UNIVERSITI PUTRA MALAYSIA

IMPLEMENTATION OF SECONDARY SCHOOL MATHEMATICS CURRICULUM BY TEACHERS IN TWO MALAYSIAN SCHOOL

ABDOLREZA LESSANI

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By

ABDOLREZA LESSANI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

February 2015

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DEDICATION

Dedicated to
All science and education scholars who serve human being with knowledge
To my family
To all who aided me to accomplish my research journey

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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Chairman : Professor Aida Suraya Bt. Md. Yunus, Ph.D.
Faculty : Educational Studies

The aim of this study was to investigate the implementation of the components of the mathematics curriculum of two secondary schools in Malaysia. The objectives of this study were to investigate: i) teachers' perceptions of the National Philosophy of Education; ii) teaching and assessment practices in 8th grade (Form 2) mathematics classrooms; and iii) contents of mathematics textbook in 8th grade (Form 2) in Malaysia, and compare with the contents of 8th grade (Secondary 2) mathematics textbooks in Singapore. This research was a qualitative case study. Two public secondary schools located in Serdang and Putrajaya were selected in the states of Selangor and the Federal Territory, respectively. The participants of this study were seven teachers of mathematics with at least three years of teaching experiences in 8th grade (Form 2), who were selected using the snowball sampling method.

Data was collected using qualitative methods of interview, observation and document analysis in order to triangulate the data and ensure its validity. The interviews were conducted using a set of structured interview questions supplemented by video tape recordings and field notes. To establish quality of research findings, measures of credibility and trustworthiness were strictly observed by the researcher. The data from the interviews and observations were categorized, coded, and grouped into themes based on qualitative analysis methods. Document analysis was performed to investigate the contents of mathematics textbook and Ministry of Education documents in Malaysia and

Singapore, which was chosen as a source of comparison due to Singapore's high ranking in Trends in International Mathematics and Science Study (TIMSS) results.

The findings of the study showed that the teachers had moderate knowledge and understanding of the Malaysian National Philosophy of Education (NPE) and the aims and objectives of mathematics education. The overall results of the interviews and observations showed that the teachers partially followed the approaches in teaching mathematics as suggested by the Ministry of Education in Malaysia. Regarding the development of lesson plans and teaching based on the plans, almost all of the teachers used and followed lesson plans for their classes. The content of the textbooks in Malaysia (Form 2) and Singapore (Secondary 2) were analyzed and compared. The mathematics books were compared based on the four content domains of TIMSS which are Numbers, Algebra, Geometry and Data and Chance, and three cognitive domains which are knowing, applying, and reasoning. Overall, the result of this study revealed that the participants emphasized the importance of morality and belief in God among their students.

The study also explored on the philosophy of education in Malaysia that aims to prepare students as balanced and harmonious individuals with a strong belief in God. Meanwhile, the aim of Singapore education is preparing students with the talent for the future of the country. The analysis of mathematics teachers' assessment practices in this study showed the necessity of providing the teachers with more professional development and in-service training by the Ministry of Education (MOE) to improve their knowledge and skills in effective teaching and assessment practices, as well as applying new teaching methods, to improve the students' achievements and the teachers' teaching practices.

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

PELAKSANAAN KURIKULUM MATEMATIK SEKOLAH MENENGAH DALAM OLEH GURU DUA SEKOLAH DI MALAYSIA

Oleh

ABDOLREZA LESSANI

Februari 2015

Pengerusi: Profesor Aida Suraya Bt. Md. Yunus, Ph.D
Fakulti: Pengajian Pendidikan

Tujuan penyelidikan ini adalah untuk mengkaji pelaksanaan komponen kurikulum matematik sekolah menengah di Malaysia. Objektif kajian ini adalah untuk mengkaji: i) persepsi guru tentang Falsafah Pendidikan Kebangsaan di Malaysia; ii) amalan pengajaran dan pentaksiran dalam bilik darjah matematik gred 8 (Tingkatan 2); dan iii) kandungan buku teks matematik gred 8 (Tingkatan 2) di Malaysia dan membandingkan dengan kandungan buku teks Matematik gred 8 (*Secondary 2*) di Singapura. Penyelidikan ini berbentuk kajian kes kualitatif. Dua buah sekolah menengah kerajaan di Serdang dan Putrajaya telah dipilih masing-masing dari Selangor dan Wilayah Persekutuan. Peserta kajian adalah tujuh orang guru matematik dengan sekurang-kurangnya tiga tahun pengalaman mengajar gred 8 (Tingkatan 2), dan pemilihan dibuat menggunakan kaedah persampelan *snowball*.

Data dikumpul dengan menggunakan kaedah kualitatif iaitu temu bual, pemerhatian dan analisis dokumen bagi tujuan triangulasi data dan memastikan kesahihannya. Temu bual dijalankan dengan menggunakan satu set soalan temu bual berstruktur ditambah dengan rakaman pita video dan nota lapangan. Untuk mewujudkan hasil penyelidikan yang berkualiti, langkah-langkah yang memastikan kredibiliti dan kebolehpercayaan telah dipatuhi oleh pengkaji. Data daripada temu bual dan pemerhatian dikodkan dan dikategorikan mengikut tema berdasarkan kaedah analisis kualitatif. Analisis dokumen telah dijalankan untuk mengkaji kandungan buku teks matematik dan dokumen Kementerian Pendidikan di Malaysia dan Singapura, yang

telah dipilih sebagai sumber perbandingan kerana kedudukan Singapura yang tinggi dalam *Trends in International Mathematics and Science Study* (TIMSS).

Dapatan kajian ini menunjukkan bahawa guru mempunyai pengetahuan dan pemahaman yang sederhana tentang Falsafah Pendidikan Kebangsaan (FPK) Malaysia, matlamat dan objektif pendidikan matematik. Keputusan keseluruhan temu bual dan pemerhatian menunjukkan bahawa guru hanya mengikuti sebahagian pendekatan pengajaran matematik seperti yang dicadangkan oleh Kementerian Pendidikan Malaysia. Tentang perkembangan rancangan pelajaran dan pengajaran berdasarkan rancangan, hampir kesemua guru yang ditemubual mengikuti rancangan pengajaran untuk kelas mereka. Kandungan buku teks di Malaysia (Tingkatan 2) dan Singapura (*Secondary 2*) telah dianalisis dan dibandingkan. Buku teks matematik dibandingkan berdasarkan kepada empat domain kandungan TIMSS iaitu Nombor, Algebra, Geometri dan Data dan Kebarangkalian, dan tiga domain kognitif iaitu pengetahuan, aplikasi dan penaakulan. Secara keseluruhan, analisis menunjukkan bahawa peserta kajian menekankan kepentingan moral dan kepercayaan kepada Tuhan dalam kalangan pelajar mereka.

Kajian ini juga meneroka tentang falsafah pendidikan di Malaysia yang bertujuan untuk membentuk pelajar menjadi individu yang seimbang dan harmonis dengan kepercayaan yang kukuh kepada Tuhan. Manakala, matlamat pendidikan Singapura pula adalah untuk menyediakan bakat untuk masa depan negara. Analisis amalan pentaksiran guru matematik dalam kajian ini menunjukkan keperluan untuk menyediakan guru dengan lebih banyak latihan pembangunan profesional dan latihan dalam perkhidmatan oleh Kementerian Pendidikan (KP) untuk meningkatkan pengetahuan dan kemahiran mereka dalam menggunakan amalan pengajaran dan pentaksiran yang berkesan, serta menggunakan kaedah pengajaran baharu untuk meningkatkan pencapaian pelajar dan amalan pengajaran guru.

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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. Members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

CA	Continual Assessment
CDC	Curriculum Development Centre
FIMS	First International Mathematics Study
GCE	General Certificate of Education
GSCA	Index of Good School and Class Attendance
ICT	Information Communication Technology
IEA	International Association for the Evaluation of Educational Achievement
MES	Ministry of Education of Singapore
MICSSM	Malaysian Integrated Curriculum for Secondary School Mathematics
MOE	Ministry of Education of Malaysia
NCTM	National Council of Teachers of Mathematics
NMC1	New Mathematics Counts 1
NMC2	New Mathematics Counts 2
NPE	National Philosophy of Education
NSM1	New Syllabus Mathematics 1
NSM2	New Syllabus Mathematics 2
PMR	Primary School Assessment Test
PSLE	Primary School Leaving Examination
SA	Semester Assessment
SIMS	Second International Mathematics Study
SPM	Malaysian Certificate of Education Examination
STPM	Malaysian Higher Education Examination
TIMSS	Trends in International Mathematics and Science Study
UPSR	Primary School Assessment Test

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Mathematics education has always been considered as an important component of general education and specifically science education. The National Academy of Science, the National Academy of Engineers, and the Institute for Medicine confirmed that mathematics is crucial to the success of students in the current information economy (National Research Council, 2005).

Mathematics became the driving force for almost all technological and scientific developments in the 19th and 20th centuries. Scientific and mathematical models and their transformation into technology had significant influences on natural, economies, and social sciences. They also had large impact on all activities in the professional, social and daily life (Maasz & Schloeglmann, 2006).

Technology and science play fundamental roles in realizing the aspiration of Malaysia to become a developed nation. Since mathematics influences the growth of technological and scientific knowledge, providing outstanding mathematics education starting from an early age is essential in Malaysia (Curriculum Development Centre (CDC), 2006). An (2000) believes that there are some reasons for the growth of mathematics among countries. She asserted on the importance of mathematics.

> *"First, in every country, mathematics is an important part of the curriculum, usually considered the second most important subject after the native language. Second, there are many similarities in the content of mathematics curriculum among countries, and third, the language of mathematics is truly universal" (p.1).*

Due to the universal importance of mathematics education, countries are very keen on comparing their practices and achievements to those of other countries. Guangzhong (1996) stated that since the 1960s, concern on cross-national comparative studies in education has increased following the first TIMSS evaluation. Since mathematics has substantial

roles in the secondary school curriculum of all countries, and because its symbolism and notation system are "recognized world-wide", it has "attracted the most attention in those international studies compared with other areas of curricula" (p. 29). However, other researchers have emphasized the significance of developing a promising curriculum.

In order to evaluate students' performance and to develop policies to improve their achievements in science and mathematics at different levels of education, it is relevant to compare their knowledge and competencies in a specific area with students of the other countries. One such evaluation is conducted by the International Association for the Evaluation of Educational Achievement (IEA) through Trends in International Mathematics and Science Study (TIMSS). The achievements, improvements, and success or failure in the international mathematics education is being reported in the TIMSS, conducted by IEA (Gonzales, Guzman & Jocelyn, 2004).

1.1.1 Curriculum

Curriculum is considered as one of the major and significant tools which could be used in introducing fundamental changes in high schools today. Schools, classrooms, students, society and parents consider curriculum as the main force to shape students' expectation, identity, and life-long path. According to McNeil (2006), therefore, it should come as no surprise that there is interest in how one should improve and control the curriculum, since what is learned strongly impacts both the lives of students and the society in general. McNeil (2006) reminded that curriculum is a framework which must provide each student with beneficial experiences and contributes to individuals' liberation and development. The features that characterize such a curriculum are the way their goals and purposes are determined; the way it provides optimum learning opportunities, and the way it is organized for effective learning. Such a curriculum should provide the learners with the ideals of personal growth, integrity, and autonomy. Marsh (2004) also believes that curriculum framework can provide a significant attention for teachers regarding the planning of curriculum. He had provided a definition of curriculum framework. He asserted that:

> *"A 'curriculum framework' can be defined as a group of related subjects or themes, which fit together according to a predetermined set of criteria to appropriately cover an area of*

study. Each curriculum framework has the potential to provide a structure for designing subjects and a rationale and policy context for subsequent curriculum development of these subjects" (p.19).

Marsh (2004) further elaborated that curriculum framework is a developed set of guidelines which are intended to provide educators with a permanent assist with educational decision-makings. He stated that a typical curriculum framework consists of the following sections:

i. a rationale or platform;
ii. scope and parameters of the curriculum area;
iii. broad goals and purposes of subjects within the curriculum area;
iv. guidelines for course design;
v. content;
vi. teaching and learning principles;
vii. guidelines for evaluation of subjects;
viii. criteria for accreditation and certification of subjects;
ix. future developments for the area (p. 18).

Contemporary curriculum in thought and action, designs practical instruments for performing the curriculum at all levels: institutional, policy making, and classroom (McNeil, 2006). There are five principles being studied in curriculum: (i) development; (ii) design; (iii) aims, goals, and objectives; (iv) implementation; and (v) evaluation (Ornstein & Hunkins, 2004). One of the key elements in curriculum is curriculum implementation. A curriculum with the finest plan for students cannot have an impact on students' learning unless it is effectively implemented through the school system. Implementation is the actual use and practice of the curriculum, a complex process that may differ from one school to another (Marsh, 2004; Ornstein & Hunkins, 2004).

1.1.2 Philosophy of Education

An (2000) stated that one of the fundamental components of a curriculum is the philosophy upon which the curriculum is stabilized. Philosophy can help curriculum leaders specify purposes in education, clarify objectives and learning activities in schools, define the roles that school members can play in facilitating students' learning and guide the selection of teaching and learning strategies and methods in the

classroom.

It is believed that a philosophy is essential to any meaningful development effort. Diverse societies and cultures have various philosophies concerning education, specifically with respect to the learning and teaching of mathematics as illustrated in their curriculum. This variety of values and believes regarding mathematics curriculum ends in different mathematics educational systems. The philosophy of education specifies the purposes, processes, ideals and basis of education. According to Peterson (2005) the philosophy of education deals with how children need to be educated, what the children ought to be educated in, and what the final goal of education is supposed to be for the society. Noddings (2007, p.1) mentioned that "the philosophers of education are interested in analyzing and clarifying concepts and questions central to education". Philosophy of education is considered as the philosophical study of education and its problem.

A philosopher of education raises questions such as the following (Nodding, 2007):

i. What should be the aim of education?
ii. What role should the state have in education?
iii. Who should be educated?
iv. Why should the answers of questions be ignored?
v. In case we are not able to answer certain questions, why ask them?

1.1.3 The National Philosophy of Education in Malaysia

The philosophy of education refers to the Malaysian National Philosophy of Education (NPE) which states that "Education in Malaysia is an ongoing effort towards developing the potential of individuals in a holistic and integrated manner, so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious based on a firm belief in God, and are able to contribute to the harmony and betterment of the family, society, and the nation at large" (Curriculum Development Centre, 2006, p.vi).

1.1.4 Philosophy of Mathematics Education

Philosophy is a study of problems which are very general, abstract, and

ultimate. These problems are related to the nature of morality, knowledge, existence, reason and human goal (Teichman & Evans, 1999). Some of the problems discussed in philosophy are about existence, universe, human, life, death, and soul which have been topics of philosophical discussions at least for two thousand years.

According to An (2000), in order for defining the philosophy of mathematics education, the subsequent questions ought to be answered:

i. What is mathematics?
ii. What should be the purpose of mathematics education?
iii. Who should be taught mathematics?
iv. How do we teach mathematics?
v. Do we listen to the voice of students about learning mathematics? (p. 6)

A philosophy of mathematics education has at its core a set of aims and purposes for mathematics education, a theory of mathematical learning, and a theory of teaching, which implements the learning theory within the stated aims (Wilding-Martin, 2009). The following questions can only be addressed by reflecting upon the philosophy of education:

i. What are the aims of teaching and learning of mathematics?
ii. Do students need all the mathematics we are teaching them?
iii. What is the status of mathematics education as knowledge of field?
iv. How do philosophers of mathematics education link with mathematics learning and teaching?

Figure 1.1 depicts the relationship between philosophy, philosophy of education, and philosophy of mathematics.

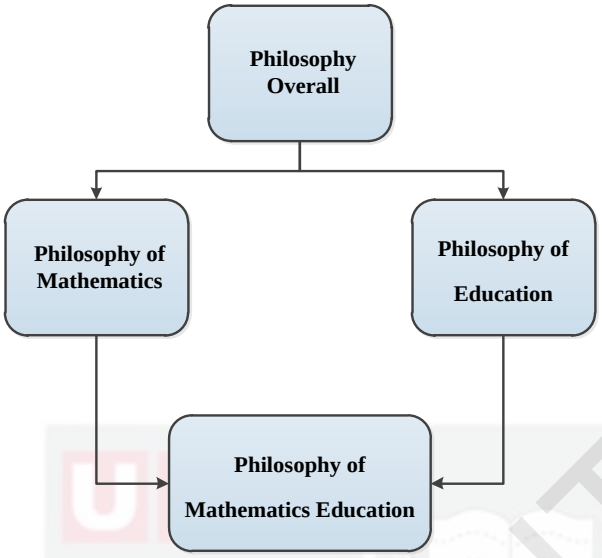

Figure 1.1 Relationship between Philosophy, Philosophy of Education, and Philosophy of Mathematics
(Source: Brown, 1995)

1.1.5 Teaching Practice (Learning Theories)

To be aware of teaching practice activities done by teachers, we should have enough knowledge about learning theories and teaching methods. Thus, a brief review of theories of learning will be presented in this section. Different learning theories and teaching methods have been used in educational systems all over the world. As a continuous effort, more are being developed as a subsequent of the technology advancements and in pursuing the most effective results.

Behaviourist theory defines learning as a change in behaviour due to experience (Ormord, 1995). In a mathematics class, using behaviourist theory, the teacher reviews previous material and homework, and then demonstrates low-level problem solving followed by seatwork imitating the teacher's demonstration (Stonewater, 2005). This pedagogical approach of placing the primary focus on the teacher as a transmitter of knowledge (that is, teaching by telling) is representative of behaviourist theory (Hackman, 2004). The common method of teaching mathematics using behaviourists' theory is a teacher-centered and giving lecture is the dominant situation. Teachers who favor behaviourist theory demonstrate

behaviours such as looking for students' pattern in mathematics problem solving.

Cognitive theory focuses on the conceptualization of students' learning processes and addresses the issues of how information is received, organized, stored and retrieved by the mind (Ertmer and Newby, 2013). Cognitive theory suggests that learning emphasizes on what students know and how they obtain it (Ormord, 1995). On the same note, Ormord (1995) also mentioned that when too much information is presented too fast, students simply cannot store it all in their long term memory. He further stated that spreading study time over several occasions usually leads to better learning than massed practice.

Constructivist theory asserts that learning is a change in mental association due to experience (Ormord, 1995). Mathematics teachers following a constructivist approach may favor extending class time to engage in varied activities associated with the discovery and construction of knowledge. In principle, the application of constructivist theory yields an enriched environment by engaging the students in the construction of knowledge. In a mathematics class based upon constructivist principles, students will participate in knowledge construction and real world problem solving rather than focusing on mathematical abstractions. Constructivist theory and its application in mathematics instruction provide the basis for hypothesizing that longer class session may lead to more desirable student outcomes.

1.1.6 Assessment

In addition, teaching practice involves the issue of evaluation. Assessment consists essentially of taking a sample of what the students do, making inferences and estimating the worth of their action. National Forum on Assessment (2007) suggested that assessment is required to be integrated with instruction and curriculum. Well qualified assessment needs to focus on strong educational principles. These principles include organizing schools to achieve the learning needs of all their students, understanding how students learn, specifying high standards for student learning, and providing logical and enough opportunities to learn. For the purpose of this study, assessment will be viewed from two dimensions; from the type of assessments of students by teachers used in the class, and from the types of assessments Ministry of Education uses for evaluating students.

1.1.7 Resources and Materials

Another aspect for assisting teachers in implementing the methods in classroom is the educational resources and materials. The materials may be the focal point that keeps students' attention in the classroom. These can include text books, work books, visual pictures, video tapes, charts, multimedia (such as CDs, software, and courseware), and many other instruments that are related to the process of delivering curriculum intentions and expectations. These educational materials help students and teachers to progress in their learning and teaching. They are instruments or tools that teachers use in order to deliver the curriculum contents. On this matter, Kissane (2000) asserts that the use of technology is considered as a vital skill in the current school mathematics teaching. These skills can include very complicated abilities such as working with powerful computer software, such as Mathematica, Maple, and Math Lab or simple skills like the use of paper and pencil. In recent times, utilizing hand-held technologies like graphic calculators are promoted in the learning and teaching of mathematics by the mathematics reform. Utilizing graphic calculators is associated with its ease of use and access in terms of cost and availability (Kissane, 2000). According to Jones (2003), a graphic calculator is actually a mathematics computer that is able to draw and analyze graphs, computes the expressions' values, can be used to solve equations, do statistical analysis and also can maintain the information communication among devices.

1.1.8 Mathematics Textbook Content

The curriculum is much directed by the contents that have been outlined by the curriculum guides, as proposed by the Curriculum Development Centre (CDC). Contents that are included in a curriculum shape students' learning. In Malaysia, the school mathematics textbooks reflect the curriculum document (Curriculum Development Centre 2004) very closely. Begg, Erickson, MacGillivray, and Matis (2004) stated that curriculum developers and teachers functioning at all levels are involved in the content of textbook, which have frequently been explained in terms of what students ought to know. Conventionally, this has been planned in terms of conceptual, factual and operational knowledge, as well as procedural skills. In recent times, several mathematics curricula have been organized in terms of both doing and knowing, emphasizing on doing associated with large-scale issues and holistic approaches.

Accordingly, what students "do" may be regarded in terms of reasoning with uncertainty, communicating, problem-solving, and making connections.

1.1.9 Introducton to NCTM and TIMSS

According to research and writings in mathematics education, there are many factors for a teacher to be successful in his/her job including teachers' beliefs, knowledge of mathematics, having knowledge about teaching methods, lesson plan, and being aware of important institutes. For example, the National Council of Teachers of Mathematics (NCTM) in the United States (U.S.) and Canada, and the International Association for the Evaluation of Educational Achievement (IEA) that conducts the periodic Trends in Mathematics and Science Study (TIMSS). The above factors are attended for the roles teachers play in translating the curriculum contents into practice.

1.1.9.1 NCTM

NCTM was established in 1920 and has developed having almost 100,000 members all through Canada, the USA, and internationally and is also competent in establishing sound reasoning on the efficacy of teachers' implementation of the mathematics curriculum. NCTM offers six principles for school mathematics including 1) equity principle; 2) curriculum principle; 3) teaching principle; 4) learning principle; 5) assessment principle; and 6) technology principle.

1.1.9.2 TIMSS

Every nation has an elaborate system of schooling through which students acquire academic and social knowledge and skills to become competent members of their community. More nations today are starting to take international comparisons of students' achievements to assess their success in education (Mullis, Martin, Gonzales & Chrstowski, 2004; TIMSS 2003). Among the most recognized is the International Associations for the Evaluation of Educational Achievement (IEA) that has been conducting the First International Mathematics Study (FIMS). This institution has conducted a research investigating mathematics achievement in the final year of secondary school across 12 countries in the 1960s. Furthermore, in the 1980s, IEA undertook the Second International Mathematics Study (SIMS), in which 20 countries

participated. The later conducted the Third International Mathematics and Science Study (TIMSS) in 41 countries in 1995 (Kawanaka, 2000).

The first three assessments of mathematics education held by IEA were named as follows: FIMS (1960s), SIMS (1980s) and TIMSS (1995). After that, it has always been named Trends in International Mathematics and Science Study (TIMSS). TIMSS has six components including i) student assessments; ii) questionnaires; iii) curriculum analysis; iv) performance assessments; v) videotape classroom study and vi) case study.

Malaysia and TIMSS

In the first three international comparisons for mathematics education conducted by IEA, Malaysia did not participate, but Malaysia participated in the following TIMSS conducted in 1999 where 38 countries participated for education at 8^{th} grade. In the fourth TIMSS, Singapore ranked the first and Malaysia was at the 16^{th} place (Gonzales et al., 2004) as presented in (Table 1.1). The underlying basis for comparison in this study is the Malaysian students' achievements in mathematics as shown in the TIMSS reports (1999, 2003, 2007 and 2011) through comparing the ranking of Malaysia with some countries in south-eastern Asia such as Chine Taipei, South Korea, Hong Kong, Singapore, and Japan (Table 1.1).

Table 1.1 TIMSS Results in 8th Grade based on Ranks and Scores of Some Countries in Southeast Asia in 1999, 2003, 2007, 2011

Country	1999	2003	2007	2011	Rank of Participants			
					1999	2003	2007	2011
Singapore	604	605	593	611	1	1	3	2
South Korea	587	589	597	613	2	2	2	1
Chinese Taipei	585	585	598	609	3	4	1	3
Hong Kong	582	586	572	586	4	3	4	4
Japan	579	570	570	570	5	5	5	5
Malaysia	**519**	**508**	**474**	**440**	**16**	**10**	**20**	**26**
International Average	487	466	500	467	----	----	----	----
Highest Score	604 Singapore	605 Singapore	598 China Taipei	613 Korea Republic	----	----	----	----
Lowest Score	275 South Africa	264 South Africa	307 Qatar	331 Ghana	----	----	----	----
Number of Participating Countries	38	45	48	42	----	----	----	----

(Source: Mullis et al., 2004; Mullis et al., 2008; Mullis et al., 2012)

A review of the TIMSS results indicated that Malaysian students' ranking has declined from 1999 to 2011. Since Singapore, which is a close neighbor of and culturally similar to Malaysia, is successful in TIMSS, hence, the researcher selected Singapore as an example and benchmark for doing this investigation.

In TIMSS 2003, 45 countries participated at the eighth-grade level. Malaysia's eighth grade (Form 2) students took part in TIMSS, 2003 and scored 508 among the participating countries. Malaysian students' performance was lower than some of the south-east Asian countries students as presented in (Table 1.1). According to Mullis, Martin, and Foy (2008), 48 countries participated in TIMSS 2007 in the eighth grade and Malaysia scored 474. Also from Table 1.1, Mullis, Martin, and Foy (2012) indicated that in TIMSS 2011, 63 countries participated in the eighth grade and Malaysia scored 440 which was lower than some of the south-east Asian countries. As shown in the four assessments of TIMSS on 1999, 2003, 2007 and 2011, the scores and achievements of Malaysian students were more than many countries but lower than Singapore students. Still, both countries emphasize on the importance of mathematics education and its effect on the development of countries, since mathematics forms the basis for many sciences such as physics, chemistry, economy, astronomy, and so on. The director of the

Curriculum Development Center in the Ministry of Education in Malaysia, Mahzan (cited in Curriculum Development Centre, 2006), also emphasized on the importance of mathematics education in transforming the country to a developed leading country in South Asia through the following statements:

> *"Science and Technology play a critical role in realizing Malaysia's aspiration to become a developed nation. Since mathematics is instrumental in the development of scientific and technological knowledge, the provision of quality mathematics education from an early age in the education process is thus important" (Curriculum Development Centre, 2006, p.7).*

Therefore, there is a need to improve students' outcomes in mathematics education programs. These mathematics education programs are wisely oriented towards students' better performance in mathematics. Considering the above mentioned explanations regarding the role of mathematics education and the average results of Malaysian students' performance in mathematics education, the researcher found that there have not been enough studies conducted in this area. Therefore, there is a need to find the reasons for such a gap among the mathematics scores obtained by Malaysian students in TIMSS and students' scores from other south-east Asian countries. Table 1.1 and Figure 1.2 show the summary of TIMSS results in 8th grade in 1999, 2003, and 2011 to compare the scores and ranks among Malaysia and some of the Southeast-Asian countries' students.

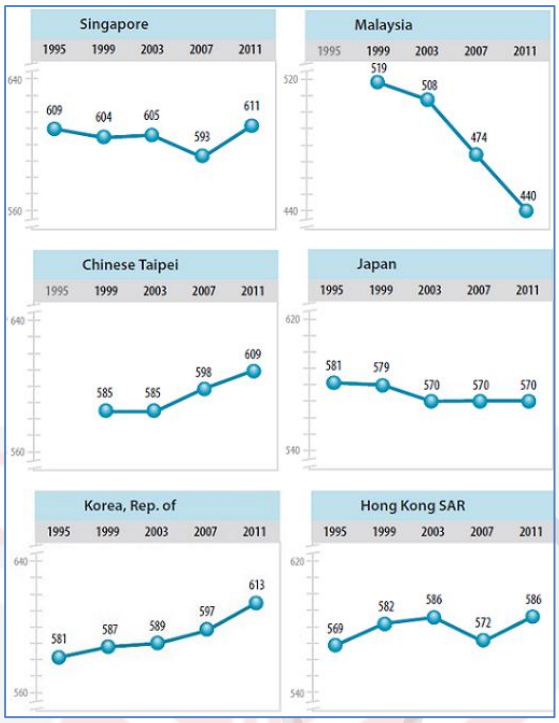

Figure 1.2 Trends in Mathematics Average Achievement in TIMSS 1995 to 2011
(Source: Mullis et al., 2012, p. 60-64)

1.2 Statement of the Problem

Although Malaysian students' performance was at an acceptable level in TIMSS (1999, 2003, 2007 and 2011), but their performance is lower than some of their south-east Asian counterparts, which are the highest ranked in the world. The results of TIMSS also indicated that Malaysian students' ranking has declined from 1999 to 2011.

The achievement of students depends on their learning at the school and their learning is influenced by the successfully implementation of the curriculum of mathematic through the school system. In fact, a curriculum with an optimum plan could not be helpful without appropriate implementation (Marsh, 2004; Ornstein & Hunkins, 2004). Hence, there is a need to investigate the implementation of the mathematics curriculum as an important factor in the achievement of Malaysian students in mathematics.

It is often mentioned that the conceptualization and understanding of National Philosophy of Education (NPE) is considered as the pre-condition for successful implementation of the curriculum. This conceptualization and understanding heavily depends on the ability of teachers to transform the aspiration of the curriculum into form that can be accepted and understood by the students (Marsh, 2004). The perception of teachers regarding curriculum of education has been increasingly emphasized by scholars as an influential factor in student performance in mathematics (Ebby, 2000; Jong, Pedulla, & Reagan, 2009; McClintock, O'Brien & Jiang, 2005). Therefore, there is a need to investigate the teacher's perception of the Philosophy of Education and teaching practice in mathematics classes in order to go beyond looking at student's academic performance.

Furthermore, the data from textbooks are considered as a main source for better implementation of the curriculum by the teachers at the schools. Considering this fact, the nature and types of activities supported by these curriculum materials deserve a closer look (Rezat, 2006). Accordingly, this study has further investigated the content of mathematics textbooks in Malaysia. However, these textbooks have weaknesses in covering necessary learning materials based on the content domain of TIMSS (Numbers, Algebra, Geometry, Data and Chance). Johansson (2005) believes that an increased awareness of textbooks and the way they are being used by teachers are important to understand the process of mathematics' teaching and learning. Considering a reform of the mathematics curriculum is crucial to understand the role of textbooks. Also, there are not enough studies to evaluate the content of mathematics textbooks of Malaysia with content domains of TIMMS. In addition, for better understanding these weaknesses, the researcher compared the content of mathematics textbooks in 8^{th} grade of Malaysia with Singapore, since Singapore is one of the highest ranking holders in TIMSS (1999-2011).

TIMSS evaluates students in two levels, 4^{th} grade and 8^{th} grade .This study focused on teaching in 8^{th} grade because the investigations showed that the numbers of participating countries in 8^{th} grade were higher, comparing to other grades, between 2003, 2007 and 2011 (TIMSS, 2003; TIMSS, 2007; TIMSS, 2011). Also, the researcher possesses extensive experience in teaching mathematics in secondary schools in Iran. Therefore, the researcher chose to study on the secondary schools in 8^{th} grade in order to better achieve the purposes of the current study.

1.3 Objectives of the Study

The general objective of this study is to investigate the implementation of the major components of secondary school mathematics curriculum in Malaysia. These components are chosen according to the literature review in general. The particular bases to support the choice of these components include Marsh's (2004) nine components of curriculum framework, the six NCTM principals for teaching mathematics in secondary schools, and the first component of TIMSS (student assessments). Considering all the sources mentioned above, the components of curriculum studied include the philosophy of mathematics education, teaching practices and assessment, the content of mathematics textbooks (subject matter), and the educational resources and materials. More specifically this study has the following specific objectives:

i. To investigate the teachers' perception of the National Philosophy of Education in Malaysia;
ii. To investigate teaching and assessment practices in 8^{th} grade (Form 2) mathematics classroom in Malaysia;
iii. To investigate the contents of mathematics textbooks of Malaysia (Form 2) and Singapore (Secondary 2).

1.4 Research Questions

In order to pursue the above research objectives, the researcher has formulated the following research questions:

i. How do the teachers in the study perceive the National Philosophy of Education?
ii. How are the teaching and assessments practices of the teachers in the study?
iii. To what extent do the teachers in the study perceived that their mathematic teaching practices are in line with the National Philosophy of Education?
iv. What are the viewpoints of the teachers in the study on the contents of mathematics Form 2 textbooks?
v. What are the similarities and differences in the contents of mathematics textbooks used in Malaysia (Form 2) as compared to Singapore (Secondary 2)?

1.5 Significance of the Study

The findings of this study have both theoretical contribution to mathematics teaching and learning process, and practical implication for the mathematics educators. In this respect, investigating the implementation curriculum of mathematics textbooks between Malaysia and Singapore will help educators and policy makers to understand the differences and similarities in mathematics education in both countries. This also makes aware the educators of strengths and weaknesses that can help the policy makers to shape the improvement that needs to be made in the content of Malaysian textbooks. The results of this study particularly will benefit the following organizations and people.

Firstly, mathematics educators will benefit and will be introduced to new possibilities in utilizing available resources for a better and more efficient teaching method. Secondly, the findings based on the investigations of knowledge of teaching and contents of textbook in Malaysia will give inputs to mathematics educators to further improve the teaching of mathematics and the structures of textbooks.

Furthermore, the findings of this study can be used by the Malaysian Ministry of Education to improve the implementation of the mathematic curriculum to ensure better achievement in mathematics education so that it might lead to better ranks in TIMSS in the coming years.

Lastly, based on the findings, curriculum developers can design a better program by considering the weaknesses and strengths of the content of mathematics textbooks of secondary school in Malaysia (Form 1 and 2) and Singapore (Secondary 1 and 2). Apart from that, it may also provide guides to other countries to have a deeper look at the implementation of curriculum of their mathematic education system by conducting better teaching and assessment practices and improving mathematics textbook approach and design, to improve student's achievements.

1.6 Limitations of the Study

There are some limitations for the current research. These limitations are assumed to affect both the research procedure and the potential implications and applications of the research findings.

Since this research is a case study, the analysis of mathematics

curriculum in this study is limited to only two schools in Malaysia. This will hinder any generalization to Malaysia in general and to other countries. The Curriculum is, however, designed and developed for certain conditions in which preset missions and visions are proudly stated. These conditions limit any direct influence to other nations' curriculum.

As this is a qualitative study, the findings may not be readily generalizable to a bigger population of teachers. The participants of this study were limited to teachers of two secondary schools, one in Putrajaya and one in Selangor.

1.7 Operational Definition of Terms

The operational definitions of terms used throughout this study are presented in this section. These definitions include curriculum, the national philosophy of education, philosophy of mathematics education, teaching practice, assessment practice, educational resources and materials, and contents of textbook.

1.7.1 Curriculum

The definition of the term curriculum, as far as its educational connotation is concerned, has been undertaken with the concept of school education and the related pedagogical endeavors. As the term has been applied to different aspects of general education, it has established links with some major branches of human science, such as psychology, philosophy and pedagogy (Marsh & Willis, 2003). There are five principles of curriculum: i) Curriculum Development; ii) Curriculum Design; iii) Aims, Goals, and Objectives; iv) Curriculum Implementation; and v) Curriculum Evaluation (Marsh 2004; Ornstein & Hunkins, 2004). In this study, mathematics curriculum at Form 2 equivalent to 8^{th} grade refers to the aims, goals, and objectives based on philosophy of mathematics education. Curriculum implementation refers to teaching and assessment practices. In terms of curriculum development, the focus is on contents of textbook and educational resources and materials.

1.7.2 Philosophy of Mathematics Education

An (2000) believed that a philosophy is essential to any meaningful development effort. Diverse societies and cultures have various philosophies concerning education, specifically with respect to the learning and teaching of mathematics as illustrated in their curriculum

1.7.3 Teaching Practice

Teaching practice includes all activities done by the teacher in the classroom to fulfill the task of education. This term covers many aspects including the teaching methods, materials, and assessment. Teaching methods involves the use of learning theories. In this study, three theories are considered, namely behaviourism, cognitivism and constructivism. Teachers also have to gain more knowledge and skills with positive attitude due to better implementation of curriculum of education in secondary schools (Alimuddin, 2008).

Behaviourist theory asserts that learning is a change in behaviour due to experience (teacher-centered). Cognitive theory suggests that learning is based upon how people mentally process stimuli encounter (thought-centered). And constructivist theory asserts that learning is a change in mental association due to experience (student-centered) (Ormord, 1995). In this study, teaching practice will be measured through the questions in Appendix B, Part Two.

1.7.4 Assessment Practice

Brown, Bull and Pendelbury (1997) defined assessment as estimating the level of some attributes of a person or a group of learners. In this definition there are three important aspects to pay attention to; i) assessment is systematic and follows a quantification procedure which is looking at the degree of achievement of some attributes; ii) assessment is an equivalent for measurement; and iii) assessment is the end (or could be the end) of a cycle of teaching learning process. Therefore, it is set to describe the approximation towards the predetermined goals. In this study, the researcher aims to know how the mathematics courses in the 8^{th} grade will be assessed by teachers. So, assessment will be measured through questions in Appendix B.

1.7.5 Educational Resources and Materials

These materials include text books, work books, visual pictures, multimedia (such as CDs, software, and courseware), and many other materials that are related to the process of delivering curriculum intentions and expectations. It includes educational materials that help students and teachers' progress in their learning and teaching such as study books, text books, software, courseware, facilities, audio/visual aids and so on. These instruments are tools that teachers use in order to deliver the curriculum contents. In this study, educational resources and materials will be measured through six questions in Appendix B.

1.7.6 Contents of Textbook

According to the Third International Mathematics and Science Study (TIMSS) 1999, the data from textbooks are the main source for instruction in the classroom. Considering this fact, the nature and types of activities supported by these curriculum materials deserve a closer look (Rezat, 2006). Contents of Textbook refer to learning contents in the text books. In this study, contents of the Form 2 mathematics textbook in Malaysia and the General Certificate of Education 2 (GCE2) textbook in Singapore, which both are used in the teaching of 8^{th} grade, are analyzed.

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