# MATHEMATICS EDUCATION IN SINGAPORE - AN INSIDER'S PERSPECTIVE

Berinderjeet Kaur

National Institute of Education, Nanyang Technological University, Singapore
e-mail: berinderjeet.kaur@nie.edu.sg

***Abstract***

Singapore's Education System has evolved over time and so has Mathematics Education in Singapore. The present day School Mathematics Curricula can best be described as one that caters for the needs of every child in school. It is based on a framework that has mathematical problem solving as its primary focus. The developments from 1946 to 2012 that have shaped the present School Mathematics Curricula in Singapore are direct consequences of developments in the Education System of Singapore during the same period. The curriculum, teachers, leaners and the learning environment may be said to contribute towards Singapore's performance in international benchmark studies such as TIMSS and PISA.

**Keywords**: Mathematics Education, Singapore, Differentiated Curriculum, TIMSS, PISA

**Abstrak**

Sistem Pendidikan di Singapura telah berkembang dari waktu ke waktu sehingga memiliki sistem Pendidikan Matematika. Hari ini kurikulum matematika di sekolah dapat digambarkan sebagai salah satu yang melayani kebutuhan setiap anak di sekolah. Hal ini didasarkan pada kerangka kerja yang memiliki pemecahan masalah matematika sebagai fokus utamanya. Perkembangan tersebut dimulai dari tahun 1946-2012 yang telah membentuk kurikulum matematika sekolah saat ini di Singapura, yang merupakan konsekuensi langsung dari perkembangan Sistem Pendidikan Singapura selama periode yang sama. Kurikulum, guru, pembelajar (siswa), dan lingkungan belajar dapat dikatakan memberikan kontribusi terhadap kinerja Singapura dalam studi yang berstandar internasional seperti TIMSS dan PISA.

**Kata kunci**: Pendidikan Matematika, Singapura, *Differentiated Curriculum*, TIMSS, PISA

Singapore is an island, with an area of 712.4 square metres. The population is approximately 5.4 million of which more than one million are foreigners working in the country. The GDP per capita as of November 2013 is Singapore Dollars $90,166. The two largest budget items of the government expenditure are Defense and Education. Education for primary, secondary, and tertiary levels is mostly supported by the state. All institutions, private and public, must be registered with the Ministry of Education. English is the language of instruction in all public schools and all subjects are taught and examined in English except for the "Mother Tongue" language paper. While "Mother Tongue" generally refers to the first language internationally, in Singapore's education system it is used to refer to the second language as English is the first language.

Education takes place in three stages: "Primary education", "Secondary education", and "Post-secondary education". Pupils begin with six years of primary school, which is made up of a four-year foundation stage and a two-year orientation stage. In the foundation stage the curriculum is focused on the development of English, the mother tongue, and mathematics. In the orientation stage pupils study

the four standard subjects: English, the mother tongue, mathematics, and science. Secondary school lasts from four to five years, and is divided between "Special", "Express", "Normal (Academic)", and "Normal (Technical)" courses of study within each school, depending on a pupil's ability level. The school curriculum is comprehensive and pupils take subjects in Languages, Arts, Humanities and Sciences. Post-secondary education takes place from two to three years at Junior Colleges, polytechnics and institutes of technical education. For junior colleges, the curriculum comprise of specialized subjects and a contrasting subject for a broad based education. For polytechnics and institutes of technical education the curriculum is specialized and specific to the course of study the students are undergoing, for example, business studies, mass communication, engineering, etc. National examinations are standardized across all schools, with a test taken after each stage of school. After the first six years of education, pupils take the Primary School Leaving Examination, which determines their placement at secondary school. At the end of secondary education pupils take the General Certificate of Secondary Education examinations and at the end of pre-university education they take the General Certificate of Advanced Education examinations.

This paper presents a historical perspective on developments that have shaped mathematics education in Singapore and evolution of school mathematics curricula. It also explores factors that may explain the achievement of Singapore students in mathematics.

**Major Developmental Phases of the Education System**

The developments from 1946 to 2013 that have shaped the present School Mathematics Curricula in Singapore, are direct consequences of developments in the Education System of Singapore during the same period. Major changes in the education system during the last six decades fall into a number of reasonably well-marked phases in the development of the system. Generally the period from 1946 to 2013 may be categorized into 5 phases of development. These phases are:

a. 1946 – 1965: Conflict-Resolution and Quantitative Expansion (Yip, et al., 1990)

Two major thrusts and priorities of this period stand out in bold relief. The first is the use of education, in the period after 1959 to resolve some of the pressing conflicts and dilemmas Singapore faced in the 1950s. The second concerns the pressure to rapidly expand educational opportunities in Singapore with a view not only to democratizing education, but also to using education as a device for achieving national cohesion and the economic restructuring of the society. In 1959 when the People's Action Party (PAP) came to power it acted upon the White Paper of 1956 and put in place a Five-Year Plan in education. The main features of this Plan were:

1. Equal treatment for the four language streams of education: Malay, Chinese, Tamil and English;
2. The establishment of Malay as a national language of the new state;
3. Emphasis on the study of Mathematics, Science and Technical Subjects.

The government embarked on an accelerated school building programme with the objective of providing a place in school for every child of school-going age in Singapore.

b. 1965 – 1978: Qualitative Consolidation (Yip, et al., 1990)

1965 witnessed the end of Singapore's merger with Malaysia and the beginning of a new chapter in the history of Singapore. It also marked the beginning of a transformation from statehood to nationhood. Under the leadership of PAP, education remained a key to it's survival. Education was crucial in facilitating the nation's economic transformation and of building a socially-disciplined cohesive Singaporean society. There was a shift in emphasis from academic to technical education to provide the manpower base for industrialization. This period also witnessed the onset of systematic improvements via research undertaken by the Ministry of Education (MOE) to the education system.

c. 1978 – 1984: Refinements and New Strides (Yip, et al., 1990)

By the late 1970s, certain 'cracks' and weaknesses in the system had begun to manifest themselves. Amongst the weaknesses identified by the MOE's Study Team led by Dr Goh Keng Swee (Ministry of Education, 1979) was the high education wastage resulting in low literacy levels in the country. In line with the 'simple objective' of education in Singapore,

> *…..to educate a child to bring out his greatest potential so that he will grow into a good man and a useful citizen (Lee, 1979).*

As spelt out by the then Prime Minister of Singapore in 1979 and the findings of the Goh's Report (Ministry of Education, 1979), the New Education System (NES) was introduced in February 1979. The NES introduced ability-based streaming both at the primary and secondary levels of education on the grounds that in the past a common curriculum in the primary and secondary schools had failed to take into consideration variations in the learning capacities of children. Streaming, according to Goh's report, would provide an opportunity for less capable pupils to develop at a slower pace and it would also enable a child to go as far as he can. Pupils who are not academically inclined could still acquire basic literacy and numeracy required for skills training. The NES was implemented in 1981. Pupils were streamed in primary three and secondary one.

d. 1984 – 1996: Towards Excellence in Schools (Yip, et al., 1990)

1985 marked a watershed in the economic development of Singapore. Based on two key reports, one in Singapore (Economic Committee, 1986) and another in the United States (Tan, 1986), the Minister for Education in 1986 enunciated that future education policies in Singapore would be guided by three principles. These were:

1. Education policy must keep in pace with the economy and society;
2. Basics – Languages, Science, Mathematics and Humanities will be stressed to encourage logical thinking and life-long learning;
3. Creativity in schools must be boosted through a 'bottom up' approach whereby the initiative must come from principals and teachers instead of from the Ministry (Tan, 1986).

As part of an on-going process of self-improvement, in 1987 based on the report, Towards Excellence in Schools (Ministry of Education, 1987), schools became the center of attention. This was

a result of the premise that the goal of excellence in education could only be achieved through better schools (Tan, 1987). Several refinements to the NES have been made since its implementation in 1981. In 1991, the level at which streaming in the primary school was carried out was changed to primary four. In 1994, the Secondary Normal (Technical) Course was introduced to secondary one normal stream students.

e. 1996- 2012: The Way Forward… (Kaur, 2002)

In 1997, the Prime Minister, Mr Goh Chok Tong (Goh, 1997) in his speech at the opening of the Seventh International Conference on Thinking held in Singapore signaled that changes had to be made to the existing education system. These were necessary to prepare young Singaporeans for the new circumstances and new problems that they will face in the new millennium. He emphasized that we must ensure our young can think for themselves, so that the next and future generations can find their own solutions to whatever new problems they may encounter. He also announced at the opening of the conference that Singapore's vision for meeting this challenge is encapsulated in four words: THINKING SCHOOLS, LEARNING NATION.

Three initiatives were launched in Singapore's education system in 1997. They are National Education, Information Technology and Critical and Creative Thinking (Ministry of Education, 1998). To forge the vision THINKING SCHOOLS, LEARNING NATION (TSLN) and to push forward the initiatives of information technology and critical and creative thinking, changes were recommended in four main areas, namely curriculum, teaching, teachers and assessment (Ministry of Education, 1997). To accommodate the recommendations, the MOE initiated a content reduction of all curricular subjects. Every subject underwent a content reduction ranging from 10 – 30 % and the reduced content syllabuses were effective in 1999. The amount of curriculum time for each subject remained the same. The time freed by the content reduction supported the implementation of the three initiatives.

Since 1997, the MOE has begun a shift in strategic paradigm from an efficiency-driven education system to an ability-driven (ADE) one. To achieve this, MOE is equipping schools with the hardware and software necessary to bring about the change. In 2000, at the MOE work plan seminar for school leaders it was noted that the hardware to 'make ADE happen' was already in place. To build up the software the emphasis is on the people factor – school leaders who create an environment conducive to learning and innovation and teachers who are thinking and caring professionals who believe and share the vision – TSLN [12].

The most recent development is the Teach Less, Learn More initiative that was launched in the education system in 2003. TLLM builds on the groundwork laid in place by the systemic and structural improvements under TSLN, and the mindset changes encouraged in our schools. It continues the TSLN journey to improve the quality of interaction between teachers and learners, so that our learners can be more engaged in learning and better achieve the desired outcomes of education. TLLM aims to touch the hearts and engage the minds of our learners, to prepare them for life. It reaches into the core of education - why we teach, what we teach and how we teach. It is about

shifting the focus from "quantity" to "quality" in education. It emphasizes "more quality" in terms of classroom interaction, opportunities for expression, the learning of life-long skills and the building of character through innovative and effective teaching approaches and strategies. It also emphasizes "less quantity" in terms of rote-learning, repetitive tests, and following prescribed answers and set formulae.

**The Evolution of School Mathematics Curriculum**

A school curriculum can be defined in terms of its aims, content and resources, teaching and learning strategies, and assessment practices (Wong, 1991). However it also exits within a broader context involving the physical, political, cultural, economic, and social environments that define and constraint its role in educating the people. It is clear from the review of the developments in the education system of Singapore in the last six decades that the aims of the school curriculum are shaped by economic policies of the government that are necessary for the survival of Singapore in a fast changing world. School mathematics curriculum as part of the school curriculum has played a significant role in the economic development and progress of Singapore during the last six decades. A review of developments in secondary school mathematics syllabuses follows.

a. Diverse beginnings…

Up to the 1950s, schools in Singapore were mainly vernacular in nature, i.e. there were Chinese, Malay, Tamil and English schools. The language of instruction in Chinese schools was Chinese and their curricula were adopted from China. Likewise the language of instruction in English schools was English and their curricula were adopted from Britain. Therefore several mathematics syllabuses were in use across Singapore, with each school adopting their own. The first local set of syllabuses for mathematics was drafted in 1957 and published in 1959 (Lee & Fan, 2002). These set of syllabuses were for Primary and Secondary schools contained in a single booklet. The syllabuses adopted a spiral approach and were for all schools irrespective of their language streams.

In 1959, after the PAP came into political power, the government placed emphasis on educating the masses. In schools, the study of mathematics, science and technical subjects were emphasized. The first local set of syllabuses was used across all schools and little consideration was given to differences in the mathematical abilities of the pupils. The secondary school mathematics syllabuses referred to as Syllabus B prepared pupils for the mathematics examinations of the Cambridge Certificate of Education conducted by the University of Cambridge Local Examination Syndicate (UCLES).

b. Keeping in line with world trends

A revision of the first local set of syllabuses for secondary schools took place in late 1960's in response to the "Math Reform of the 1960's". The revised syllabus known as Syllabus C was implemented in the early 1970's (Lee & Fan, 2002). Towards the end of the 1970s the syllabus underwent yet another revision resulting in Syllabus D.

At the secondary level, all pupils take the mathematics (elementary) course. At the upper secondary level, the more able pupils take the additional mathematics course too. Both courses are based on the "Ordinary" level syllabuses of the University of Cambridge Local Examination Syndicate

(UCLES). Since the 1980's Singapore secondary pupils have been doing the Syllabus D. The Ministry of Education issues the syllabus for the Lower Secondary levels. This syllabus covers topics in Arithmetic, Mensuration, Algebra, Graphs, Geometry, Statistics and Trigonometry. For each topic, the syllabus describes the instructional objectives, lists the main concepts and learning outcomes. These topics are a subset of the syllabus for the "Ordinary" level UCLES mathematics examination.

c. Mathematics for every child

In 1981, when the New Education System (Ministry of Education, 1979), was implemented, the Ministry of Education produced a mathematics syllabus for the Express and Special Streams in the secondary school by arranging the topics in Syllabus D into a four-year programme. At the same time, a sub-set of the topics in Syllabus D was selected for the weaker Normal Stream pupils for the "N" Level examination.

In 1988, the Curriculum Development Division of the Ministry of Education set up a Mathematics Syllabus Review Committee to review and revise the mathematics syllabuses in use since 1981. The goal of the committee was to study the adequacy of the syllabuses in meeting the needs of the pupils and to revise the syllabuses to reflect if appropriate recent trends in mathematics education (Wong, 1991). It was during this review that the committee felt that besides elaborating the aims and objectives, a framework was necessary to describe the philosophy of the revised curriculum. Hence, the framework shown in Figure 1 that spells out the primary focus of the mathematics curriculum as mathematical problem solving. In 1990, the revised Mathematics Syllabus for the New Education System was implemented.

In 1992, the mathematics syllabus for the Normal (Technical) stream pupils was produced by the Ministry of Education (Ministry of Education, 1992). The Normal Stream mathematics syllabus was also renamed as Normal (Academic) stream mathematics syllabus A (4010). The Normal (Technical) stream mathematics syllabus is a sub-set of the Normal (Academic) stream syllabus. The Normal (Technical) stream mathematics syllabus T (4012) was implemented in 1994 when the Normal (Technical) stream came into being at the secondary one level for the first time.

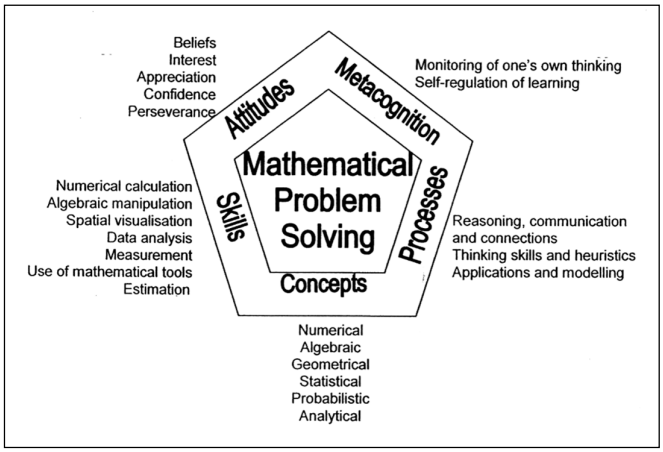


**Figure 1. Framework of the Mathematics Curriculum (Ministry of Education, 2006a, 2006b, 2006c, 2006d)**

d. Consolidation of content

In 1998, the mathematics syllabus underwent a content reduction exercise. The following rationale guided it.

1. The learning of mathematics is sequential and hierarchical in nature. Therefore, essential topics and skills removed from one level were transferred to another level in order to ensure continuity in the learning of the subject.
2. Topics that were core content, i.e. essential as the foundation for further mathematics learning; developed the desired outcomes of the syllabuses; and provided continuity and completeness were retained.
3. Topics that were less fundamental and not connected to other topics in the syllabus; which placed heavy emphasis on mechanical computation; which overlapped with those taught at other levels; that were too abstract for the intended level and concepts/skills that were taught in other subjects, were removed from the syllabus.

e. Mathematics for knowledge based economies

In 1998, following the content reduction exercise, a revision of the syllabuses was undertaken to:

1. Update the content to keep abreast with the latest developments and trends in Mathematics education.
2. Explicate the thinking processes inherent in the subject and to encourage the use of IT tools in the teaching and learning of Mathematics.
3. Ensure the content meets the needs of the country in the next millennium (21$^{st}$ century).

Every six years or so, the mathematics syllabuses undergo a periodic review to ensure that they remain relevant so as to prepare our pupils for the challenges and opportunities of the future and also to be in line with the national objectives. As people are the only resource of Singapore, education is the key to the success of its economy and in turn survival (Goh, 2001). At present it may be said that every child in school does mathematics that is suited to his or her ability. School mathematics curriculum emphasizes a balance between mastery over basic skills and concepts and the application of higher order thinking skills to solve mathematical problems.

**Mathematics Courses at School**

a. Primary school mathematics

Primary school comprises six years of schooling. The first four years constitute the foundation stage and the next two years the orientation stage. During the foundation stage emphasis is on building a strong foundation in the English Language, Mathematics and Mother Tongue language. All pupils take the same course for mathematics. In the orientation stage pupils are streamed according to ability. Subject-based banding is adopted. Pupils either take the Foundation Mathematics or Mathematics course of study. The Foundation Mathematics syllabus is a sub-set of the Mathematics course of study.

The recommended curriculum time per week for mathematics in the primary school is as follows.

| | |
|---|---|
| Primary 1 - 2 | 4 hours |
| Primary 3 - 4 | 5.5 hours |
| Primary 5 – 6 (Mathematics) | 5 hours |
| Primary 5 – 6 (Foundation Mathematics) | 6.5 hours |

b. Secondary school mathematics

Pupils sit a national examination called the Primary School Leaving Examination (PSLE) at the end of Primary six. The examination assesses pupils suitability for secondary education and places them in an appropriate secondary school course that matches their learning ability. Three Courses are available at the secondary school level. Pupils undergo four or five years of secondary education with different emphases.

1. Special Course – a four-year course leading to the Singapore-Cambridge General Certificate of Education (GCE) 'O' level examination. In this course, pupils study their mother tongue at an advanced level, in addition to the usual humanities, mathematics and science subjects.
2. Express Course – also a four-year course leading to the GCE 'O' level examination. In this course pupils study their mother tongue at an ordinary level and offer a curriculum similar to that in the Special course.
3. Normal Course – a four-year course leading to the GCE 'N' level examination. A fifth year is available to pupils who do well in this examination to prepare for and take the GCE 'O' level examination. Pupils in this course follow either the Normal (Academic) or Normal (Technical) curriculum. In the N(A) curriculum, they will learn English, mother tongue, mathematics and a range of subjects similar to those in the Special and Express courses. In the N(T) course, pupils will learn English, mother tongue at a basic level emphasizing oral/aural competence and reading comprehension, mathematics, computer applications and subjects with a technical and practical bias such as technical studies.

As mathematics is a compulsory subject for pupils in school, the mathematics curriculum at the secondary school level is differentiated to cater to the needs and abilities of pupils in the different courses. Core mathematical concepts are common to all courses and the content for the Special Course is identical to the Express Course. The content for the Normal (Academic) Course is a subset of the content for Special/Express Course while that of the Normal (Technical) Course is a subset of the Normal (Academic) Course. For all the three courses most of the topics taught at the various year levels for mathematics are similar. However the depth to which they are taught at a particular year level differs. The following extract from the syllabuses (Ministry of Education, 2012a, 2012b, 2012c) highlight the varying depth.

**Secondary One - Algebra**

Special / Express Course

- Algebraic expressions and formulae
- Use letters to represent numbers
- Express basic arithmetic processes algebraically
- Substitute numbers for words and letters in formulae and expressions
- Simple algebraic manipulation
- Manipulate simple algebraic expressions – include collecting like terms and removing brackets
- Simple linear equations
- Solve simple linear equations
- Solve problems involving linear equations – emphasize understanding of the problem leading to formulation of mathematical expressions/equations

Normal (Academic) Course

- Algebraic expressions and formulae
- Use letters to represent numbers
- Express basic arithmetic processes algebraically
- Substitute numbers for letters in formulae and expressions
- Simple algebraic manipulation
- Manipulate simple algebraic expressions – include collecting like terms and removing brackets

Normal (Technical) Course

- Algebraic expressions and formulae
- Concept and notation
- Use letters to represent numbers
- Express basic arithmetic processes algebraically
- Substitution
- Substitute numbers for letters in expressions and formulae (exclude expressions with brackets & expressions involving squares and high powers)
- Simplification
- Simplify simple algebraic expressions (include collecting like terms but exclude removing of brackets at this level & expressions involving squares and higher powers)

The recommended curriculum time per week for mathematics in the secondary school is as follows.

| | |
|---|---|
| Special / Express Course | 2.5 - 3 hours |
| Normal (Academic) Course | 2.5 - 3 hours |
| Normal (Technical) Course | 4 - 5 hours |

**Singapore's Performance in TIMSS and PISA**

a. Singapore's participation in TIMSS and PISA

Singapore participates in international studies such as Trends in International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA) to benchmark the outcomes of schooling, viz-a-viz the education system against international standards. It also does so to learn from educational systems that are excelling, to update school curriculum and keep abreast of global advances and to contribute towards the development of excellence in education internationally. To date Singapore has participated in Trends in International Mathematics and Science Study (TIMSS) in 1995, 1999, 2003, 2007 and 2011. The following table shows Singapore students' achievement in mathematics for TIMSS 1995, 1999, 2003, 2007 and 2011.

**Table 1. Singapore students' mathematics achievement in TIMSS**

| TIMSS | Rank | |
|---|---|---|
| | Grade 4 | Grade 8 |
| 1995 | 1 | 1 |
| 1999 | - | 1 |
| 2003 | 1 | 1 |
| 2007 | 2 | 3 |
| 2011 | 1 | 2 |

For the first time Singapore participated in the Organization for Economic Cooperation and Development (OECD) study – Programme for International Student Assessment (PISA) in 2009. The following table shows Singapore students' achievement in mathematics for PISA 2009.

**Table 2. Singapore students' mathematics achievement in PISA**

| | Rank |
|---|---|
| PISA 2009 | 2 |

b. Factors that may explain Singapore's performance in TIMSS and PISA

***The Curriculum***

It may be said that the curriculum is tailored to meet the needs of the students and matched to their abilities. The intended curriculum is provided by the Ministry of Education to all schools and

adopts a spiral approach. The syllabuses are a guide for teachers to plan their mathematics instructional programmes. Teachers are not bound by the sequence of topics but ensure that the hierarchy and linkage are maintained. Teachers are free to exercise flexibility and creativity when drawing up plans of work which serve as a blueprint for them to implement the instructional programme. Textbooks are an essential part of the intended curriculum. They are produced by publishers with close guidance from Curriculum specialists of the Curriculum Planning and Development Division (CPDD) at the Ministry of Education. All textbooks used in schools must have the approval of the Ministry of Education.

***The Teacher***

To forge the vision: THINKING SCHOOLS, LEARNING NATION (Goh, 1997) ahead, teachers have been identified as the key and hence accorded due importance. The learning journey of a teacher begins with pre-service education at the National Institute of Education (NIE) in Singapore. The NIE is the sole teacher education institution in Singapore where all the pre-service primary, secondary and junior college teachers for the Singapore Education Service are trained. Like all other institutions of higher learning in Singapore, the programmes and courses at the NIE are constantly undergoing change so as to keep abreast of the rapid changes taking place both locally and internationally. Periodic reviews of all programmes are carried out and necessary revisions instituted. The NIE represents the nation's hopes that its teachers will be well educated, committed, caring and dedicated to the task of moulding the future of Singapore (The National Institute of Education, 2002).

The Ministry of Education in Singapore recruits suitable candidates for teaching positions in primary schools, secondary schools and junior colleges all year round. Information pertaining to all aspects of "Teaching as a Career" is posted on the Ministry's webpage: http://www.moe.gov.sg/teach. Successful candidates without teaching qualifications are appointed into the Singapore Education Service as trainee teachers on the General Education Officer 1 (GEO 1) or General Education Officer 2 (GEO 2) salary scales depending on their entry qualifications. Trainee teachers receive a full monthly salary while teaching in school or undergoing training at the NIE. Their tuition fees at the NIE is fully borne by the Ministry. Upon successful completion of their training at the NIE, they are deployed to teach in schools and have to serve a 3-year teaching bond.

The numbers are controlled as the number of teachers recruited must match the number of vacancies in the Education Service. The number of trainee teachers in the various programmes of study at the NIE change over periods of time and are guided by factors such as,

1. Changes in the number of pupils in each education sector (primary / secondary / junior college)
2. Number of teachers leaving the education service, either retiring or resigning
3. The prevailing economical and financial situation faced by the government.

With the unveiling of the TSLN vision, it was realized that teachers are the key to the success of the mission and hence their on-going professional development (PD) is critical. From the year, 1998

onwards all teachers are entitled to 100 hours of funded training and core-upgrading courses each year to keep abreast with the current knowledge and skills. Schools have People Developers who take charge of the PD needs of their teachers.

Yet another development that has accorded teachers the responsibility of their own professional development is the Enhanced Performance Management System (EPMS) (Ministry of Education, undated) put in place by the Ministry of Education (MOE) in 2005. The EPMS is an appraisal system that contains rubrics pertaining to fields of excellence in the education system be it teaching, leadership or senior specialist. The EPMS clearly articulates the expectations of teachers in their chosen fields of excellence. For the field, excellence in teaching teachers must slowly but surely develop themselves in the core competency (nurturing the whole child) which comprises of 4 main areas: cultivating knowledge (subject mastery, analytical thinking, initiative and teaching creatively), winning hearts and minds (understanding the environment, developing others), working with others (partnering parents, working in teams) and knowing self and others (turning into self, personal integrity, understanding others and respecting others). The levels in the teaching field are characterized as follows:

1. Beginning Teacher
2. General Education Officer (GEO) 1 / 2
3. General Education Officer (GEO) 1A1 / 2A1
4. General Education Officer (GEO) 1A2 / 2A2
5. Senior Teacher
6. Master Teacher

The following table shows expectations of a mathematics teacher related to the domains of Knowledge and Skills for three levels of the teaching field. It is apparent from the table that a teacher desirous of advancement in his/her career must engage in lifelong learning so as to gain deeper insights into both the content and pedagogical areas that are specific to his/her teaching needs. There is extrinsic motivation for teachers to advance from one level to another in their field, as their salaries and other performance perks are pitched to their levels in their field of excellence, in this case teaching.

**Table 3. Expectations in the domains of Knowledge and Skills**

| Level | Knowledge (Mathematics) | Skills (Teaching of Mathematics) |
|---|---|---|
| Beginning Teacher | Comprehend framework and core concepts of relevant school mathematics curriculum. | Understand pupil management skills. Competent in the delivery of mathematics lessons. |
| GEO 1A1/2A1 | Demonstrate knowledge of: - relevant core concepts and broad coverage of mathematics curriculum; - teaching resources and enrichment/remedial programmes associated with level of mathematics being taught. | Demonstrate pupil management skills and appropriate application of a variety of pedagogic techniques in teaching mathematics. Deliver interesting lessons to students of varied abilities and profiles and instill learning in mathematics through interactive activities. |
| Master Teacher | Demonstrate - knowledge of significant relationships, history, structure with Mathematics and the application of this knowledge to inspire interest in Mathematics; - strong awareness of trends and issues surrounding mathematics beyond the school setting and in industry/field. - knowledge core concepts of other related subjects which integrates the learning of mathematics to the world outside of school. | Demonstrate specialized techniques and strategies in the teaching of mathematics and curriculum integration to ensure achievement of learning objectives and inspire learning across schools in the cluster including customized approaches for niche groups of students. |

***The Learner***

Since, 1981 when the NES was implemented every effort has been made to cater to the diverse learning needs of students in the education system. Also flexibility in the system caters for late bloomers and also different aptitudes of individuals. The only natural resource that Singapore has is its people for economic survival and therefore the nation invests heavily in developing its natural

resource. No child is deprived of educational opportunities. Adequate funding is available for all to school comfortably. Both the rich and poor are equal in the system as rewards are based on merits. In addition, the lower socio economic status students are assisted in multiple ways to bridge their needs in terms of support for school meals, textbooks, uniforms, subsidies for educational trips, etc. Parents of students are key stakeholders of the school and they are engaged through multiple avenues, for example Parent Support Groups, Parent-Teacher meetings, etc.

Teachers have high expectations of their students, and make special effort to track the progress of their charges through the academic year. Failing students are helped and excelling students are challenged. Parents too, generally, have high expectations of the children and are often in communication with teachers about the development of their child in school. Success in school is viewed by society as an avenue for social mobility and therefore society as a whole values education. Generally issues related to education are always close to the hearts of many in Singapore.

***The Learning Environment***

In 1959 the government embarked on an accelerated school building programme with the objective of providing a place in school for every child of school-going age in Singapore. Since then, the government has slowly but surely improved significantly on school buildings to create learning spaces that are conducive to holistic development of students. Today, state of the art technology pervades all schools with learning laboratories facilitating learning via virtual and real learning aids. Schools have sporting facilities that meet high standards and a rigorous curriculum in sports is a must for all students in school. School cafeterias provide students with balanced meals at affordable prices. The school is a very safe environment. Strangers are not allowed into the premises of the school. In the primary schools, a teacher is on duty each day to see that every child has left the school premises by a certain hour after school dismissal, before he or she takes leave to go home. In secondary schools and junior colleges, the school security guards do the same.

Finally, schools have their policies on certification and promotion of students from one year level to the next. Benchmarks exist and standards are maintained. These are transparent and all – teachers, students and parents are all knowledgeable about them.

## CONCLUSION AND SUGGESTION

The education system in Singapore is dynamic and constantly evolving. Initiatives and policies are guided by research evidence, scans of other systems in the world and careful deliberations of leaders in education. Whatever the new initiative or policy may be the one thing that always “keep the house in order” is the TEACHER. Therefore it is vital that the development of teachers keep abreast of changes in the system. Finally, as stated by the Mckinsey report (Mckinsey & Co, 2007) the quality of an educational system cannot exceed the quality of its teachers.

**REFERENCES**

Economic Committee. (1986). *Report of the Economic Committee The Singapore Economy: New Directions*. (Chaired by BG Lee Hsien Loong). Singapore: Ministry of Trade and Industry.

Goh, C.T. (1997). Shaping our future: "Thinking Schools" and a "Learning Nation". *Speeches*, 21(3): 12-20. Singapore: Ministry of Information and the Arts.

Goh, C.T. (2001). *Shaping lives, moulding nation*. Speech at the Teachers' Day Rally, Friday 31st August 2001. Singapore: Ministry of Education.

Kaur, B. (2002). Singapore's school mathematics curriculum for the 21st century. In J. Abramsky, *Reasoning, explanation and proof in school mathematics and their place in the intended curriculum – Proceedings of the QCA International Seminar*, 4-6 October 2001, pp 166 - 177. London: Qualifications and Curriculum Authority, UK.

Lee, K.Y. (1979). Letter in response to the report on the Ministry of Education by Dr Goh and his team. In *Ministry of Education, Report on the Ministry of Education by Dr Goh and his team.* Singapore: Ministry of Education.

Lee, P.Y. & Fan, L. (2002). *The development of Singapore mathematics curriculum – understanding the changes in syllabus, textbooks and approaches*. A talk given at the Chongqing conference 17 – 20 August 2002. Unpublished.

Mckinsey & Co. (2007). *How the world's best-performing school systems come out on top*. Mckinsey & Co Report.

Ministry of Education. (2012a). *O-level mathematics teaching and learning syllabus*. Singapore: Curriculum Planning & Development Division, Ministry of Education.

Ministry of Education. (2012b). *N(A)-level mathematics teaching and learning syllabus*. Singapore: Curriculum Planning & Development Division, Ministry of Education.

Ministry of Education. (2012c). *N(T)-level mathematics teaching and learning syllabus*. Singapore: Curriculum Planning & Development Division, Ministry of Education.

Ministry of Education. (1979). *Report on the Ministry of Education by Dr Goh and his team*. Singapore: Ministry of Education.

Ministry of Education. (1987). *Towards Excellence in Schools*. Singapore: Ministry of Education.

Ministry of Education. (1992). *Mathematics syllabus – Secondary 1 and 2 Normal (Technical) Course*. Singapore: Curriculum Planning Division, Ministry of Education.

Ministry of Education. (1997). *Towards Thinking Schools*. Singapore: Ministry of Education.

Ministry of Education. (1998). *Mathematics Newsletter*, 1(17). Singapore: Curriculum Planning and Development Division, Ministry of Education.

Ministry of Education. (2000). *Proceedings of MOE work plan seminar: Ability-Driven Education – Making it Happen*. Singapore: Ministry of Education.

Ministry of Education. (2006a). *A guide to teaching and learning of O level mathematics 2007*. Singapore: Curriculum Planning & Development Division, Ministry of Education.

Ministry of Education. (2006b). *A guide to teaching and learning of N level (Academic) mathematics 2007*. Singapore: Curriculum Planning & Development Division, Ministry of Education.

Ministry of Education. (2006c). *A guide to teaching and learning of N level (Technical) mathematics 2007*. Singapore: Curriculum Planning & Development Division, Ministry of Education.

Ministry of Education. (2006d). *A guide to teaching and learning of primary mathematics 2007*. Singapore: Curriculum Planning & Development Division, Ministry of Education.

Ministry of Education. (undated). *Enhanced Performance Management System*. Singapore: Ministry of Education.

Tan, T.K.Y. (1986). *Speech delivered at the Nanyang Technological Institute*, 22 July 1986.

Tan, T.K.Y. (1987). *Speech delivered at the First Schools Council Meeting*. Reported in Straits Times, 14 Jan 1987.

The National Institute of Education. (2002). *Moulding lives, shaping tomorrow – The NIE story*. Singapore: The National Institute of Education.

Wong, K.Y. (1991). Curriculum development in Singapore. In C. Marsh, & P. Morris (Eds.), *Curriculum development in East Asia* (pp. 129-160). London: Falmer Press.

Yip Yip, S.K.J., Eng, S.P. & Yap, Y.C.J. (1990). 25 Years of educational reform. In J.S.K. Yip & W.K. Sim (Eds.), *Evolution of educational excellence – 25 Years of education in the Republic of Singapore* (pp. 1-30). Singapore: Longman Singapore Publishers (Pte) Ltd.