instructional method and strategy and problem solving in mathematics. According to Norhayati, Aida Suraya, Rohani, Kamisah and Lilia (2006), a psychological approach can help teacher to expand their understanding of the student especially in teaching of mathematics. It offers an opportunity for teachers to systematically examine the actions of teachers to increase student achievement and achieve the goals of mathematics education. Mathematics teacher are known to adopt psychological approach in the implementation of teaching and learning of Mathematics in classroom. It is vital for Mathematics teachers to learn, understand and practice psychological theories in teaching of Mathematics as this knowledge enabling them to enhance their capabilities and skills to become a better teacher.

According to Asri (2005) and Noor Shah and Sazelli (2010), David Ausubel is one of the pioneering cognitive educational psychologists and is also the first to put forward a model of learning which distinguishes meaningful learning from rote learning. Ausubel (1967) argued that the teaching and learning will be successful if teachers have a good knowledge to conduct the teaching in effective way. Gagne's

(1975) research findings on the learning phases sequence are thoroughly relevant in the teaching of mathematics. Gagne used mathematics as a medium to test and apply the learning theory that involved learning phases and types of learning. Gagne also listed mathematical learning objects that he deemed as fundamentals in his mathematics learning theory. He classified these objects as direct and indirect object. Indirect object capabilities such as the transfer of learning process, researching and problem solving, self-study, appreciation of the mathematical structure and a positive attitude towards mathematics competition and capability to learn. While the direct object is referring to facts, skills, concepts and principles.

In theory of learning process, Piaget (1971) stressed that there are two adaption processes that are inter-connected which are assimilation and accommodation. According to Noor Shah and Sazelli (2010), mathematics teachers should have adequate knowledge of Piaget's theory especially about student' mental readiness and their capability according to age and intellectual levels in preparing their respective teaching.

Dienes (1969), a psychologist, developed a system of mathematical instructions based on his experience and interest in mathematics as well as Piaget's learning psychology. The system was developed to make mathematics enjoyable and easy to

learn. According to Dienes (1969), mathematics is generally looked upon as something difficult and confusing unless dedicated teacher could turn the situation around by making the learning of mathematics to be fun, stimulating and easy to learn.

According to Bruner (1966), there is different between a learning theory or an intellectual development theory and instructional theory. A learning theory is said to be descriptive while an instructional theory is regarded as prescriptive. Bruner stated that in mathematical theory that learning can be successful if the learning process is directed to the concepts and structures involved in the discussion of the topic, in addition to the relationship between the concepts and structures concerned. Brownell (2007) argued that while learning mathematics should be a meaningful and understanding. It is also emphasis that the fact that learning is a meaningful process (Elliot, 2000; Hill, 1990; Turmudi, 2001).

Learning theories have shifted from the emphasis on the traditional behaviourists theories to constructivist theories which pay emphasis to generating and disseminating knowledge and not just the acquisition of information which is often passed off as knowledge (Nagendralingan et al., 2014). Constructivism can be described as a learning process that explain how knowledge is acquired and structured in the mind of

an individual. From the constructivist perspective, students are actively involved in the construction of their own knowledge rather than passively receiving knowledge (Bruning, Schraw, Norby, & Ronning, 2004).

According to Nik Aziz (1999) the teaching and learning of mathematics using the constructivist approach involves three stages: active experiential learning, reflection and abstraction. Student would acquire active experiential learning by carrying out a series of action in an activity. Reflection is a mental process that monitors the various operations that occur while carrying out the actions. Abstraction involves expressing concepts, facts or algorithms that are represented by these actions into mathematical forms. Comprehending the theories of how humans learn and the ability to apply these theories in teaching of mathematics is an important prerequisite for an effective mathematics teaching.

1.3 Statement of Problem

The quality of teacher is the significant school-based issue in order to determinine student's outcomes. The formulation of the Malaysia Education Blueprint (2013) aspires to ensure not only quality teachers are produced but to ensure that these quality teachers remain in the Malaysia education system and maintain their teaching

quality throughout their service. The question is, is there any guidelines need to be followed by mathematics teachers to teach mathematics effectively in Malaysia? Which party will be responsible for determining guidelines for the teaching of mathematics?

A study about the scientific reasoning skills (SRS) level of science, mathematics and engineering among students in Malaysian Public Higher Education Institutions showed that their level is at the Concrete Operational (Tajudin et al., 2012). Concrete Operational is the lowest stage in the SRS scheme score by Grasha, 1996. It was suggested that these students need modification in teaching and learning styles to increase the level of SRS. Pre-service teachers in Malaysia are also reported lack of skills either in work or teach in their practical teaching in schools (Goh & Matthews, 2011).

Mathematics teacher's quality is found mainly focus on six individual teacher characteristics: general ability, subject matter knowledge, pedagogical knowledge, teacher behaviors, experience, certification status, practices and beliefs (Darling-Hammond, 2000; Wayne & Youngs, 2003; Zeichner & Cochran-Smith, 2005). However, the report of the Teacher Education Study in Mathematics, TEDS-M results indicated that Malaysian pre-service mathematics teachers at both the primary

and secondary level have low mathematics content knowledge (Leong, Chew & Suzieleez, 2015). Similarly, the pre service teachers also have lower score than the international average in pedagogical content knowledge. This is worrying as these are the future teachers who would be teaching in Malaysian schools in the near future steps have to be taken by the education authorities to address this problem because schools need teachers with strong content knowledge and pedagogical content knowledge to deliver effective mathematics lessons (Leong, Chew & Suzieleez Syrene, 2015).

With that, the research study by Higher Education Leadership Academy (AKEPT) found that, 12% of teachers showed good quality in teaching practices, 38% at satisfactory standard and 50% or half of Malaysia teachers failed to deliver their lessons effectively and efficiently (Malaysia Education Blueprint, 2013). As a result, the classes did not sufficiently involve students, followed a more inactive and lecture format of content delivery. The lessons only focused on reaching a surface-level content understanding, instead of focusing on higher-order thinking approaches. This statistic is mostly challenging because an estimated 60% of today's teachers will continue to teach in 20 years time (Malaysia Education Blueprint, 2013).

Further, the analysis of the School Inspectorate and Quality Assurance 2012 report shows that the quality of mathematics teaching is declining (SEAMEO RECSAM, 2016a). Teachers teach for procedural understanding rather than conceptual understanding. Less effort has been done in mathematics teaching to absorb such thinking skills in teaching and learning mathematics.

Some people see the failure in mathematics as resulting of poor teaching approaches of the teacher (Beauchamp & Parkinson, 2008). Indirectly, Malaysia students recorded an average score of 446 in mathematics for Programme for International Student Assessment (PISA) 2015, an improvement from the 421 they scored in the PISA 2012, but still below the 490-mean score for Organisation for Economic Co-operation and Development (OECD) countries (Malaysia Ministry of Education, 2016). Our students in age 15 failed to meet the minimum benchmarks in Mathematics, basic proficiency required for students to participate productively and efficiently in life.

On top of that, Malaysia Curriculum Development Division only provided mathematics curriculum and teaching guides for teaching mathematics to be adopted by teachers. Furthermore, the School Inspectorate and Quality Assurance (SIQA) has introduced a comprehensive guideline for school and teachers known as the Higher

Standard Quality of Education for Malaysian School (SKPM) which encompasses the whole input-process-output. SKPM work as a self-evaluation system that provides a framework for the evaluation of teaching mathematics. The school will match and rank themselves from par-excellent to extremely weak. However, the perceptions about the standard of quality teachers and teaching are not the same between the school and SIQA. Using this guideline, 63% of schools evaluate their own teaching and learning practices as good and excellent, whereas the evaluation made by inspectorate of schools (JNJK) showed only 13% of the teachers achieved that level (SEAMEO RECSAM, 2016a).

The Malaysian Teacher Standard (MTS) which consists of three main content standards: (1) Professional values within the teaching profession, (2) Knowledge and understanding of education, subject matter, curriculum and co-curriculum, and (3) Skills of teaching and learning. It was found that the MTS is not specific to mathematics subject (SEAMEO RECSAM, 2016a). Therefore, there is a critical need to identify the attributes and develop a teaching framework for pre-service mathematics teacher to ensure that appropriate and effective pedagogies are used in curriculum, with the aim to equip teachers with the teaching strategies needed for effective classroom instruction.

1.4 Objectives of The Study

The main objective of the study is develop a teaching framework for pre-service mathematics teachers. Specifically, the objectives of this study are:

(1) To evaluate the goodness of fit of teaching framework for mathematics (TF@Maths) constructs in confirmatory factor analysis (CFA).

(2) To examine convergent validity and construct reliability of TF@Maths constructs in CFA.

(3) To evaluate the goodness of fit of teaching framework for mathematics (TF@Maths) constructs in Pool confirmatory factor analysis (Pool-CFA).

(4) To examine discriminant validity and construct reliability of TF@Maths constructs in Pool-CFA.

(5) To determine whether mathematics content knowledge (MCK), mathematical pedagogical knowledge (MPK), general pedagogical knowledge (GPK), classroom management skills (CMS), and mathematical disposition (MDP) are significantly related to quality mathematics teacher (QMT).

(6) To develop a teaching framework for pre-service mathematics teachers.

1.5 Research Questions

This research is guided by the following overarching questions:

(1) Do the constructs of TF@Maths achieve the acceptable fit value in confirmatory factor analyses (CFA)?

(2) Do the constructs of the TF@Maths achieve the acceptable value convergent validity and reliability in confirmatory factor analyses (CFA)?

(3) Do the constructs of TF@Maths achieve the acceptable fit value in pool confirmatory factor analyses (Pool-CFA)?

(4) Do the constructs of the TF@Maths achieve the acceptable value discriminant validity and reliability in pool confirmatory factor analyses (Pool-CFA)?

(5) Do mathematical content knowledge (MCK), mathematical pedagogical knowledge (MPK), general pedagogical knowledge (GPK), classroom management skills (CMS), mathematical disposition (MDP) significantly related to quality mathematics teacher (QMT)?

(6) What is the teaching framework for pre-service mathematics teachers?

1.6 Hypothesis

Based on Research Question 5, the five research hypotheses are formulated as follows:

H1: Mathematics content knowledge is significantly related to quality mathematics teacher.

H2: Mathematical pedagogical knowledge is significantly related to quality mathematics teacher.

H3: General pedagogical knowledge is significantly related to quality mathematics teacher.

H4: Classroom management skills is significantly related to quality mathematics teacher.

H 5: Mathematical disposition is significantly related to quality mathematics teacher.

1.7 Conceptual Framework

The conceptual framework of the present study seeks to comprehend and clarify whether mathematics content knowledge (MCK), mathematical pedagogical knowledge (MPK), general pedagogical knowledge (GPK), classroom management skills (CMS), and mathematical disposition (MDP) are significantly related to quality

mathematics teacher (QMT). MCK, MPK, GPK, CMS and MDP function as Independent Variables (IVs) while QMT functions as Dependent Variable (DV) in this study.

Basically, the study was constricted to six latent variables and 119 of their respective indicators are chosen to estimate the variables as shown below:

(a) Latent construct 1: Mathematics Content Knowledge (MCK) which is measured by 18 indicators.

(b) Latent construct 2: Mathematical Pedagogical Knowledge (MPK) which is measured by 33 indicators.

(c) Latent construct 3: General Pedagogical Knowledge (GPK) which is measured by 15 indicators.

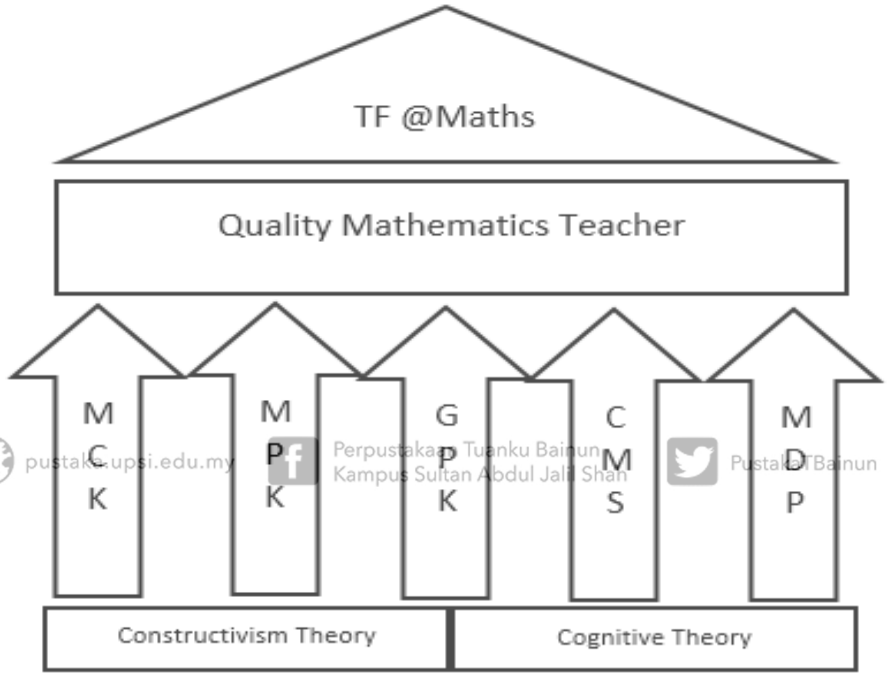
(d) Latent construct 4: Classroom Management Skills (CMS) which is measured by 24 indicators.

(e) Latent construct 5: Mathematical Disposition (MDP) which is measured by 20 indicators.

(f) Latent construct 6: Quality Mathematics Teacher (QMT) which is measured by 9 indicators.

The conceptual framework TF@MATHS shows that, there are five attributes of mathematics teacher's quality: (1) mathematics content knowledge, (2) mathematical

pedagogical knowledge, (3) general pedagogical knowledge, (4) classroom management skills, and (5) mathematical disposition. Moreover, the TF@MATHS is constructed based on cognitive theory and constructivism theory.



Note: MCK= mathematics content knowledge; MPK= mathematical pedagogical knowledge; GPK= general pedagogical knowledge; CMS= classroom management skills; MDP= mathematical disposition; TF@Maths= Teaching Framework for Pre-service Mathematics Teachers

Figure 1.1. The Proposed Conceptual Framework of the Study

1.8 Significance of The Study

Excellence in teaching mathematics is the desired goal for our future teachers. This study is intended for university lecturer of mathematics education and educational leaders who care about how our teachers grow and develop as one of the most important citizens of our country in the next decades. The focus of this study has the potential to provide a thorough understanding of teaching and learning experiences for prospective teachers from their own perspectives as learners. This has important implication for the search for way to improve the quality of their teaching and learning in mathematics.

This study may identify possible strategies and support structures that could be adopted more generally in order to promote more effective mathematics teaching and learning environment. The finding of this research may also help reveal issues in the education training programme relating to approaches to teaching and learning that are faced by pre-service teachers and which prevent them from successfully adopting an interactive approach.

This study will hopefully help teacher education institutions; university mathematics professors and school administrators assess and improve the performance of mathematics teachers. The qualities of effective mathematics teachers

in terms of what they need to know (knowledge), what they are expected to do to achieve quality learning outcomes (practice) and what they should possess to be able to embrace change and sustain professional growth (attributes) are also included. All these are anchored on the objective of improving the quality of mathematics education.

Moreover, it will help policy makers and curriculum developers to comprehend the teachers' and learners' challenges where teaching and learning are concerned and to provide benchmarks for relevant Malaysian educational divisions in formulating policies to improve and develop the quality of mathematics teachers.

This study will shed some light on stakeholders including students, teachers, administrators and parents as teaching and learning mathematics will be the yardstick which provided accurate information about the achievement of student's learning and also contribute some positive impact on teacher and student learning. It is hoped that this framework will be widely used and applied by the multiple stakeholders, and that together we will work towards achieving the desired goal of effective mathematics teaching among the teachers.

1.9 Limitations of the Study

A limitation of this study is that participants were completed an instrument on a voluntary basis. The participants self-reported their answers meaning that interpretations of various items may have varied among participants and the previous experiences may influence their participation and their responses to some items. Moreover, the participants of this study are only limited to the mathematics pre-service teachers representing from public university and institution of teacher education.

1.10 Operational Definitions

Teacher Education Programme is defined as an accredited programme that is related to the development of teacher quality in terms of proficiency and competency that would empower the teacher to meet the requirements of the profession. Teacher education programmes is an essential course that is well arranged and designed for a certain period to achieve the learning outcomes stated in the ideal purposes (Casey & Childs, 2017). In this study, teacher education programme is a programme that train mathematics pre-service teacher at Faculty of Education and Faculty of Science and Mathematics at public local universities and Institution of Teacher Education as an authorized organization to train teachers in Malaysia..

Pre-service Teacher is a trainee teacher throughout a teacher education programmes in colleges or university (Zheng, 2009). In this study, pre-service teacher is a student who undergo mathematics teacher education programme from selected Institution of Teacher Education (ITE) and Public Institution of Higher Education (PIHE) in Malaysia.

Teaching Framework is designed to support teachers in the delivery of high quality teaching practices which eventually aim to improve the students' ability to learn and understand the material that they are being taught (Duit & Treagust, 2003). In the context of this study, mathematics teaching framework provide specific information about the attributes in term of mathematics content knowledge, mathematical pedagogical knowledge, general pedagogical knowledge, classroom management skills and mathematical disposition that needed for every mathematics pre-service teacher.

Mathematics Content Knowledge refers to the knowledge of mathematics, about mathematics, and how to do mathematics (Onno & Lilia, 2009). In this study, mathematics content knowledge is defined as Mathematics teachers' knowledge of, understanding of and competencies in the contents of mathematics.

Mathematical Pedagogical Knowledge refer to the manner in which a subject content is to be presented effectively by using appropriate strategies and thories

(Onno & Lilia, 2009). In this study, mathematical pedagogical knowledge is defined as mathematics teachers' understanding and use of teaching approaches, learning theories and modalities particular to mathematics.

General Pedagogical Knowledge refer to knowledge of students, general theories, general teaching strategies, and general educational aims and strategies (Onno & Lilia, 2009). In this study general pedagogical knowledge is defined as Mathematics teachers' understanding and use of teaching approaches, learning theories and modalities in general contexts and environment.

Classroom Management Skills refer to the knowledge of organizing the physical set-up, providing alternative modalities and modes for learning and the use of equipment, tools, kits, gadgets and facilities needed to effectively teach mathematicsis (MATHTED & SEI, 2011). In this study, classroom management skills defined as Mathematics teachers' approaches in providing for the favourable environment for student learning.

Mathematical Disposition refer to the mathematics teachers' ability to make decisions for themselves that would impact on students' learning and on their own professional development (MATHTED & SEI, 2011). In this study, mathematical diposition is defined as teachers' belief and attitude, their inclination to use mathematics and their willingness to reach out to others.

Quality Mathematics Teacher is operationalised as a construct that related to student or teacher outcome measures (Bolyard & Moyer-Packenham, 2008). In this study, quality mathematics teacher is defined as a continuous process of self-renewal where mathematics teachers work to impact and improve the quality of their teaching.

1.11 Summary

This chapter briefly explain the situation that warrants a research on the challenge for teaching mathematics nowadays and the lacking on literature on the teaching framework in Malaysia. This chapter also outline the questions that set out the problem to be addressed in this research, the research objectives to pursue, the conceptual framework of the study and the definition of the constructs of this research. The next chapter offers discussion of the existing literature and detailed explanation of the underpinning theories and research framework.

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