

## Initial Mathematics Teacher Training in Singapore

Berinderjeet Kaur, Koay Phong Lee, Yap Sook Fwe

National Institute of Education

Singapore

### 1. Overview

In Singapore, the development of education and teacher education has a lineage that goes back to its immigrant roots and colonial past (Sim & Ho, 1990). There were separate language-based initiatives up to the 1940's that provided basic training for teachers of different language backgrounds. There were then four types of schools – English, Chinese, Tamil and Malay – using the respective languages, i.e. English schools taught in English, as medium of instruction. The establishment of a formal teacher training institution was only realized in 1950 with the setting up of the Teachers' Training College (TTC) (Gopinathan, Ho & Tan, 1999). TTC provided training for non-graduate teachers, while the University of Singapore School of Education and the Nanyang University provided training for graduate teachers.

In 1973, the training of all teachers came under the purview of the Institute of Education (IE) which resulted from the amalgamation of the TTC and the other providers of teacher training in Singapore. In 1984 the College of Physical Education (CPE) was set up and the training of physical education teachers came under its purview. In 1990, the IE and the CPE merged to form the National Institute of Education (NIE). The formation of NIE was a significant event in the history of teacher education in Singapore. Not only did NIE become an institute of the newly formed Nanyang Technological University in July 1991, it also offered for the first time four-year degree programmes for prospective teachers. The degree programmes led to the award of the Bachelor of Arts with Diploma in Education or the Bachelor of Science with Diploma in Education, with their respective Physical Education specializations. Since 1990, the NIE has been the sole teacher-training institute in Singapore.

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, Singapore's sole teacher education institution 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 rest of this chapter will present the current (2007) state of training mathematics teachers for both primary and secondary schools in Singapore.

The Ministry of Education (MOE) 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 MOE's



webpage: <http://www.moe.gov.sg/teach>. All successful candidates who are not trained in teaching pedagogy undergo training at the NIE. NIE conducts all initial (pre-service) teacher training programmes for trainee teachers of the Singapore Education Service.

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 MOE. 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 projected 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,

- changes in the number of pupils in each education sector (primary / secondary / junior college)
- number of teachers leaving the Education Service, either retiring or resigning
- the prevailing economical and financial situation faced by the nation.

Table 1 shows an overview of the main pre-service programmes at NIE for the academic year 2005/2006 which caters for the pre-service training of mathematics teachers and the number of prospective mathematics teachers training in each of the programmes.

Table 1: Main Pre-service programmes for mathematics teachers in 2005/2006.

Programme	Entry requirements	Duration of programme in years	Approximate number preparing to be mathematics teachers (to the nearest 10) in the 2005/2006 intake cohort	
			Secondary	Primary
PGDE(S)	University Degree	1	380	-
PGDE(Pri)	University Degree	1	-	280
BA/BSc (Ed)	'A' Level or polytechnic graduate	4	< 40	< 60
Dip Ed	'A' Level or polytechnic graduate	2	-	310

## 2 PRIMARY

### Length of courses and qualification

There are mainly three programmes that provide initial training for primary school mathematics teachers. The programmes are:

- a) Diploma in Education Programme (National Institute of Education, 2005a).  
The Diploma in Education (Dip Ed) programme is a two-year full-time programme meant for GCE 'A' Level holders and Polytechnic Diploma holders. The Dip Ed [General] programme prepares trainee teachers to become either generalist teachers



or upper primary specialists in the primary school. All these teachers are trained to teach Mathematics in the primary school.

- b) Bachelor Degree Programme (National Institute of Education, 2005b).  
The Bachelor of Art (Education) [Primary] and Bachelor of Science (Education) [Primary] are four-year full time courses meant for GCE 'A' Level holders and Polytechnic Diploma holders. These programmes prepare trainee teachers to become generalist teachers or upper primary specialists in the primary school. All of these teachers teach mathematics in the primary school. Some of these teachers would have read Mathematics as an Academic Studies subject and therefore undertaken a rigorous study of Mathematics at the University level during their four-year course.
- c) Postgraduate Diploma in Education (PGDE) [Primary] Programme (National Institute of Education, 2005c).  
The PGDE (Primary) programme is a one-year full-time programme meant for University graduates who wish to be trained as primary school teachers. The graduates of this programme become generalist teachers or upper primary specialists in the primary school and would teach Mathematics in the primary school.

### **Entry qualifications**

All trainee teachers, who will be teaching curriculum subjects in the English Language, need to pass the English Entrance Proficiency Test for admission into NIE. In addition, the entry qualifications are as follows:

- a) For the Diploma in Education Programme, the requirements are

#### ***For GCE 'A' Level holders***

- i) a Singapore-Cambridge GCE 'A' Level Examination Certificate or its equivalent with at least two 'A' level passes and two 'AO' level passes including a pass in General Paper (English) obtained at one or two sittings of the examination;
- ii) passes in at least five subjects including English as a First language obtained at the Singapore-Cambridge GCE Ordinary Level Examination; and
- iii) a pass in Mathematics at least at the GCE 'O' Level Examination.

#### ***For applicants with Diplomas from Polytechnics***

- i) a polytechnic diploma; and
- ii) passes in at least five subjects including Mathematics and English as a First language obtained at the Singapore-Cambridge GCE Ordinary Level Examination.
- iii) may be required to sit for an entrance proficiency test and other tests.

- b) For the Bachelor Degree Programmes, the requirements are

#### ***For applicants with GCE 'A' Level Qualifications***

- i) passes in at least two subjects at 'A' level and two subjects at 'AO' level including a pass in General Paper (English) taken at one and the same sitting of the examination,



- ii) a minimum grade of C6 in at least five subjects including English as a First language taken at the GCE 'O' Level Examination,
- iii) a minimum grade of D7 in a second language taken at the GCE 'A' Level Examination or a minimum grade of D7 in a first language (Higher Mother Tongue) taken at the GCE 'O' Level Examination,
- iv) a pass in Mathematics obtained either at the GCE 'O' Level Examination or at least 'AO' level in the GCE 'A' Level Examination,

#### **For Polytechnic Diploma Holders**

Any polytechnic diploma with good results.

#### **Other Requirements:**

In addition to fulfilling the entry requirements, students intending to read the various Academic Subjects have to satisfy subject requirements stipulated by the Institute, for example:

students who propose to read the academic subject Mathematics must have at least a Grade B pass at GCE 'A' Level in Mathematics or at least a Grade B pass at GCE 'A' Level in Further Mathematics or a pass in the Mathematics Qualifying Test.

- c) For the Postgraduate Diploma in Education (Primary) Programme, the minimum requirements are
  - i) A degree from the National University of Singapore, the Nanyang Technological University or other Universities whose degrees are acceptable to the education service of Singapore, and
  - ii) GCE 'O' Level passes in English, Mathematics and any Science subject.

#### **Main components of the courses**

Table 2 shows the main areas of study in each of the programmes.

Table 2: Main Areas of Study for the Three Programmes

Area of study	Diploma in Ed	BA Edn /BSc Edn (Primary)	Postgraduate Dip Ed (Primary)
Education Studies	✓	✓	✓
Curriculum Studies	✓	✓	✓
Subject Knowledge	✓	✓	✓
Practicum	✓	✓	✓
Academic Subject		✓	
Language Enhancement & Discourse Skills	✓	✓	✓
Group Endeavours in Service Learning – a year long student initiated group project	✓	✓	✓

Table 3 shows the mathematics pedagogy course (curriculum studies and subject knowledge) modules that are a must for prospective primary school teachers in the above three programmes. The content of these modules is given in detail in Appendix I. Trainees in the degree programme who may have taken Mathematics as their Academic Subject would certainly have done Mathematics at the university level.



From Appendix I, it is evident that the basic curriculum studies module for all the three programmes is similar. This course is meant to equip trainees for the beginning of their journey as primary school mathematics teachers. Hence, emphasis is placed on basically understanding the philosophy and framework of Singapore's school mathematics curriculum (see figure 1), learning theories that guide the teaching strategies for the learning of mathematics, conceptual understanding of the primary school mathematics topics and modes of assessment of mathematics. The course also introduces the trainees to the prevailing MOE's initiatives, such as National Education, Information Technology and The Thinking Programme (Kaur, 2002), through the infusion of these initiatives in classroom ideas for the teaching of particular topics in the mathematics curriculum. Implicit to the entire course are modeling of attributes such as metacognition and attitudes by the tutors of the course which are essential components of the school mathematics curriculum in Singapore. For trainees specializing in the teaching of mathematics at the upper primary level, there is provision for more advanced study in the pedagogy of upper primary school mathematics.

Trainees in the PGDE(P) programme are university graduates. In this programme, only those intending to specialize in the teaching of mathematics at the upper primary level must take modules in subject knowledge. The rest are exempted. However, all trainees in the Diploma in Education and the BA / BSc (Ed) programmes must take modules in subject knowledge. Subject knowledge which is essentially curriculum content focuses on mathematical ideas related to, and yet beyond, the primary mathematics curriculum (Lim, 2002). Lim, Chua, Cheang & Yeo (2005), in their study on the development of mathematics pedagogical content knowledge (MPCK) of pre-service primary school teachers found that there was significant improvement in their MPCK on completion of their mathematics pedagogy course (curriculum and subject knowledge) at the NIE. The other significant component of their preparation is Teaching Practice in school. This will be described in some detail in the section school-based work.

Table 3: Curriculum Studies and Subject Knowledge Modules taken by Prospective Primary Mathematics Teachers

Programme	Duration of Programme (years)	Curriculum Studies		Subject Knowledge	
		Module (s)	Duration (hours)	Module (s)	Duration (hours)
Dip Ed	Year 1	DCM 100	36	DSM 100	36
				DSM 101	36
	Year 2	DCM 200 DCM 201 DCM 202 <sup>#</sup>	36 24 24	DSM 200 <sup>#</sup>	36
BA (Edn) [Primary]/ BSc (Edn) [Primary]	Year 1	-	-	-	-
	Year 2	ACM 201	36	ASM 201 ASM 202 <sup>*</sup>	24 24



	Year 3	ACM 301	36	ASM 301	24
				ASM 302*	24
	Year 4	ACM 401	24	ASM 401 <sup>#</sup>	24
		ACM 402 <sup>#</sup>	24		
PGDE(P)	Year 1	QCM 501	72	QSM 501 <sup>#</sup>	24
		QCM 502	24	QSM 502 <sup>#</sup>	24

\* only for trainees who offer Mathematics as an Academic Subject

<sup>#</sup> for trainees intending to be specialist teachers in the upper primary level

### Assessment of training institution component

For all the three programmes, Diploma in Education Programme, Bachelor Degree Programmes and Postgraduate Diploma in Education, the institution-based component is mainly assessed through a combination of

- in-class quizzes and tests (e.g. pedagogical content knowledge test)
- written assignments including lesson planning and test construction
- individual presentations (micro-teaching and teaching ideas)
- group presentations
- end-of-semester examination (for Academic Studies subjects and Subject Knowledge modules).

### School-based work

Table 4 shows the duration of practicum in each of the three programmes.

Table 4: Teaching practice for the pre-service programmes

Programme	Duration of Programme (years)	Teaching practice duration
PGDE(P)	1	10 weeks of Teaching Practice
Dip Ed	2	5 weeks of Teaching Assistantship in year 1 10 weeks of Teaching Practice in year 2
BA (Ed) [Primary] BSc (Ed)[Primary]	4	2 weeks of School Experience in year 1 5 weeks of Teaching Assistantship in year 2 5 weeks of Teaching Practice in year 3 10 weeks of Teaching Practice in year 4

During School Experience, Teaching Assistantship and Teaching Practice, trainee teachers are attached to schools. The school-based work is mainly organized and supervised by the school coordinating mentor (SCM) and cooperating teachers (CTs) in the school. NIE provides the school with guidelines regarding School Experience, Teaching Assistantship and Teaching Practice. NIE also conducts briefing sessions for the SCMs and CTs. The NIE supervision coordinator (NSC) oversees the work of trainee teachers under his/her charge.

#### a) Observing

During School Experience and the first week of Teaching Practice, trainee teachers mainly observe their CTs and other teachers teaching in the school. During



Teaching Assistantship, trainee teachers are also given opportunities to observe their CTs teaching.

**b) Teaching classes**

During Teaching Assistantship, trainee teachers help their CTs plan lessons, prepare resources, manage pupils and also do some guided teaching. During teaching practice, from the second week onwards, trainee teachers gradually take on the task of teaching their CT's classes. They are closely guided and monitored for a period of two to three weeks before they undertake independent teaching.

**c) Schools used for training**

Every school of the Ministry of Education in Singapore is a partner school of NIE for the training of teachers. Normally, trainee teachers are posted to schools close to their homes.

**d) Assessment of school-based component**

As part of formative assessment, during the entire period of teaching practice, CTs carry out observations of trainee teacher's lessons. Normally, the NSC observes the trainee teacher twice. Both the CTs and the NSC are engaged in supervision with a developmental focus and practise the three step supervision cycle which comprises of the pre-observation conference, lesson observation and the post-observation conference. Towards the end of teaching practice, the SCM and school principal are involved in the summative assessment of the trainee teacher. The final grade, distinction, credit, pass or fail, is by consensus at the Assessment Panel Meeting which is chaired by the school principal. The NSC, SCM and CTs must be present at the meeting.

## **SECONDARY**

### **Length of courses and qualification**

There are two main programmes that provides initial training for secondary school mathematics teachers. The programmes are:

**a) Bachelor Degree Programme (National Institute of Education, 2005b).**

The Bachelor of Art (Education) [Secondary] and Bachelor of Science (Education) [Secondary] are four-year full time courses meant for GCE 'A' Level holders and Polytechnic Diploma holders. These programmes prepare trainee teachers to become mathematics teachers in the secondary school. All of these teachers must read Mathematics as an Academic Studies subject and therefore undertake a rigorous study of Mathematics at the University level during their four-year course.

**b) Postgraduate Diploma in Education (PGDE) [Secondary] Programme (National Institute of Education, 2005c)**

The PGDE (Secondary) programme is a one-year full-time programme meant for University graduates who wish to be trained as secondary school teachers. The graduates of this programme specialize in the teaching of two subjects, one of which would be Mathematics, in the secondary school.



**Entry qualifications**

All trainee teachers, who will be teaching curriculum subjects in the English Language, need to pass the English Entrance Proficiency Test for admission into NIE. In addition, the entry qualifications are as follows:

- a) For the Bachelor Degree Programmes, the requirements are the same as for the primary teachers.
- b) For the Postgraduate Diploma in Education (Secondary) Programme applicants must possess a degree from the National University of Singapore, the Nanyang Technological University or other Universities, whose degrees are acceptable to the education service of Singapore. Trainee teachers who are assigned Mathematics as one of their Curriculum Studies Option (CSO) must satisfy the following criteria:

**Mathematics as 1<sup>st</sup> CSO**

- a) Major in Mathematics at University (as given in university transcripts) or
- b) Engineering graduates with at least two modules of Engineering Mathematics at University Level with at least a 'C' grade and a pass in Further Mathematics at 'A' levels, or
- c) Engineering graduates with at least two modules of Engineering Mathematics with at least a 'C' grade and an 'A' grade for Mathematics C at 'A' levels.

**Mathematics as 2<sup>nd</sup> CSO**

- a) Minored in Mathematics at University, or
- b) BSc university graduate with Statistics as major, or
- c) All Engineering graduates with at least two modules of Engineering Mathematics at University Level with at least a 'C' grade and at least a grade B for 'A' level Mathematics, or
- d) All Engineering graduates with at least two modules of Engineering Mathematics at University Level with at least a 'C' grade and at least a distinction (A1/2) in Additional Mathematics at 'O' levels (includes SPM).

**Lower Secondary Mathematics as 2<sup>nd</sup> CSO**

- a) Engineering graduates who do not satisfy the criteria of (c) and (d) above but have at least a distinction (A1/2) for 'E' Mathematics at 'O' levels, or
- b) All other degree holders with at least a grade B in 'A' level Mathematics.

**Main components of the course**

Table 5 shows the main areas of study in each of the programmes.

Table 5: Main Areas of Study for the Two Programmes

Area of study	BA Edn /BSc Edn (Secondary)	Postgraduate Dip Ed (Secondary)
Education Studies	✓	✓
Curriculum Studies	✓	✓
Practicum	✓	✓
Academic Subject	✓	



Language Enhancement & Discourse Skills	✓	✓
Group Endeavours in Service Learning – a year long student initiated group project	✓	✓

Trainee teachers in the four year BSc / BA (Ed) degree programme undertake the study of two Academic Subjects at the university level. They will major in one subject and minor in the other. Mathematics could be their major or minor subject. A summary of the pedagogy (curriculum studies) and content courses the PGDE(S) trainees and the BSc / BA (Ed) degree programme trainees take in preparation to be secondary school mathematics teachers are given in Appendix II.

Trainee teachers in the PGDE(S) programme are university graduates and during the programme they are prepared to teach two main subjects, which are determined by the MOE based on their undergraduate study. For example a Science graduate who majored in Mathematics and minored in Physics at the university would be required to take two Curriculum Studies Options (CSO) of which the first would be Mathematics and the second would be Physics. Similarly an Arts graduate who majored in English Language and minored in Mathematics would take English Language as his/her first CSO and Mathematics as his/her second CSO.

In both the programmes, the curriculum studies course which is in essence a mathematics pedagogy course, is similar. This course is meant to equip trainees for the beginning of their journey as secondary school mathematics teachers. Hence, emphasis is placed on basically understanding the philosophy and framework of Singapore's school mathematics curriculum (see figure 1), learning theories that guide the teaching strategies for the learning of mathematics, conceptual understanding of the secondary school mathematics topics and modes of assessment of mathematics. The course also introduces the trainees to the prevailing MOE's initiatives, such as National Education, Information Technology and The Thinking Programme (Kaur, 2002), through the infusion of these initiatives in classroom ideas for the teaching of particular topics in the mathematics curriculum. Implicit to the entire course are modeling of attributes such as metacognition and attitudes by the tutors of the course which are essential components of the school mathematics curriculum in Singapore.



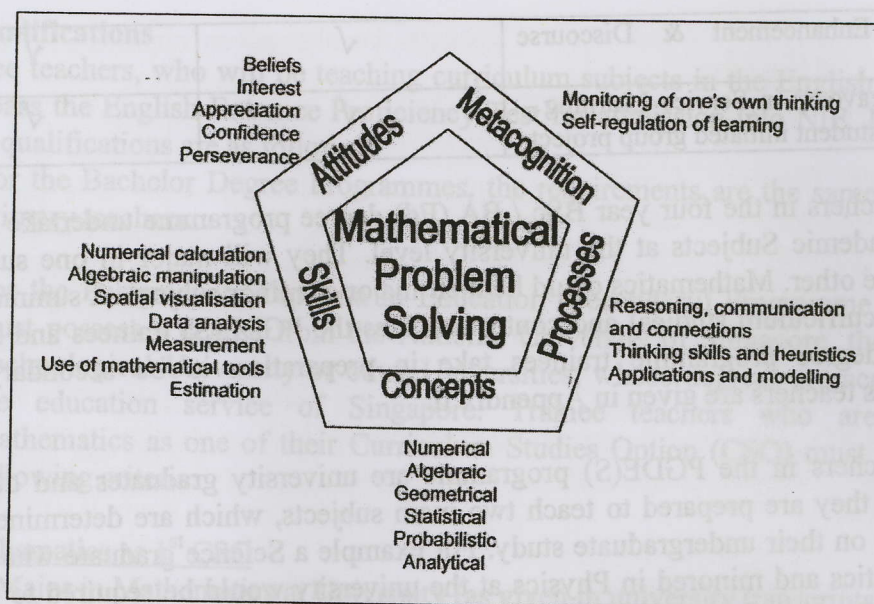


Figure 1: Framework of the Mathematics Curriculum  
(Ministry of Education, 2006)

For both the programmes, there is no explicit curriculum that deals with subject knowledge. The content knowledge of trainees in the BSc / BA (Ed) degree programme is sufficient as it is apparent from their study of mathematics at university level at the NIE. For the PGDE(S) programme, the historical assumption has been that since the trainees are graduates with mathematics as a subject at their undergraduate education they should have sufficient knowledge of mathematics to teach at secondary level. However, the profile of trainees in the PGDE(S) programme doing Curriculum Studies (Mathematics) in the last few years has spanned a large range, from some trainees having an honours degree in mathematics to others who have a university degree but only an 'A' level qualification in mathematics. Therefore the 2001 PGDE(S) cohort of trainees were assessed for their content knowledge of "Ordinary" (O) level Mathematics at the onset of their study at NIE. Pupils in the secondary school take the O level Mathematics national examination at the end of their secondary schooling. The performance of the trainees raised some cause for concern and hence the Mathematics and Mathematics Education Academic Group in NIE has put in place the Secondary School Mastery Test (SSMT) and trainees are expected to pass within three attempts before leaving NIE. The other significant component of their preparation is Teaching Practice in school. This will be described in some detail in the section school-based work.

### Assessment of training institution component

The institution-based component is mainly assessed through a combination of

- in-class quizzes and tests
- written assignments
- individual presentations
- group presentations
- end-of-semester examination (for Academic Studies)



### School-based work

Table 6 shows the duration of practicum in each of the two programmes.

Table 6: Teaching practice for the pre-service programmes

Programme	Duration of Programme (years)	Teaching practice duration
PGDE(S)	1	10 weeks of Teaching Practice
BA (Ed) [Secondary] BSc (Ed)[Secondary]	4	2 weeks of School Experience in year 1 5 weeks of Teaching Assistantship in year 2 5 weeks of Teaching Practice in year 3 10 weeks of Teaching Practice in year 4

The scope, nature and assessment of school-based work are the same as those in the Primary Section reported earlier.

### Strengths of current provision

Some strengths of the current training provision are as follows:

- The training has a good balance of theory and practice.
- The partnership model of practicum supervision has given the schools an opportunity to play a greater role in teacher training.
- An attempt is being made to improve the mathematical content knowledge of prospective mathematics teachers. Non-graduate primary pre-service mathematics teachers do subject knowledge (Mathematics) and secondary pre-service mathematics teachers have to pass the compulsory module Essential Mathematics for Secondary Teachers.
- There are opportunities for non-graduate trained teachers to read for a degree in NIE. Trainees who have excelled in the Diploma programme may be admitted to the third year of the Degree Programme.

### Problems of current provision

Some problems of current provision are as follows:

- The introduction of PGDE Lower Secondary Mathematics course in 1995 has helped in increasing the number of mathematics teachers trained but there can be problems in deploying these teachers since they can only teach mathematics at lower secondary level.
- In recent years, a high percentage of trainees in the PGDE (Sec) programme are engineering graduates who have only done engineering mathematics at the university level. Very often, these teachers have not been exposed to the more rigorous reasoning and proofs of the fundamental concepts of pure mathematics. There seems to be a need to provide more content-based in-service training for secondary mathematics teachers.
- It is often very difficult for teachers to find time for professional development. Unlike teachers attending full-time courses like the Diploma in Departmental Management, teachers attending in-service courses at NIE have to do so during out-of-school time. As teachers spend a lot of their out-of-class time during the



school day attending meetings, carrying out administrative work and extra-curricular activities, they are not able to focus on their professional development.

### Other relevant issues concerning training

- An effective teacher must possess both pedagogic knowledge as well as content knowledge. Specialists at NIE in each of the areas have legitimate concerns about the limited time available to teach their disciplines. What is the appropriate balance between the content and pedagogic courses in a programme?
- Many school principals believe that a great teacher in the making is one with the appropriate professional attitude. How can applicants with positive attitudes be identified during the recruitment exercises? How can NIE help the trainees develop positive attitudes toward teaching?
- It has been noted that trainees with some field experience prior to their enrolment at NIE, appear to be more receptive to training. They also tend to be more focused and seek solutions to the problems they encountered during contract teaching. Hence, should all trainee teachers be first sent to schools for contract teaching for a period of time, say 3 – 6 months, before embarking on their training at NIE? Should the schools-NIE collaboration be extended to contract teaching as well?
- The revised and better salary scales for the newly trained teachers have attracted many applicants to the education service, but monetary reward alone seems to lose its attraction to many teachers after a while. Why do qualified teachers leave the teaching profession? What more needs to be done to improve the status of the teaching profession?

These problems and issues defy easy solutions. MOE, NIE, the schools and the teachers have to work together to address them.

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This paper has been accepted for publication in the first of the series of publications for the International Comparative Study on Mathematics Teacher training directed by Prof David Burghes from CIMT at University of Plymouth, UK to be published by the Centre for British Teachers in the UK by December 2007.



# Appendix I

## Dip Ed, BA / BSc (Education) [Primary] and PGDE(P) Curriculum Studies and Subject Knowledge Modules

Programme: Dip Ed Programme	
Curriculum Studies	<p><b>Duration:</b> 96 h (DCM 100 [36 h]; DCM 200 [36h]; DCM 201 [24h])</p> <p><b>Scope:</b> Overview of the Singapore Primary Mathematics Curriculum. National Education infusion; Preparation of Scheme of Work and Lesson Plans. Pedagogical Strategies and Psychological Theories; Teaching of Primary School Mathematics Curriculum Topics. Teaching Problem Solving and Investigations; Mathematical Communication; Use of ICT and common pupils' errors will be dealt with in the teaching of various topics. Various traditional assessment modes in Mathematics and the use of these modes in schools to assess pupil performance, in particular, the planning and construction of test items. Practice of teaching skills by trainees, including catering for pupils of mixed abilities.</p> <p>#DCM 202[36h] for Upper Primary Specialist</p> <p>Further pedagogical skills for those who will go deeper into teaching mathematics especially at upper primary levels. Topics include: Games in Mathematics; Advanced use of ICT in Mathematics Teaching; Challenging Problems in Upper primary Mathematics. Student teachers will also undertake Independent Study Topics which will enhance their teaching repertoire.</p>
Subject Knowledge	<p>DSM 100 - Number Topics (36 h)</p> <p>DSM 101 - Geometry Topics (36 h)</p> <p>#DSM 200- Further Mathematics Topics (36 h) for Upper Primary Specialist</p>
Programme: BA / BSc (Ed)	
Curriculum Studies	<p><b>Duration:</b> 96 h (ACM 201 [36 h]; ACM 301 [36]; ACM 401 [24]</p> <p>*DSM 402 [24 h] for Upper Primary Specialist</p> <p><b>Scope:</b> Same as Dip Ed programme</p>
Subject Knowledge	<p><b>Duration:</b> 48 h (24 h in year 2 &amp; 24 h in year 3),</p> <p><b>Scope:</b></p> <p>For non-AS Math trainees:</p> <p>ASM 201 - Number Topics (24 h)</p> <p>ASM 301 - Geometry Topics (24 h)</p> <p># ASM 401 - Further Mathematics Topics (24 h) for Upper Primary Specialist</p> <p>For AS Math trainees:</p> <p>ASM 202 - Fundamental Principles of Primary Mathematics I (24 h)</p> <p>ASM 302 - Fundamental Principles of Primary Mathematics II(24 h)</p>
Programme : PGDE(P)	
Curriculum Studies	<p><b>Duration:</b> 96 h (QCM 501 [72 h]; QCM 502 [24 h])</p> <p><b>Scope:</b> Same as Dip Ed Programme</p>
Subject Knowledge	<p><b>Duration:</b> 48 h</p> <p>#QSM 501 – Number Topics (24 h)</p> <p>#QSM 502 – Geometry Topics (24 h)</p> <p># For Upper Primary Specialist</p>



## Appendix II

### PGDE(S) and BSc / BA (Education) [Secondary] Curriculum Studies and Subject Knowledge Modules

Programme	PGDE(S)
Curriculum Studies	<p><b>Duration:</b> 108 h (QCM 520 / 530 [72 h] &amp; QCM 521 / 531 (36 h)</p> <p><b>Scope:</b> Aims and objectives of mathematics education, Mathematics curriculum in Singapore, concept formation and learning theories in mathematics, teaching approaches and classroom organization, lesson planning, mathematics communication, metacognition, mathematical thinking and problem solving, technology in mathematics education. Teaching and learning of topics in the secondary school mathematics curriculum. Assessment in mathematics, test construction and marking. Project work and enrichment in mathematics at the secondary level. Hands-on sessions on the use of IT to teach mathematics. Classroom presentations of teaching ideas or practice of teaching skills, by trainees which will be critiqued by the tutor and fellow trainee teachers.</p>
Subject Knowledge	<p><b>No formal curriculum</b> but trainees must have the content knowledge to teach secondary school mathematics curriculum. They are required to pass the Secondary Mathematics Mastery Test within three attempts.</p>
Programme	BSc / BA (Ed) [Secondary]
Curriculum Studies	<p><b>Duration:</b> 144 h (ACM 321 [36 h]; ACM 322 [36 h]; ACM 421 [36 h]; ACM 422 [36 h])</p> <p><b>Scope:</b> same as that of the PGDE(S) programme</p>
Academic Subject	<p><b>Mathematics as a major subject:</b></p> <p><b>Duration:</b> 468 h (144 h [year 1]; 144 h [year 2]; 144 [year 3]; 36 [year4])</p> <p><b>Scope:</b></p> <p>Year 1: AAM 101: Calculus I (36 h); AAM 102: Algebra I (36 h); AAM 103: Finite Maths (36 h) &amp; AAM 104: Number theory (36 h)</p> <p>Year 2: AAM 201: Calculus II (36 h); AAM 202: Algebra II (36 h); AAM 203: Statistics I (36 h) &amp; AAM 204: Computational Maths (36 h)</p> <p>Year 3: AAM 331: Differential Eqns or AAM 332: Statistics II (36 h); AAM 341: Real Analysis or AAM 342: Modern Algebra (36 h); AAM 333: Modelling with Differential Eqns or AAM 334: Statistics III (36 h); AAM 343: Combinatorial Analysis or AAM 344: Complex Analysis (36 h)</p> <p>Year 4: AAM 431: Advanced Mathematical Modelling or AAM 432: Statistical Theory or AAM 433: Applied Statistics or AAM 434: Techniques in Operations Research or AAM 435: Mathematical Programming and Stochastic Processes or AAM 436: Metric Spaces or AAM 437: Galois Theory or AAM 438: Graph Theory or AAM 439: Geometry (36 h).</p> <p><b>Mathematics as a minor subject:</b></p> <p><b>Duration:</b> 288 h (144 h each in years 1 &amp; 2)</p> <p><b>Scope:</b></p> <p>Year 1: AAM 101: Calculus I (36 h); AAM 102: Algebra I (36 h); AAM 103: Finite Maths (36 h) &amp; AAM 104: Number theory (36 h)</p> <p>Year 2: AAM 201: Calculus II (36 h); AAM 202: Algebra II (36 h); AAM 203: Statistics I (36 h) &amp; AAM 204: Computational Maths (36 h)</p>