



PERSPECTIVE

International comparative study in Mathematics teacher training

Professor David Burghes

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Contents

Introduction	4
Mathematics Teacher Training in China	7
Mathematics Teacher Training in the Czech Republic	10
Mathematics Teacher Training in England	13
Mathematics Teacher Training in Finland	16
Mathematics Teacher Training in Hungary	19
Mathematics Teacher Training in Ireland	23
Mathematics Teacher Training in Japan	26
Mathematics Teacher Training in Russia	29
Mathematics Teacher Training in Singapore	33
Mathematics Teacher Training in Ukraine	36

Introduction

David Burghes, University of Plymouth

“...the quality of the education received by children depends on the intelligence, knowledge and professional skills of their teachers...”

Schools are seen by many people as a way to pass on the values and morals of society so that they are not lost, whilst others regard schools as a mechanism for achieving a better society through more education of the young. However, the quality of the education received by children depends on the intelligence, knowledge and professional skills of their teachers, which in turn depends on:

- the selection of the highest-achieving candidates
- high quality and inspirational pre-service
- high quality support in induction
- high quality continuing professional in-service education.

However these conditions are not always achieved, partly due to the demands and conflicting expectations of governments and the public. So, in practice, we often have:

- candidates who are not of the highest quality
- subject knowledge and research not linked to teaching practice
- teachers who are more concerned with practical issues to ensure survival
- teachers poorly paid
- schools under-funded
- training institutions out of touch with schools
- employment-based routes which tend to lower the quality and prestige of teacher education.

In summary, there are many issues and problems in teacher education but little practical research has been done to identify good practice.

Over the past decade, *The Centre for Innovation in Mathematics Teaching* (CIMT) based at the University of Plymouth has undertaken two international longitudinal research studies to identify the factors which give rise to good practice in mathematics teaching

and learning in secondary schools (Kassel Project) and primary schools (International Project on Mathematical Attainment). These projects involved monitoring the progress of pupils in mathematics over a number of years, using value-added analysis to identify pupils, classes and schools which over- or under-performed and determining the key factors in teaching and other strategies which made the difference. Both projects resulted in recommendations for good practice in the teaching and learning of mathematics in primary and secondary schools.

It is therefore a natural progression for our work to move on to initial teacher training in mathematics. As in our earlier research, we will undertake an international longitudinal study. The following countries have agreed to participate:

China, Czech Republic, England, Finland, Hungary, Ireland, Japan, Russia, Singapore and Ukraine.

Although this is a small number of countries, all apart from England have a good track record in mathematics teaching and learning generally but in particular, they had high progress scores in the Kassel Project and/or IPMA and represent a wide range of diverse practice. Most of the country coordinators have worked together for the past 10 years and have gained much insight from the collaboration.

The research commissioned by CfBT in December 2006 aims to determine good practice in the training of teachers of mathematics for both the primary and secondary sectors of education. Each country coordinator provided a summary and audit of the current forms of initial mathematics teacher training in his or her country and, in particular, reported on the strengths and problems of that provision and any other relevant issues concerning training. Their papers are provided in this document.

“ We will sample and track about 300 trainee teachers in both the primary and secondary sectors in their last year of training... ”

Particular issues to be considered for the duration of the project are:

- **Mathematical ability of trainees**

There are wide differences in the entry standard of trainees; in some countries, a good honours degree in Mathematics is required before a person can even be considered for a place on a training course for teaching secondary mathematics; and in the primary sector, trainees are expected to have studied mathematics up to the age of 18, whereas in England a grade C at GCSE is the modal entry qualification.

- **Length of training and level of award**

The Bologna declaration (1999) proposes a three + two years model for teacher training, where three years are spent on subject knowledge leading to an undergraduate degree or its equivalent, followed by two years of training, both practical and theoretical, leading to a Master's degree and a qualification that permits the trainee to teach in schools. However, this model has been widely interpreted in practice and in England there are one-year PGCE courses for both primary and secondary training.

- **Balance between theory and practice in training**

In some countries there is a genuine link between the two, with University Practice Schools being used to show how the theory is put into practice. In other countries, including England, there seems little linkage between the two, with the result that trainees do not have an educational foundation for their career.

- **Effective use of ICT to enhance training**

Some countries use ICT extensively to support their training courses. Information is provided electronically and lessons are videoed for discussion; assignments are submitted electronically and extensive use is made of whiteboard technology and software in the teaching of mathematics.

- **School-based work and its assessment**

There is huge variation among countries in this respect, with some countries expecting their trainees to undertake only a small number of lessons before passing, whereas we in England expect a greater amount of teaching. There is also the issue of consistency in the support provided in

different schools when a large number is used, whereas the University Practice School model seems to minimise this problem. Another crucial aspect is the assessment of trainees; in England we have detailed standards which easily lead to a tick-box mentality, whereas other countries have a much simpler system, based on constructive and detailed feedback and an 'exam' lesson at the end of the course.

- **Role of university tutors**

This relates to the school-based element. In England, tutors tend to be remote from schools and spend much of their time on quality assurance. This is very different in other countries where there is a more integrated policy.

- **Support of newly qualified teachers in their first teaching posts**

This is an extension to the proposed project that would require a further year to monitor the progress of the trainees when taking up their first teaching post.

This research project will endeavour to provide the evidence to meet the aims above by implementing a one-year (with anticipated extension for a second year) longitudinal research study in which we select a sample of trainees on each of the main routes into teaching.

In England, for example, this will be:

- University-based training (PGCE and BEd)
- Employment-based training (GTP).

We will sample and track about 300 trainee teachers in both the primary and secondary sectors in their last year of training, selected in proportion to the numbers on the different training routes and from representative locations in the country, for an in-depth study.

The information (* means computer based) sought from the trainees will include:

- (a) mathematics audit* taken at the start and end of the year
- (b) personal details*, including attitudes towards mathematics and teaching
- (c) progress report on training, including an online diary entry for each week of the course for a sub-sample of trainees

- (d) questionnaire* on all aspects of the course, including school-based work
- (e) video evidence of teaching practice, with sample clips from the beginning and end of the teaching practice to monitor the progress of the sub-sample.

We will also observe and interview a significant proportion of the selected sample in order to gain more understanding of the data collected and to help clarify aspects of current good practice in each country.

The trainees will also have the facility of an e-Portfolio system (developed for us by the Faculty of Medicine at Newcastle University) to support their learning and help provide a community of trainee mathematics teachers from around the world.

Online questionnaires and personal interviews will also be undertaken with both school-based mentors and university tutors, particularly those linked to the trainees, and in these cases mentors' and tutors' lessons and feedback sessions to trainees will be observed.

With the proposed extension, we will also have some evidence on the retention rate of trainees in their first year of teaching and, in particular, what is the most effective support given to new teachers that would improve the retention rate. If possible, we would also want to follow the sample for one further year.

The first meeting of the country coordinators took place at the Latimer Conference in Buckinghamshire on 4–6 May 2007 to discuss methodology, finalise the research instruments and establish agreed protocols. The report of this first meeting, as well as other background information and assessment instruments to be used, can be viewed at the project's website: <http://www.cimt.plymouth.ac.uk/ittp/>

The report is also available on www.cfbt.com/evidenceforeducation

The information from all countries will be processed at CIMT, leading to meetings of project coordinators from each country, with a view to obtaining agreement on what constitutes (and what conditions facilitate) good practice, in the training of teachers of mathematics in both the primary and secondary sectors. The next meeting of country coordinators will be held in August 2008 to review the data and agree recommendations for good practice, in training teachers of mathematics.

We hope that you will find these initial papers informative, interesting and a relevant starting point to our research.

Mathematics Teacher Training in **China**

Yanming Wang, University of Science and Technology of Suzhou, P. R. China



“...to ensure that teachers are suitably qualified and committed to undertake the training of talented personnel for science and technology...”

1. Overview

Social and educational reforms over the past 20 years have had a huge impact on teacher training in China. Two actions are currently being implemented in teacher training: firstly, to ensure that teachers are suitably qualified and committed to undertake the training of talented personnel for science and technology (considered essential for the country's modernisation), the government decided (1998) to improve teacher training in general; secondly, to provide sufficient teachers for the increasing number of schools resulting from the move (since 1986) to nine-year compulsory education, the government called for the establishment of a highly

qualified contingent of primary and secondary school teachers. Investment in teacher training is recognised as being essential to the country's modernisation.

The table below summarises some of the main features of ITT courses in China.

2. School Based Work

Primary

(a) Observing teaching

Generally, student teachers spend two weeks observing teaching and working as teaching assistants, helping with the marking of homework, and as lunchtime assistants.

	Primary	Junior Secondary	Senior Secondary
Entry route			
Length of course and qualification	3 or 4 year course leading to Bachelor Diploma ¹ and Certificate of Teacher Training	4 year Bachelor Diploma/Bachelor Degree and Certificate of Teacher Training (² Bachelor degree required for senior secondary teaching)	
Entry qualification	Entrance exam for 16+ junior secondary school graduates (including Chinese, Mathematics, English and Physics)	National entrance exam for senior secondary school graduates	
Course components	Compulsory subject and methodology/ pedagogy courses Optional courses (to support local development needs) School-based work Extra-curricular activities	Pedagogy Psychology Educational Technology Mathematics and applied Mathematics Computer Science Teaching Practice Dissertation	

¹ There are some four-year courses where the trainees are awarded a Bachelor degree when they graduate.

² Some Master's degree graduates have recently become senior secondary school teachers in the developed and coastal areas in China.



“Teacher education had been promoted to a much higher status than ever so the strategic status of teacher education and the necessity and importance for its development are further strengthened.”

(b) Teaching classes

Towards the end of their third year of training, student teachers usually teach six weeks in a local school, teaching one or two lessons each day.

Students work as groups in a school with between six and eight students in a group. Training teachers from the institution, school teachers and the other students in the group observe each student's teaching, with feedback and discussion after each lesson.

(c) Schools used for training

Local primary schools are used for teaching practice. The government stipulates that local schools must work with training institutions to provide experience for trainee teachers; some are more willing to comply than others, but, in general, schools have close relationships with their partner institutions and training colleges.

(d) Assessment of the school-based component

The formal requirements for students' teaching practice are that student teachers should observe lessons for about two weeks and then teach at least 12 lessons by themselves, under the observation of their instructing teachers (school teachers and, usually, their teacher training institution teachers). The student teachers must check the pupils' homework each day and give extra help to the pupils when necessary during lunchtimes or after school.

The teacher training institution and school teachers involved decide whether or not the formal requirements have been fulfilled although, in practice, the decision rests mainly with the institution. It is very unusual for a student teacher to fail his or her teaching practice.

The teaching practice handbook lists the formal requirements of the teaching practice.

Secondary

(a) Observing

In the first two weeks of teaching experience, student teachers observe lessons and mark the homework each day.

(b) Teaching classes

Student teachers must teach at least eight lessons by themselves under the observations

of the instructing teachers (school's teachers, sometimes the university teachers). The student teachers must check the pupils' homework every day and give extra help to pupils when necessary during lunchtime or after school.

(c) Schools used for training

Institutions use local secondary schools for training. As for primary teacher training, the government stipulates that local schools must work with training institutions to provide experience for trainee teachers; here again some are more willing to comply than others, but, in general, schools do have close relationships with their partner institutions.

Usually, a group of six or eight trainee teachers will be placed in a mathematics department and the schools will also have trainee teachers in other subjects.

(d) Assessment of the school-based component

Teachers from the institution, teachers from the training school and other members of the group of trainee teachers, observe each trainee's lessons and take part in a feedback and comment session immediately after each lesson.

The instructing teachers from the university decide the final mark of the student teachers for their teaching practice, after discussion with teachers in the training-practice school.

3. Strengths of the current provision

There is emphasis on the qualifications of primary and secondary teachers and on the ability, application and practice of student teachers.

The Reform of the Educational System pointed out that the development of teacher education and training for in-service teachers should be regarded as strategic measures in developing education. Teacher education had been promoted to a much higher status than ever so the strategic status of teacher education and the necessity and importance for its development are further strengthened. The quality of teaching and the academic competence of the faculty



“ As has been the case for a long time, teaching remains a relatively unattractive profession for the most academically qualified and ambitious young people. ”

members in the teacher training institutions are comprehensively improved through these reforms. Many achievements in scientific research, especially in educational research, are being accomplished.

4. Problems of the current provision

Some of the training issues of concern are:

- the low status of teachers, although this does seem to be improving
- the pressure of tests and examinations during the courses
- increasing gaps between families who can afford to pay high fees for their children and those dependent on the state's provision
- often students who would be suitable to train as teachers are unable to continue in education because of financial hardship
- the best-qualified students often apply to study subjects such as law and medicine rather than train to become teachers.

As has been the case for a long time, teaching remains a relatively unattractive profession for the most academically qualified and ambitious young people. Salaries are relatively low, and the professional standing of education faculties

within universities tends to be lower than that of professions such as engineering, medicine and law. Normal universities and colleges can recruit only the second or third tier of students, in terms of academic achievement in the unified higher education entry examinations, relative to comprehensive and engineering universities which tend to recruit the most able students. Recently, however, this situation has begun to change. With the noticeable improvement in teachers' salaries in major urban areas and the national priority given to education, large numbers of talented young people are being attracted to what they see as a career providing both stability and professional standing.

5. Other Relevant Issues concerning training

Teacher training has faced strong influences from the market economy, reformation of the volatility of the information era and the existing crisis in teachers' education. How to integrate the eastern fine tradition of respecting teachers with the progressive idea of western teacher's education at a high level is a worthwhile subject deserving an in-depth study to inform China's teacher education in the 21st century.

Mathematics Teacher Training in the Czech Republic

Miroslav Belik and Tomas Zdrahal, J.E.Purkyne University, Usti nad Laben



“ Students who would like to become teachers and graduated in majors other than the teacher training programmes have to complete their education by taking classes such as pedagogy, psychology, didactics of subjects etc. during three or four semesters. ”

1. Overview

Universities in the Czech Republic develop their own study programmes for their study majors accredited by the Accreditation Committee, which reviews a detailed description of each course and programme. The Committee, established by the State Department of Education, comprises distinguished experts in the given study field and evaluates whether the university has adequate faculty members, facilities and equipment for the proposed study programme. Additionally, it reviews whether the programme coincides with legal regulations and can be financially supported from the State budget. During accreditation, the Committee may audit the programme to verify that given conditions are being met, and it has the right to cancel the accreditation if the contract is breached. An accredited degree programme provides a higher education which terminates in a state examination and the awarding of a degree (Bc., Mgr. and Ph.D.). In accordance with the Higher Education Act, Master's programmes that do not follow a Bachelor's programme may be accredited and offered, though only on an exceptional basis – *this is the case with Primary Mathematics Teacher Training.*

The study mode may take the form of on-site, combined or distance studies. The on-site mode is mostly based on class attendance, while the distance mode comprises independent learning complemented by consultations with teachers. The combined mode shares features of the two other modes; classes are usually concentrated in blocks.

Students who would like to become teachers and graduated in majors other than the teacher training programmes have to complete their education by taking classes such as pedagogy, psychology, didactics of subjects etc. during three or four semesters.

The table overleaf summarises some of the main features of ITT courses in the Czech Republic.

2. School Based Work

Primary

Although teacher training programmes at various universities may vary, the time requirements and methods of field experiences in these programmes differ only slightly. Most of the teacher training programmes include the following forms of teaching field experience:

(a) Direct Field Experience

As a part of course requirements, a group of 15 to 20 students regularly attends class instruction at local schools under the supervision of a college department instructor. The time requirements are 60 hours over the course of the training programme. The students observe class lessons taught by an experienced teacher followed by detailed discussion and each student also prepares and teaches a class lesson. The advantage of this form of teaching experience is the regular and direct student participation in the teaching process and subsequent analysis and feedback of teaching methods. The difficulty with this approach is that it is time consuming and requires great adjustments and flexibility of the university courses. The schoolteachers also criticise the frequent disruptions of regular class instruction. Financial compensation of teachers who prepare model lessons and participate in the post-lesson analysis constitutes another difficulty. In the past, one partner school was selected to participate in the directed field experience programme. The teachers' contract provided additional time for advanced preparation by reducing the amount of their instructional hours per week. However, these arrangements could not be renewed and the university now has to cover the financial expenses. Therefore, this form of teaching experience is being used less and is often replaced by videotaped class lesson demonstrations and clinical teaching experience.

(b) Continuous Student Teaching

During the course of the study, the students have to complete 3 continuous student teaching



“ Students are supervised by master teachers, participate in all school activities and become familiar with school administration. ”

	Primary	Secondary
Entry route Length of course and qualifications	5-year Masters degree ¹	3-year Bachelor degree + 2-year Masters degree (from 2007–08) ³
Entry qualifications	High school diploma and leaving exam Psychological testing (some Universities) Oral interview evaluates general knowledge	
	University entrance exam (mathematics, Czech, abilities audition for music, fine arts and sports) ²	University entrance exam (mathematics plus second subject) ⁴
Course components	All primary subjects Specialist subject Didactics Pedagogy Psychology IT Foreign language Social studies	Mathematics Second specialist subject Didactics Pedagogy Psychology IT Two foreign languages
Time in school	12 weeks over 3 blocks	
¹ 5-year course from 2007–08: previously a 4-year course ² Czech and mathematics may be waived for outstanding high school graduates in these subjects ³ Previously 5-year Masters ⁴ Mathematics test may be waived for outstanding high school mathematics graduates		

experiences with a total of 12 weeks of teaching practice at schools close to their university or in the town of their permanent residence. Students are supervised by master teachers, participate in all school activities and become familiar with school administration. The students are also supervised by university instructors.

The students prefer this form of teaching experience and ask for longer student teaching time requirements. However, student teaching presents a great financial expense to the university and, consequently, the time requirements for this form of teaching experience have been reduced. Therefore, new methods of teaching field experience are being investigated.

(c) Clinical Teaching Experience

Students observe class lessons and teach their own instructional lessons in participating schools. Analysis of the lessons and feedback are discussed during ‘methods of teaching’ seminars at the university. The students

complete 14 clinical teaching hours over the course of their training programme. Originally, this approach was meant to supplement the other methods of teaching practice but, recently, the clinical teaching experience tends to replace the directed field experience approach.

Participating schools sign a contract with the University prior to the beginning of the student teaching experience regarding the conditions of the experience, extent and supervision of student work, methods of evaluation etc. The supervising teacher assists the student with development of lesson plans, provides analysis and feedback of lessons and evaluates the student’s performance including a final written evaluation. The faculty of the University Mathematics Department also conducts evaluation of the student teaching experience. Final evaluation is completed by the designated faculty member of the Mathematics Department based on the written report from the supervising teacher and written lesson plans that the student must submit.



Secondary

The student teaching experience in the training programmes for secondary levels (middle school and high school) is focused on clinical and continuous teaching experience. The administration and organisation of the student teaching experience is similar to the experience for students attending the primary level training programme. The clinical practicum is conducted in groups of 15–20 students. The components of this practicum are described above. The continuous student teaching experience is usually individual. Some universities use their own practicum school for the student teaching experience; however, most universities use local, regular public schools to provide their students with teaching experience.

The teaching field experience is a subject of a continuous discussion in the Czech Republic. Educational experts state that the mathematics graduates are theoretically well prepared; however, they seem to need more experience applying the learned methods of teaching in the classroom. Beginning teachers are often criticised for their lack of psychological preparedness and communication skills with pupils and parents. The graduates also underestimate the educational agenda of the school administration. Increasing the quality and time requirements of the teaching field experiences would help to improve these concerns.

The student teaching experience and its evaluation is similar to the practicum for the primary level training programme as described above.

3. Strengths of the current provision

The strength of educating future teachers in the Czech Republic is a unified system of teacher training programmes.

Each region has several education centres that organise lectures and workshops, usually provided by universities' faculty members or experienced schoolteachers. Universities with teacher training programmes regularly offer workshops for the public, with emphasis on the didactics of given subjects.

4. Problems of the current provision

The main problems are insufficient funds to ensure updated multimedia equipment in classrooms and laboratories, updated software and adequate and competitive faculty salaries. In particular, salaries of younger, less experienced faculty members are well below the average salary in the Czech Republic, causing young teachers to leave the universities and find other jobs in the business sector.

The compulsory continuous education programme that was provided by universities was discontinued because it was found ineffective. Since then many different projects were proposed but none was accepted and adopted. Currently, the school principals are responsible for the continuous educational development of their teachers but allocated funds are insufficient to encompass all their educational needs.

5. Other Relevant Issues concerning training

The principal at each school assigns an experienced teacher with the same subject major to coach the first-year teacher and assist him or her with lesson plans, pupil evaluation and parent communication. Each school also has *subject committees*, comprising teachers with the same subject major, that coordinate the subject curriculum in the school. They collaborate on developing lesson plans and share their experiences. The school principal reviews and evaluates the teaching methods and other activities of the first-year teacher and makes decisions regarding the teacher's further functioning and responsibilities at the school.

Mathematics Teacher Training in England

David Burghes and Robert Smith, University of Plymouth



“ Teach First is an initiative to persuade graduates with a good degree in Mathematics or a Mathematics related subject to spend at least two years teaching mathematics in challenging secondary schools in London and Manchester. ”

1. Overview

Most initial teacher training in England (over 90%) is undertaken by universities in partnership with local schools but there are other routes into teaching approved by the Training and Development Agency for Schools (TDA) such as School-centred Initial Teacher Training Courses (SCITTs), the Graduate Teacher Programme (GTP) and **Teach First**.

School-centred Initial Teacher Training courses (SCITTs) are normally run by a group of schools in a particular area, with the involvement of a university for accreditation and, in some cases, direct involvement (e.g. trainee teachers spending one day a week at the university).

On the Graduate Teacher Programme (GTP), graduates are employed at a lower level of pay than qualified teachers to teach and essentially

learn ‘on the job’. These trainees usually have one day each week allocated for training at a local college or university. This is becoming a more popular route into teaching but it has a high dropout rate. It does, though, provide the means for mature students with dependents to undertake a semi-funded career change.

Teach First is an initiative to persuade graduates with a good degree in Mathematics or a Mathematics related subject to spend at least two years teaching mathematics in challenging secondary schools in London and Manchester. After an intensive 6-week training period they start teaching at the beginning of the school year in September. The idea is to get high quality graduates to act as role models to encourage pupils to consider going to University.

The following table summarises some of the main features of ITT courses in England:

	Primary (5–11)		Secondary (11–16/18)
Entry route	BEd	PGCE	PGCE
Length of course and qualification	3 or 4 year degree course leading to Qualified Teacher Status (QTS)	1 year Post Graduate Certificate in Education (PGCE) leading to QTS	
Entry qualification	2 relevant A-level passes GCSE grade C+ in Mathematics, English and Science	Relevant degree GCSE grade C+ in Mathematics, English and Science	Mathematics (or mathematically-based) degree GCSE grade C+ in Mathematics, English and Science
Course components	Professional studies Subject study School-based work		
Time in school	At least 24 (3 year) or 32 weeks (4 year) spread out in blocks over the course	At least 18 weeks (2 or more schools)	24 weeks in two or more schools.
All trainee teachers – primary and secondary – are required to pass the TDA’s national computerised tests in Numeracy, Literacy and ICT before obtaining QTS. (They can retake these tests as many times as necessary.)			

“ Normally, a trainee teacher in mathematics will be the sole trainee in the department, although the school will probably have trainee teachers in other subjects so some of their professional work will be undertaken with these other trainees. ”

2. School Based Work

Primary

(a) Observing

In the first few weeks of teaching experience, a trainee teacher will only observe and act as a classroom assistant. Normally a trainee teacher will be attached to a particular class teacher and will see a full range of teaching in *all* subjects.

(b) Teaching classes

Initially, trainee teachers often start teaching just parts of lessons but will eventually take over whole lessons and, over two practices, be expected to have experience of teaching all subjects.

(c) Schools used for training

Institutions use ‘partner’ schools for training. These are often local but might be at a considerable distance from the institution. Typically, an institution with 100 trainee teachers could be using up to 100 partner schools for the two required placements. This inevitably means that quality control is not perfect and teacher training institutions are often struggling to find sufficient places in schools for all their trainees.

(d) Assessment of the school-based component

Normally, trainee teachers will have weekly reviews of their progress in the components of teaching standards that have to be met (see <http://www.tda.gov.uk/partners/ittstandards.aspx>). Often the trainee teacher will have a school mentor to oversee his or her progress. There will also be termly (or half-termly) visits from a visiting tutor (appointed by the institution) whose main role is quality assurance; that is, to ensure that the school is providing the necessary support for the trainee.

Secondary

(a) Observing

In the first few weeks of teaching experience, trainee teachers will observe, then gradually take over the teaching of classes.

(b) Teaching classes

Trainee teachers are required to have at least 12 hours’ contact time with classes each week. By the end of the second practice they

will be expected to be teaching whole lessons for at least 12 hours per week (which is about two thirds of the timetable of an established full-time teacher).

(c) Schools used for training

As with primary, there is often a shortage of high quality placements and of expert teachers to supervise and mentor the trainees. Often schools are keen to have a mathematics trainee teacher in the hope that (if capable) he or she will apply for a job there.

Normally, a trainee teacher in mathematics will be the sole trainee in the department, although the school will probably have trainee teachers in other subjects so some of their professional work will be undertaken with these other trainees.

(d) Assessment of the school-based component of the course

The secondary school will have an ITT Coordinator with overall responsibility for the training and assessment of trainee teachers. There is usually a weekly tutorial for trainee teachers with the mentor who will probably not be a mathematics teacher. A member of the mathematics department will have day-to-day responsibility for the training. The time available to support the trainees is limited but in the best schools they are given considerable support, help and advice.

There will also be termly (or half-termly) visits by a university tutor, as for primary trainees.

The final assessment is very much the responsibility of the school, but the university visiting tutor and, possibly, the university’s external examiner, will also contribute to this process. If a trainee teacher does not meet the standards, he or she is usually given an opportunity to repeat the teaching practice.

3. Strengths of the current provision

- The courses have a strong, school-based component (about two thirds of the PGCE course).
- Trainee teachers have opportunities to observe good teachers and are encouraged to become reflective practitioners.

“...research in the USA found that pupils made most progress when taught by effective teachers who have more than five years’ teaching experience.”

- Teacher trainers are usually dedicated and inspirational teachers of mathematics who work hard to provide high quality training for their trainees.

4. Problems of the current provision

- The status and morale of the teaching profession is low and many newly qualified teachers leave the profession after only one or two years, whereas research tells us that it takes five years for even good teachers to reach their peak as a teacher.
- The use of numerous schools for school-based work means that there is no consistency of support for all trainees. Not all mentors and subject tutors are themselves expert teachers.
- As the standards to be met are listed, there is a tendency for a ‘tick-box mentality’ to prevail, with paperwork dominating the proceedings.
- Some of the staff in teacher training institutions lose touch with school developments (there is no compulsion for such staff to teach regularly in schools or even to visit them).
- Many incoming primary teachers do not have any real understanding of the foundations of mathematics and its key concepts.

5. Other Relevant Issues concerning training

The training process has changed very much over the past 15 years, with all courses now having a strong school-based component. Despite reasonable salary increases, teaching is regarded as a fairly unattractive profession compared with doctors, dentists, lawyers, accountants, etc.

Although the TDA’s advertising and promotion campaign has increased the numbers coming into mathematics teaching, the retention rate is very low. For example, it has been suggested that over 40% of qualified mathematics teachers leave the profession within three years of completing their training, so it only takes six years to train a completely new cohort of teachers for secondary mathematics. This is worrying, as research in the USA found that pupils made most progress when taught by effective teachers who have more than five years’ teaching experience.

The system is based on accountability rather than mutual trust, with:

- Ofsted inspections of schools and training institutions
- national tests for pupils at ages 7, 11, 14, 16, 17 and 18, resulting in published school league tables
- paperwork dominating almost all aspects of the profession
- little scope for creativity.

If effective and creative mathematics teachers are to be attracted into the profession and retained in our schools, then some of these wider issues must be addressed.

Mathematics Teacher Training in Finland

George Malaty, University of Joensuu



1. Overview

In Finland, secondary school teacher training has always been provided only by universities. Primary school teacher training started in the 19th century at special institutes called seminars, but this changed in the 20th century to be provided also only by universities.

Education as a science has a special place in teacher training, starting in the 19th century with the establishment of the first university professorship for Education. In parallel to the interest in the Science of Education, practical training has had a remarkable place in teacher training. This can be seen from the tradition of providing teaching practice in University Practice Schools, where each teacher training

department has its own Practice School. The first Teaching Practice School was established in the 19th century.

Primary

In 2005, Finland had to implement the Bologna declaration of 1999. Nevertheless, the Finnish implementation has not significantly changed primary teacher training. The study has been changed from 160 credit units to 300 points in two cycles:

- Bachelor cycle (180 points) takes place in the first three years
- Master cycle (120 points) takes place in the third and fourth year.

“ In Finland, secondary school teacher training has always been provided only by universities. ”

	Primary (7–11)	Secondary (11–16/18)
Entry route	Bachelor degree plus M.Ed.	Bachelor degree plus MSc. (in which mathematics is major or minor)
Length of course*	4 or 5 years, of which 3 are on the Bachelor cycle	6+ years Mathematics majors – Senior Secondary Mathematics minors – Junior Secondary
Entry qualification	Secondary school graduation (matriculation), 'performance points', study achievement points and Faculty of Education Final Selective Tests.	Secondary school matriculation – good graduates in mathematics are exempt from further tests but others take a University-set examination in 'Long Mathematics'.
Course components Bachelor degree	Education 12 school subjects and their didactics Language, communication and ICT Minor specialisation study	Mathematics major Chemistry/physics/computer science minor Education minor Language and communication
Course components M Ed	Education Thesis Language and communication Minor study	Mathematics major (with thesis) Chemistry/physics/computer science minor Education minor Language and communication

* Courses in Finland are organised around courses and points rather than time.



“ At the moment we are in a transitional stage between the old organisation of curriculum and the new one, which has to meet with the Bologna Declaration. ”

As the study is organised in courses and thesis, students can complete in less than five years.

At the moment we are in a transitional stage between the old organisation of curriculum and the new one, which has to meet with the Bologna Declaration. Nevertheless, our faculties of education have decided not to make any significant change in the old curriculum.

Obligatory courses in mathematics account for about 6 points out of the 300 points of the whole study. This forms 2% of study points. In addition, there is a chance to choose elective courses in mathematics. There is a maximum of 6 points for such elective courses.

One way to obtain more education in mathematics is to take mathematics as a minor specialisation. This can offer 25 or 60 points more. Note that choosing 60 points for a minor is possible as there is no real boundary between Bachelor and Master cycles.

Traditionally, at the University of Joensuu most students choose mathematics as their specialisation. This has led to the University becoming a 'Centre of Excellence in Mathematics Teacher Training', awarded by The Higher Council of Education.

Secondary Mathematics

The study has changed to become two cycles. Where mathematics is the major:

- The Bachelor cycle (180 points) has at least 70 points in mathematics. One of the possible minors is Education, including Teaching Practice.
- The Master cycle (120 points) includes 60 points in mathematics, to end with a thesis.

2. School Based Work

Teaching practice for both primary and secondary is a part of educational studies.

The Bachelor cycle includes:

- 8 points for teaching practice:
- 3 points for 'Orientation Teaching Practice' and
- 5 points for 'Basic Teaching Practice'.

The Master cycle includes:

- 12 points for teaching practice:
- 3 points for 'Applied Teaching Practice' and
- 8 points for 'Deep Teaching'

All universities which undertake teaching practice have University Practice Schools which are state schools but part of the university. Teaching practice schools are normally inside the university campus and close to teacher training departments, where mathematics education specialists are also teaching practice tutors.

3 Strengths of the current provision

The Finnish teacher training programme has the following strengths:

- The level of qualification in teacher education is high.

As mentioned above regarding the teaching qualification, every schoolteacher must achieve a Master degree:

- an MEd for a primary school teacher (Grades 1–6)
- an MSc for a secondary school teacher (Grades 7–12).

- Teaching practice is provided in University Practice Schools.

Providing teaching practice in University Practice Schools offers an ideal environment where each trainee has the chance to receive close supervision from mathematics education specialists while university facilities such as the library are close at hand.

- It is able to recruit motivated students.

Entry to secondary mathematics teacher education in Finland is at a satisfactory level but primary teacher education is one of the most popular studies in higher education; the number of applicants for primary teacher education is five to six times greater than the number of places available. This is largely because of the status and respect accorded to primary school teachers who have long been seen as 'enlightening candles' for their communities. While salaries are not as high as other professions, Finnish youngsters remember their own primary schooling



“ *Most Finnish teachers remain in the profession throughout their working life...* ”

with great warmth: it is still quite usual to end the school day by shaking hands with the teacher and not uncommon to give the teacher a hug. This explains why the minor ‘Teaching Beginners’ is a popular choice of primary school teacher students.

- The profession of teaching is chosen for life.

Most Finnish teachers remain in the profession throughout their working life, the reason being related to two factors and their interplay. One is the pleasant work environment in Finnish schools and the second is society’s appreciation of teachers’ work. Key elements in the work environment are welfare and the daily traditions of school life, where care, comfort and equality are basic principles.

4. Problems of the current provision

In the training of primary school teachers, mathematics and mathematics didactics play a modest compulsory part. In secondary teacher training, it is still difficult to attract

those with higher mathematical abilities to mathematics departments and mathematics teacher training in particular. One of the outcomes of this problem is the high percentage of student dropout.

In addition, there are problems in teaching practice. Both the number of teaching practice periods and the length of each period are much shorter than before. Also, primary school teacher students have to teach only two school subjects, so they can obtain a Master’s degree without any teaching practice in mathematics.

For secondary school student teachers, mathematics education specialists are not involved in tutoring, which is left to practice school teachers, and this does not help in developing mathematics teaching at the secondary level. This is a serious problem, especially when we consider the fact that the part allocated to mathematics education in educational studies is a modest one.

Mathematics Teacher Training in Hungary

Dr. Tibor Szalontai, College of Nyíregyháza, Hungary



1. Overview

Hungary has a strong reputation for education and a tradition of expertise in mathematics and mathematics teaching. In the past, teaching was regarded as a very prestigious career, with a strong demand for places. In the Communist era, teachers were not only valued but also paid well in comparison with many other jobs and professions. This has partly changed during the last and this decade, with teachers still valued but no longer remunerated as well as before. This is particularly pertinent to mathematics since mathematics graduates now have many other well paid options available, particularly in the booming IT industry.

Hungary also has a different structure to its schools in different regions, with both primary and secondary schools but also general schools and separate kindergarten schools where education is not compulsory until the age of five. The main characteristics of the different sectors and their initial teacher training courses are summarised below:

Kindergarten Teacher Training course
Four-year (240-credit) complex BEd course for educating children aged 3–6 years

Children who are five years old must attend a kindergarten where they are prepared for primary school. This preparatory time is normally one year (although almost half of the children stay in the kindergarten for an extra year if parents or the kindergarten recommend it). Teachers are now trained for this sector with a four-year degree course.

Primary Teacher Training course
Four-year (240-credit) complex BEd course for teaching pupils in Years 1–6

Primary teachers usually teach classes only in Years 1–4, the current lower section of general school, but in larger schools teachers sometimes take classes in Years 5–6 in the subject of their specialisation. The Government

plans that primary teachers will teach all classes up to Year 6 in the future. The course consists of:

- social studies and informatics
- psychology and pedagogy
- seven academic subjects and their teaching methodologies for years 1–4
- school-based practice
- diploma work
- compulsory specialisation in a subject area for Years 5–6 (e.g. in mathematics), with advanced academic content, special teaching methodology and additional teaching practice.

The school-based practice is detailed in the next section.

The current two types of **secondary** teacher training courses are being phased out gradually from 2006 and this system is being changed to a unified two-year (120-credit) Master's degree teacher training course following a BSc degree. In the 2006/2007 academic year in Hungary there were no new entrants to secondary teacher training courses.

General School Mathematics plus Another Subject Teacher Training Course
Four-year (240-credit) complex Bachelor's degree course for teaching pupils in Years 5–10 of general schools

These subject teachers usually teach only in Years 5–8, the current upper section of general school. (At the moment, a very limited number of general schools extend to Year 10.)

The course consists of:

- scientific courses in two subjects
- pedagogical and psychological courses
- the two subject methodologies
- facultative and intellectual aspects

“Hungary has a strong reputation for education and a tradition of expertise in mathematics and mathematics teaching.”



- diploma work
- school-based work.

The school-based work is detailed in the next section.

Secondary School Mathematics plus Another Subject Teacher Training Course

Five-year (300-credit) complex MSc degree course for teaching pupils in Years 5–12 and also for teaching mathematics in higher education if the applicant has already attended a PhD course in mathematics

The majority of these subject teachers teach only in Years 9–12 (in four-year gymnasiums and technical and vocational secondaries) but an increasing number of gymnasiums run six-year and eight-year classes.

The structure of this course is similar to that of the previous course but it requires more knowledge of course subjects at advanced level in mathematics (and in the other subject). Teaching practice is in the final, fifth year and consists of both University Practice School (UPS) practice and a longer practice in an ordinary school.

2. School Based Work

Primary

The main points are summarised below:

- individual, complex, pedagogical and psychological practice at a University Practice School (UPS) and other schools over four semesters
- group teaching practice at the UPS for two semesters, 3 hours per week of a collaborative practice model of training in which trainees teach in front of their peer group, discuss the lesson, then prepare for the next group day
- group and individual teaching practice at the UPS for the next two semesters, consisting of 3 hours per week of collaborative practice; observation of lessons taught by the mentor teachers (and occasionally by peers) and two batches of 12 lessons taught individually
- complex, individual, teaching practice in an ordinary school for the last semester, with 50 lessons observed and taught over one month

- an examination lesson taught at the UPS in front of an examining committee consisting, at the very least, of a UPS mentor and a university tutor.

General/Secondary

The main points are summarised below:

- pedagogical and psychological group and individual observations and tasks
- group and individual teaching practice under the supervision of a UPS mentor, mathematics in one semester and the other subject in the other semester of the last year (using a collaborative practice model, consisting of 3 hours of group collaboration each week plus the observation of two batches of 15 lessons and teaching of two batches of 15 lessons, the last lesson for each subject being the teaching examination)
- individual school teaching practice under a mentor in an ordinary school for the last two weeks of each semester, when 25 lessons are observed and 25 lessons are taught in each subject.

One other important characteristic of the use of UPSs in the training process is the collaborative group practice which is detailed below:

- The 3-hour mathematics group day each week consists of a lesson observed by the group, then its discussion, and then preparation for the next group day.
- The first two lessons are demonstrated by the mentor, the next ones are taught by the trainees in order.
- About half of these group day lessons are also examination lessons (at the end of the trainees' individual periods) and this has a negative impact, since the gradual building up of lesson analysis abilities cannot be sustained. After the examination lesson, the need to participate in the remaining group days and the final two-week practice in ordinary schools might be questioned. However, because of the examination lessons, tutors' participation in group days is more frequent, which is again positive.
- The theme, curricular and class-specific information, the main aims and didactic tasks of the lesson are given briefly by the mentor for the lesson two weeks later and each trainee



“ Only the best teachers are used as mentors to show a rich variety of methods and effective classroom management. ”

has to produce a draft lesson plan, handing it in two to three days before the next group day. The mentor reads, corrects and comments on each plan and gives them back to the trainees at the start of the next group day.

- In the preparation session, first the mentor briefly evaluates each lesson plan, then the trainee and their ‘buddy’ (trainees work in pairs) present their plans, ideas and methods. After the other trainees contribute their ideas to the mentor’s suggestions, experiences and moderations, the trainee summarises the changes he or she would make to the plan. The trainee and buddy then prepare a detailed lesson plan, discussed and agreed by the mentor before the group day lesson.
- During the lesson, each group member must write down the lesson process, points noted, questions and remarks. Aside from this, there are special points to observe, set by the mentor in advance. Classically, observation was planned to evolve gradually from one or two viewpoints at the start to a complex observation and evaluation but in the case of examination lessons, a complex review is required from the teacher trainee, the buddy, the mentor and the tutor.
- The review of the lesson begins with a report and self-evaluation by the trainee who has taken the lesson, relating what actually happened to the aims and tasks planned. Then the buddy reflects on the lesson, followed by each of the other trainees. The discussion is led by the mentor, either as an open discussion or (since trainees are frequently asked to bring to bear their pedagogical, psychological and theoretical knowledge and embed it in concrete practice) focusing on assigned viewpoints. Each group member contributes.

3. Strengths of the current practice

- Both primary and secondary trainees have studied school mathematics up to Year 12 (some of them having chosen facultative, advanced mathematics in Year 11/12) and have sat the Matura Examination at intermediate or advanced level.
- The complex secondary training courses provide solid mathematical, pedagogical and mathematics methodological studies.

- The UPS system has advantages, especially in the first phase of teaching practice.
- Many good mentors have educated and influenced generations of trainees. Only the best teachers are used as mentors to show a rich variety of methods and effective classroom management. The good mentors are keen to learn good practice and ideas from each other.

4. Problems of the current practice

- Universities do not require the advanced level matura examination and this allows less able applicants also to enter mathematics teacher training courses.
- The Government’s Education Department no longer permits our current complex secondary teacher training and the new (MSc) secondary teacher training courses are not yet in place.
- The two remaining institutions (BSc colleges) which have been training mathematics teachers for general schools (Years 5–10), are not likely to achieve accreditation for the new MSc course because of competition for students by the mathematics university lobby, despite the fact that these colleges have a rich experience in the training of teachers for Years 5–8 mathematics.
- The new mathematics BSc course is less attractive than the mathematics teacher training courses were, so decreasing the number and standard of students applying.
- The main strength of the UPS system is the collaborative group work but not all practice schools or mentors use that effectively.
- We can only hope that the new training system will keep our University Practice Schools. If a university/college cannot train teachers in the future, consequently it will lose its university practice school as well. The UPS mentors have eight lessons fewer per week, and if teaching practice is lost, many experienced mentors might be released.
- From previous mentoring and observational experience, we can see that the teaching approach and capacity of the trainees are mostly influenced by good mentors, but recently some less able or less creative



teachers have become mentors. More effective and methodologically rich practice is demonstrated by primary mentors than by secondary mathematics mentors. Besides a good number of excellent secondary mathematics teachers, many others teach in a mathematically correct but methodologically narrow and less effective way.

- Use of IT in the mathematics classroom is not yet sufficiently strong. More secondary teachers use computers and data projectors than primary teachers. The computer laboratories are used mainly for informatics lessons. Only a few schools have interactive whiteboards although gradual development is expected.

5. Other Relevant Issues concerning training

- Since the 1990s there has been a shortage of teaching positions which may be one of the reasons for the smaller number of applicants to mathematics courses (and even to primary teacher training courses). If there was a return to the situation of a shortage of teachers, perhaps more young students would apply again.

Mathematics Teacher Training in Ireland

Noreen O’Loughlin, Mary Immaculate College, University of Limerick



“Teaching is a highly regarded profession in Ireland so the demand for both the undergraduate and postgraduate courses is extraordinarily high.”

1. Overview

Teaching is still considered an attractive, high-status profession in Ireland and attracts extremely high-calibre applicants, particularly at primary level. A Teaching Council came into being in the Spring of 2006, one of its remits being to provide for the establishment of standards, policies and procedures for the education and training of teachers.

Each provider is responsible for the development of its own programme syllabus and content for the education of its prospective teachers, though each qualified teacher is expected to meet the requirements of the Teaching Council.

The following table summarises some of the main features of ITT courses in Ireland:

Teaching is a highly regarded profession in Ireland so the demand for both the undergraduate and postgraduate courses is extraordinarily high.

2. School Based Work

Primary

(a) Observing

There is no common approach in this regard. Some colleges send students to observe classroom teachers one day per week for the first semester/year while others allow time on placement for observation by reducing the teaching load.

(b) Teaching classes

Prospective teachers will usually teach in a variety of subject areas on initial class-based

	Primary		Secondary
Entry route	B.Ed	Graduate Diploma in Education (specialising as either Primary or Secondary)	
Length of course and qualifications	3 year degree course leading to a BEd	1 year (secondary) or 18 month (primary) Graduate Diploma in Education	
Entry qualifications	450 out of 600 points on School Leaving Certificate 3 'honours' grades (to include Irish) and 3 'pass' grades (to include English and Mathematics)		Initial degree to include at least 30% Mathematics
		As for B. Ed plus initial degree and interview passes in English and Irish	
Course components	Education modules (subject pedagogies) Teaching Practice placements		Foundation studies Professional studies The study of teaching Teaching Practice placements (teaching at least 100 hours)
	Academic subject		



experiences and build up to teaching entire blocks/days/weeks before the course concludes. Students have an opportunity to teach at all class levels during the course of their study.

(c) Schools used for training

Each College utilises schools, usually from either its own hinterland or from the students' own locality. There is no formal partnership arrangement between the provider and the school or teacher. Neither the school nor teacher receives payment nor do they have any input into the assessment of the students' performance. The supervision of the classroom experience rests entirely with the faculty from the College or University.

(d) Assessment of the school-based component

College staff will visit the student a number of times while they are on school placement. After each visit, students will receive a critique of their teaching and will be offered advice and assistance by the supervisor. A grade is assigned by the supervisor/s at the end of the placement.

Secondary

(a) Observing teaching

Most programmes offer observation in primary and post-primary schools as part of their initial introduction to class-based teaching.

(b) Teaching classes

The teaching practice programme involves a minimum of 100 teaching hours in a subject or subjects taken to degree level. There are different arrangements as to how the teaching load is spread but in general, teaching practice is undertaken over the course of the academic year.

(c) Schools used for training

All the schools that are used are within a particular radius of the University provider. In most situations, the student must make the contact and necessary arrangements with the Principal.

(d) Assessment of the school-based component

Subject specialist tutors visit the students on their placement, give feedback on their

observations and ultimately award a grade. A student may be supervised in each of their subjects. There is no formal school-based mentor to support the student. Informal support and guidance is provided by the subject teacher.

3. Strengths of the current training provision

- The status of teaching remains extremely high in Ireland.
- Teaching attracts high-calibre students.
- Retention rates are unusually high.
- There is a strong emphasis on the teaching practice component of the programme.
- There is greater regulation of standards by the Teaching Council.
- Long overdue attention is now being paid to mathematics and mathematics education.

4. Problems of the current training provision

- The minimum entry requirement to the BEd in the case of mathematics is set too low at a D3 on either the higher or lower course.
- The lack of an exit qualification in mathematics means that many students do not have an adequate grasp of mathematical concepts.
- In-service in the area of mathematics education is poor. (Delaney 2005)
- Insufficient in-school time is provided, with too little emphasis on the observation of experienced, effective practitioners.
- The lack of a formal mentoring system means that students do not always receive an adequate level of support in the teaching practice situation.
- There is insufficient time for the adequate treatment of a broad range of relevant mathematical concepts and methodologies and for the study of effective strategies in an international context.

“ *Standardised testing has now been introduced in primary schools and it will be interesting to see how this will affect teachers’ approaches in the future.* ”

5. Other Relevant Issues concerning training

At primary level, a revised curriculum in mathematics published in 1999 has been supported in its implementation by a Primary Curriculum Support team. One of the by-products of this training and subsequent support has been an obvious openness to change and willingness to undertake further professional development in mathematics. The demands for such courses are evidence of this transformation. Standardised testing has now been introduced in primary schools and it will be interesting to see how this will affect teachers’ approaches in the future.

At post-primary level, the debate about mathematics as outlined earlier is often fuelled by both ‘push’ (poor levels of understanding) and ‘pull’ (economic) factors. There is also a concern about mathematics as a support for the sciences and this issue often emerges in such debate. Movement towards change is slower at post-primary level, driven mainly by reluctance to take any risks in the face of examination pressure.

Mathematics Teacher Training in Japan

Masataka Koyama, Hiroshima University



1. Overview

In Japan, the initial (pre-service) teacher training for a general teacher certificate is undertaken by universities and other institutions of higher education, which have the course approved by the Ministry of Education, Science, Sports, Culture and Technology (*Monbukagakusho*) in partnership with university-attached schools, or local schools if universities/institutions have no attached school. Teaching practice is mainly undertaken by university-attached schools or local schools.

Training for primary and secondary school teachers is possible not only at national universities of teacher education/faculties of

education but also at other non-educational national, local public and private universities/faculties with courses for teacher certificates approved by the Ministry. Therefore, in general, the total number of trainee teachers at all universities/institutions in Japan is not easily or directly controlled by the Ministry. In the case of national universities of teacher education/faculties of education, however, the number of trainee teachers can be controlled annually by the Ministry, being based on national recruitment and target figures deduced from all relevant factors such as the increase/decrease in the number of pupils in each education sector (primary/secondary), the current age profile of teachers, the current financial situation faced by the government and so on.

	Primary (6–12)		Lower Secondary (13–15)		Upper Secondary (16–18)
Entry route Length of course and qualifications	4 year Bachelor degree and first class certificate	2 year second class certificate	4 year Bachelor degree and first class certificate	2 year second class certificate	4 year Bachelor degree and first class certificate at faculty of education/science
Entry qualifications	The nation-wide ‘Common Test’ in five school subject areas (<i>Japanese Language, Foreign (mainly English) Language, Mathematics, Science and Social Studies</i>) Individual university entrance examination (for example <i>Japanese Language, Mathematics, Essay, Interview, etc.</i> dependent on universities/colleges) Report submitted by upper secondary schools (i.e. applicant’s evaluation of all school subjects and his/her record of activities in upper secondary school)				
	Students must have taken four of the six Mathematics subjects taught at upper secondary		Students must have taken all six Mathematics subjects taught at upper secondary		
Course components	Subject study Professional study School-based work				
Time in school	Varies but e.g. 6 weeks at Hiroshima University		Minimum 5 weeks		Minimum 3 weeks

Students are required to work for seven days as carers in special education schools and/or social welfare facilities to be awarded general teacher certificates at primary and lower secondary schools.

A 2-year PG route is available leading to a Master’s degree and advanced certificate.

There is also a part-time route and correspondence courses in education for those students who have graduated from a junior college or a university without a teaching certificate.



“ In the case of Hiroshima University, for a week in the fifth semester trainee teachers in a group observe lessons and classroom management, discuss them with their teacher and act as classroom assistants in their university-attached primary schools.”

2. School Based Work

Primary

(a) Observing

In the case of Hiroshima University, for a week in the fifth semester trainee teachers in a group observe lessons and classroom management, discuss them with their teacher and act as classroom assistants in their university-attached primary schools.

(b) Teaching classes

In the case of Hiroshima University, for five weeks in the sixth semester trainee teachers in a group have the experience of teaching classes in their university-attached primary schools. During this period, they design a lesson (teaching and learning) plan for each lesson with advice from their teacher and teach the class with the plan followed by a group discussion on each lesson with a teacher. They also have some opportunities to observe their mentor's and other teachers' lessons.

(c) Schools used for training

Institutions (universities) use their attached primary schools and 'partner' schools for teaching practice if possible. If a university has no such school, trainee teachers undertake their teaching practice at the primary schools from which they graduated.

(d) Assessment of the school-based component

Normally trainee teachers will have regular reviews of their progress with a school mentor. There will be some visits from an institution-appointed tutor whose main role is to check the trainees' progress and the quality of school support. The final evaluation of each trainee teacher is authorised by the committee on teaching practice at the institution (university), based on a report from the school.

Secondary

(a) Observing

In the case of Hiroshima University, for a week in the fifth or sixth semester, trainee teachers in a group observe mathematics lessons and classroom management and discuss them with their teacher in their university-attached secondary schools.

(b) Teaching classes

In the case of Hiroshima University, for four weeks in the seventh and eighth semesters (in the case of lower secondary mathematics teacher certificate) or two weeks in the seventh or eighth semester (in the case of upper secondary mathematics teacher certificate), trainee teachers in a group have the experience of teaching classes in their university-attached secondary schools. (See Primary, above, for details of activity.)

(c) Schools used for training

Institutions (universities) use their attached secondary schools and 'partner' schools for teaching practice if possible. If a university has no such school, trainee teachers undertake their teaching practice at the secondary schools from which they graduated.

(d) Assessment of the school-based component

As for Primary (above).

3. Strengths of the current provision

- Many students on teacher training courses have relatively high motivation to become teachers.
- The status and morale of the teaching profession is good.
- The framework for pre-service and in-service teacher training is established, including lesson study in which teachers collaborate on planning lessons with a particular focus, delivering and observing the lessons (and often open to a wider audience) and reflecting and reviewing the lessons.

4. Problems of current provision

- The teacher training courses have a weak school-based component; for primary and lower secondary school teacher certificates there are only five weeks of teaching practice and for the upper secondary school teacher certificate just three weeks of teaching practice in schools.
- The number and capacity of schools for training teachers is limited.



“ Recently the situation concerning teacher training changed dramatically in Japan. ”

- The link between content knowledge (mathematics) and pedagogical knowledge (education) is not always strong. Teacher training courses need more staff specialising in mathematics education.
- Many incoming primary teachers do not have enough understanding of mathematical concepts to be a specialist in mathematics.
- The employment rate of graduates from national universities as school teachers is very low.

5. Other Relevant Issues concerning training

Recently the situation concerning teacher training changed dramatically in Japan. In 1997, the government set out a plan for reducing in total 5,000 trainee teachers (about 30%) at national universities/faculties for teacher training. In 2002 the five-day week schooling system was implemented at all national and local public schools and the number of school hours for mathematics at primary and secondary level was reduced. Moreover, from 2004 all national universities were reorganised as independent administrative corporation universities. These political decisions clearly seem to have been made as a result of the recent weak financial situation and the lower employment rate of graduates from the national universities as school teachers in Japan.

As has been shown by national and international investigations, many students at primary and secondary schools have a negative attitude towards mathematics, while the average score of Japanese students' achievement in mathematical knowledge and skill is relatively high. The diversity in mathematical achievement/ability of primary and secondary school students has been increasing. Moreover, mathematics curricula and teaching methods cannot ignore the rapid progress and spread of technology and the influence of calculators and computers on mathematics education.

These changes and facts necessarily force mathematics teachers to reflect seriously on their educational philosophy and teaching methods for mathematics. Training courses for mathematics teachers at universities also have to be changed to meet the needs of pre-service and in-service teachers and of Japanese society.

In any process of educational reform in Japan, the issue of mathematics teacher training must be addressed in accordance with school curriculum reform from philosophical, historical, practical, national and international perspectives.

Mathematics Teacher Training in **Russia**

Eugeny Smirnov, Yaroslavl State Pedagogical University



1. Overview

Since 1917 the training of teachers has been done mainly at teacher training universities and institutes, which provide special courses combining the study of mathematics and education with pedagogical and technological training and teaching practice. Currently there are about 100 high schools for teacher training and about 200 different kinds of pedagogical colleges providing educational and professional programmes for the training of teachers.

The Ministry of Education and Sciences coordinates, finances and supervises the activities of teacher training universities and colleges in Russia (state institutes as well as non-state, i.e. commercial ones).

2. Primary

Length of courses and qualification

Future primary school teachers master the basic educational programme over five years (the standard period). The types of professional activity include teaching, scientific and methodological research, social and pedagogical activities, and specialist pedagogical development.

There are three main routes into primary (age 5–11) teacher training leading to qualified teacher status:

- (a) Four year BEd courses + one year higher vocational training
- (b) Pedagogical College (secondary vocational training)

Main Routes into Teacher Training

Type of Institute		1 year	2 year	3 year	4 year	5 year	6 year	Qualification of Teacher
Classical University	since 1958	Linear Teacher Training					→	Mathematician. Teacher of high or secondary school
	since 1992	Bachelor of Science				Master of Science		Mathematician. Teacher of high or secondary school
					Vocation	→		
Pedagogical University (Institute)	since 1917	Linear Teacher Training					→	Teacher of primary or secondary school
	since 1995	Bachelor of Education				Master of Education		Teacher of primary or secondary school
					Vocation	→		
Pedagogical College (Secondary Vocational Training)		→						Teacher of primary school
		Linear Primary Teacher Training					→	



“ Prospective secondary school teachers master the basic educational programme over five years. ”

- (c) Primary teacher (secondary vocational training) + three years linear primary teacher training (higher vocational training).

Entry qualification

- (a) For the LPTT Linear Primary Teacher Training (LPTT) or Bachelor of Education (BEd) degree the normal minimum requirements are:
- Total State Examination (TSE) passes in two relevant subjects (Russian and Mathematics)
 - Certification in secondary education or secondary vocational training.
- (b) There is competition among the most academically able students for entry to Vocational Study after their BEd degree, as the number is determined by quota.

Main components of the course

According to the programme under consideration, students study the following cycles of disciplines:

- (1) general humanitarian and socio-economic disciplines
- (2) general mathematical and natural-scientific disciplines
- (3) general professional disciplines
- (4) disciplines that deal with subject training
- (5) optional disciplines.

The BEd course usually lasts four years for linear teacher training, with six weeks of school-based work.

Secondary

Length of courses and qualifications

Prospective secondary school teachers master the basic educational programme over five years. The types of professional activity are: training, scientific and methodical research, socio-pedagogical activities, educational work, cultural and educational activities, administration and supervision.

There are two main routes into Secondary (age 11–17) mathematics teacher training leading to qualified teacher status:

- (a) four year BEd (physics and mathematics) courses + one year higher vocational education

- (b) relevant degree (secondary vocational training or higher vocational training) + three years linear secondary teacher training LSTT (higher vocational training).

Entry qualification

- (a) For the LSTT or BEd degree the minimum requirements are normally:
- Total State Examination (TSE) passes in two relevant subjects (Russian, Mathematics)
 - Certification in secondary education or secondary vocational training.
- (b) There is competition among able students for Vocational Study after their B.Ed. degree, as the number is again determined by quota (usually 30% of the initial cohort).

Main components of the course

- (a) LSTT – According to the programme under consideration, students study the same cycles of disciplines as the primary trainees (above).
- (b) BEd course – The BEd course takes four years, with eight weeks school-based work. The disciplines studied follow the LSTT model.
- (c) Vocational courses – Most vocational courses (based on a BEd in Physics and Mathematics) last 41 weeks, of which 20 weeks must be subject study, nine weeks is school-based work and 12 weeks is course and final examinations. The main strands of the course are:
- General professional subjects
 - Disciplines pertaining to subject training
 - School-based work (nine weeks in the ninth term).

2. School Based Work

Primary

(a) Observing

In schools, students' teaching is done under the guidance of an experienced teacher (a methodologist), while the university component is supervised by university teachers in the Department of Primary Education. Also, a psychologist from the university manages special activity groups of students in different



“ Students are sent to primary classes where teaching is carried out according to the traditional scheme and methods. ”

schools. The students' school-based work is organised according to a certain schedule and totals 21 weeks over five years.

(b) Teaching classes

Students are sent to primary classes where teaching is carried out according to the traditional scheme and methods. Third-year students become familiar with a certain teacher's activities; they then master methods of educational work and give their first trial and test lessons.

(c) Schools used for training

Students work in groups (four to five students in each school). The university usually uses normal local schools in which there are experienced teachers who are expert methodologists.

(d) Assessment of the school-based components

In a school, students' teaching is done under the guidance of an experienced teacher (a methodologist) whereas at a university, students come under the supervision of university teachers. The final mark for teaching is given by the Head of Department on the basis of marks awarded by the school's teachers, school psychologist and university teachers.

Secondary

(a) Observing

In school, students' teaching is done under the guidance of an experienced teacher (a methodologist), at a university by university teachers in the Department of Secondary Education. Also, a psychologist from the university manages special activity groups of students in different schools. Students' teaching is organised according to a certain schedule that includes 17 weeks of observation.

(b) Teaching classes

Students are sent to secondary classes where teaching is carried out according to the traditional scheme and methods. Third year students become familiar with a certain teacher's activities then master methods of educational work and give their first trial and test lessons. Later, they become trainee teachers replacing the expert-teacher in the classroom for six to nine weeks. Sometimes they cover two subjects (for example,

mathematics and physics) according to the school timetable.

(c) Schools used for training

Students work in groups (four to five in each school). Universities usually use normal local schools (city and rural) in which experienced teachers act as expert teacher-methodologists.

(d) Assessment of the school-based component of the course

As for Primary (above).

3. Strengths of the current provision

- Teacher training is focused on developing professional competence in trainee teachers and the capacity to solve professional problems in real-life settings.
- ICT is widely used in teacher training, especially in teaching mathematics.
- There are integrated links and methods of visualisation between subjects and also between school mathematics and its theoretical generalisation in higher level mathematics by the creation of new forms and methods of the learning process.
- We create conditions for attracting applicants who have a great capacity for mathematics, critical thinking, creativity and oral and written communication.

4. Problems of the current provision

- The status, salary and morale of the teaching profession is low: many leave after only one or two years.
- Trainee teachers lack the desire to use new methodologies and new mathematical knowledge to strengthen the effects of their teaching. Knowledge and methodological skills are formal and have little application to real life.
- Many incoming teachers lack an understanding of the foundations and key concepts of mathematics
- Trainee teachers have little motivation to learn mathematics as pedagogical tasks and lose a lot of time adapting them to high school processes.



- There are some breaks between fundamental training and professional study, especially when mastering methods of teaching mathematics and elementary mathematics.
- Not many subject professors want to know about problems in school when they are trying to instil the professional skills and habits of their subjects in trainee teachers.

programmes in higher vocational training. Nearly 50% of universities have the opportunity to deliver Bachelor degrees. We must move to a European Credit Transfer System (ECTS) and Diploma Supplement as the final certification. Our Candidate of Science will become a Doctor of Philosophy (PhD) and we do not know what will happen to the Russian Doctor of Science degree. We are moving in this direction and are creating the basic and legal documentation to support the process. Our problem is to keep the good practice of the Russian education system (including its teacher training) while becoming a member of the European educational process.

“ In 1999, Russia signed the Bologna Declaration and until 2010 we will be part of the European educational area. ”

5. Other Relevant Issues concerning training

In 1999, Russia signed the Bologna Declaration and until 2010 we will be part of the European educational area. In short, we must move towards a multilevel system of education (Bachelor and Master degrees) that includes teacher training. It is a problem for Russia. At the moment, the Russian education system provides training in 500 specialist subjects and there are 100 Bachelor and Masters degree

Mathematics Teacher Training in Singapore

Berinderjeet Kaur, Koay Phong Lee, Yap Sook Fwe,
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1. Overview

In Singapore, the Ministry of Education (MOE) recruits suitable candidates for teaching positions in primary and secondary schools and junior colleges. All successful candidates not trained in teaching pedagogy are trained

by the National Institute of Education (NIE), the country's sole teacher education institution. Their fees are paid by the MOE and they receive a full monthly salary. Upon successful completion of their training, they are deployed to teach in schools and have to serve a three-year teaching bond.

“ In Singapore, the Ministry of Education (MOE) recruits suitable candidates for teaching positions in primary and secondary schools and junior colleges. ”

Primary			
Entry route	Diploma in Education	Bachelor Degree (Arts/Science)	Postgraduate Diploma in Education
Length	2 year	4 year	1 year
Entry qualifications	For A-level holders: <ul style="list-style-type: none"> • 2+ A-level and 2 AO-level passes to include English¹ • 5+ O-level passes including English as a First Language • At least O-level Mathematics For Polytechnic Diploma holders: <ul style="list-style-type: none"> • Polytechnic diploma • 5+ O-level passes including English as a First Language and Mathematics • Possibly entrance tests 	For A-level holders: <ul style="list-style-type: none"> • 2+ A-level and 2 AO-level passes to include English¹ • 5+ O-levels at grade C6+ including English as a First Language • Grade D7+ in A-level 2nd language or in O-level 1st language • O- or AO-level in Mathematics For Polytechnic Diploma holders: <ul style="list-style-type: none"> • Any diploma with good results 	An acceptable degree O-level passes in English, Mathematics and a Science.
Course components	Education studies, Curriculum studies, Subject knowledge, Practicum, Language Enhancement & Discourse Skills, Group Endeavours in Service Learning – a year long student initiated group project		
		Academic Subject	
Time in school	15 weeks	22 weeks	10 weeks
¹ O-, AO- and A-levels refer to the Singapore-Cambridge GCE. Mathematics specialists must have a grade B at A-level Mathematics / Further Mathematics (or pass the Mathematics Qualification Test). 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.			

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

Secondary		
Entry route	Bachelor Degree (Arts/Science)	Postgraduate Diploma in Education ¹
Length	4 year	1 year
Entry qualifications	As for Primary	An acceptable degree Depending on level of Mathematics to be taught, there are different requirements regarding Mathematics qualifications
Course components	Education studies, Curriculum studies, Subject knowledge, Practicum, Language Enhancement & Discourse Skills, Group Endeavours in Service Learning – a year-long student initiated group project	
	Academic Subjects (2)	
Time in school	22 weeks	10 weeks
<p>¹ The PGDE qualifies trainees to teach Mathematics and another subject at secondary school.</p> <p>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.</p> <p>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.</p>		

2. School Based Work

Primary

(a) Observing

During school experience and the first week of teaching practice, trainee teachers mainly observe their Cooperating Teachers (CTs) and other teachers 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 do some guided teaching. During teaching practice, from the second week on, 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 the 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 NIE supervision coordinator (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 that comprises of the pre-observation conference, lesson observation and the post-observation conference. Towards the end of teaching practice, the School Coordinating Mentor (SCM) and school principal make a summative assessment of the trainee. The final grade is agreed by consensus between the chairing principal, NSC, SCM and CTs at the Assessment Panel Meeting.

Secondary

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



“ It has been noted that trainees with some field experience prior to their enrolment at NIE, appear to be more receptive to training. ”

3. Strengths of the 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.

4. Problems of the current provision

Some problems of current provision are as follows:

- The introduction of the 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.

5. Other Relevant Issues concerning training

- An effective teacher must possess both pedagogic knowledge and 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 three to six 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.

Mathematics Teacher Training in Ukraine

Sergey Rakov, Kharkov National Pedagogical G.Skovoroda University
Kharkov Regional Center for Educational Assessment

“...educational establishments are granted the right to accept students who are willing to pay for the training themselves or obtain funds from other bodies.”

1. Overview

Primary teacher training is provided in specialised higher educational institutions or pedagogical universities. It includes six educational areas: mathematics, language and literature, science, art, prevocational education and modelling, and physical training. Primary teachers' training is conducted in pedagogical colleges, institutes and universities, with a college being the lowest level of training. The duration of study is two years after graduating from a high school or four years after eight years of school education.

Every year, after an analysis of the demand for specialists with certain qualifications, the educational establishment receives a governmental order in which the number of first year students is stated. The Government pays these students' tuition fees. Also, educational establishments are granted the right to accept students who are willing to pay for the training themselves or obtain funds from other bodies. The number of such students cannot exceed the number of the students in the governmental order, and the total number of students cannot exceed the licensed number of students who can be trained in a given specialism.

Primary

Primary school teacher training is carried out by educational institutions of different types

providing a variety of levels of qualifications, as summarised in the table below.

Prospective students (who must have completed secondary education) take entrance examinations in Mathematics and the Ukrainian language. At a Pedagogical University, training lasts up to five years: a Bachelor's degree can be obtained in four years and a Specialist degree in five. Top College or Institute graduates may study for a Master's at a university.

Bachelor's degree

The four-year Bachelor's degree is in three parts: liberal arts, sciences and professionally oriented disciplines (professional and scientific training, subject training and teaching practice). Each part has compulsory and optional elements.

Teaching practice comprises eight weeks. At the end of their study, students take state examinations in pedagogy and psychology, mathematics and methods of teaching mathematics, the Ukrainian language and methods of teaching the Ukrainian language.

Specialist degree

Training for a Specialist degree takes one year with 20% devoted to teaching practice and the rest spent on professionally oriented and social and economic training, and professional and practical training.

Type of educational institution	Qualifications	Specialty
Pedagogical specialised secondary institution	Junior Specialist	Primary school teacher
Pedagogical College	Junior Specialist, Bachelor	Primary school teacher
Pedagogical Institute	Bachelor	Primary school teacher
Pedagogical University	Specialist, Master	Primary school teacher, teacher of psychological and pedagogical subjects

During their six weeks of teaching practice, students observe how school teachers and other students give lessons and they also give test and credit lessons.

At the end of their study, students take qualifying exams in pedagogy and psychology, mathematics and methods of teaching mathematics, the Ukrainian language and methods of teaching the Ukrainian language, and defend their graduate thesis.

Secondary

The preparatory course for training a Mathematics teacher lasts up to five years (Specialist or Master's degree five years, Bachelor's degree – four years). The diploma is complicated and includes a specialism with an additional specialist subject, for example Mathematics with Informatics; Informatics with Mathematics; Mathematics with Physics; Physics with Mathematics; Mathematics with English.

Although there is no compulsory Mathematics examination in the final year of secondary school, success on the university entrance examination in mathematics is an obligatory requirement for entry to a Mathematics teacher training course.

The main components of the Mathematics teacher training course include Mathematical analysis, Analytical geometry, Complex analysis, Numerical methods and Theoretical mechanics. They are high level and somewhat abstract in nature, having little linkage to the secondary school curriculum or real life application. In the last few years some efforts are being made to make specialist mathematics courses more humanitarian and real-life oriented, based on a competence approach to mathematics education¹.

2. School Based Work

Primary

Teaching Practice

Basic schoolwork (teaching practice) has two stages:

Passive: groups of two or three students observe a class over different lessons and discuss observations.

Active: following observation, students give lessons that are subsequently analysed by the student, teacher and university tutor.

Teaching practice is conducted not only in schools which are affiliated to the university, but in ordinary schools as well. The best schools with highly qualified teachers who can provide assistance to students are chosen for conducting teaching practice.

Teaching practice assessment

The mark for teaching practice is given by a practice supervisor, who takes into account the results of all credit lessons, references from the school teacher and marks for assignments in pedagogy and psychology.

As a rule, a university teacher works with each group of students and helps to solve organisational problems while school teachers help in the preparation of lessons and attend credit lessons.

Secondary

Details of school-based work are given below:

- Passive Practice (observing teaching), attending lessons in practice schools with follow-up discussions, arranging class activities (parties, competitions, excursions, etc.)
- 1 week – acquaintance with the classes which will be used in this and future teaching practices
- 5 weeks – teaching practice (attending and analysing many lessons and delivering one or two lessons p/w)
- 6 weeks – working practice (working as a teacher with a full teaching load).

Students are assigned to practice schools in small groups (usually between three and five students per group). Each group has a common practice instructor (university lecturer or experienced teacher).

¹ The main problem in improving the training of Mathematics teachers in Ukraine is how to raise the humanitarian and real-life components of the curriculum (both in schools and in universities) without losing its traditional high level of fundamentality.

3. Strengths of the current training provision

- There is a primary school teachers' association in each school, which provides support for young teachers.
- Once every five years each teacher undergoes one month of in-service training in a Specialist Institute for Teacher Improvement.
- The current standards in mathematics education are very high.

4. Problems of the current training provision

There are many problems in higher education in Ukraine, particularly in mathematics teacher training:

- The old administrative mechanisms no longer work but the new control mechanisms of a democratic and civic society are only in the process of being developed and do not work yet.
- The high traditions of fundamentality in mathematics education in Ukraine are falling permanently by the wayside and are being replaced by humanitarian ideas and real-life applications which penetrate to the heart of the curriculum and real educational practice.
- The policy of having two standards (state funded and privately funded education) destroys the education system.
- The poor state of the economy and especially the high tech industry do not stimulate a demand for highly qualified and educated specialists.
- The low salary level of teachers causes their migration from schools to more socially defended areas.

Nevertheless, Ukraine has joined the Bologna process in educational reform so curricula will be updated in the near future and this will have an impact on both primary and secondary mathematics teacher training.

5. Other Relevant Issues concerning training

Prospective outcomes of current Mathematics educational practice in Ukraine

The Council of the IPMA² project in Ukraine, which consists of the coordinators of schools, scientists, mathematicians and teachers, discussed many problems concerning the improvement of Mathematics education and as a result formulated some ideas on the current state of good practice in Mathematics teaching in Ukraine.

1. The optimal number of pupils in a Mathematics lesson in primary should not be more than 15.
2. Ideas for developing teaching and learning in the most effective way integrate problem solving, research, the pedagogy of collaborative learning, critical thinking and other innovative individual-oriented and pupil-centred pedagogical technologies.
3. The idea of learning dialogues (dialogic pedagogy) seems to be very important and effective in practice for the self-construction of an intellectual, active, social and humanistic individual. This approach is actively developing now and teams of teachers from many schools are working in this field, together with Ukrainian and Russian colleagues. It has been suggested that the teaching dialogue has three levels:
 - a. Pupil–problem dialogue (problem situation, problem field) – the skills to pose questions about the problem and to search for their answers
 - b. Pupil–pupil dialogue – the skills needed in collaborative learning: being able to formulate and present their own ideas and to listen to and evaluate the ideas of others, searching together for the best and most encompassing solutions to challenging problems

²IPMA: International Project on Mathematical Attainment

c. Pupil–teacher dialogue – the skills to use expert knowledge (teacher, textbooks, other books, encyclopaedias, internet) in developing students' ability to learn for themselves.

4. **Creating an internet-based educational community**

The internet provides possibilities for creating a universal educational community, where all may participate (not only young people but older generations as well) through electronic libraries and other electronic information resources. Each pupil from the start of primary school should use Internet information resources, in particular educational resources. There are many useful resources in the world as a whole, and in Ukraine in particular – for example the Boyko School.

5. **Creating internet-based, educational, interactive resources for students**

A good example of this is a website in the UK that gives free access to educational material within the framework of the Mathematics Enhancement Programme. These interactive educational resources could be improved with dynamic models and interactive tests.

In this matter a team from Kharkov National Pedagogical University may be productively involved (the team includes the authors of the DG in geometry course, widely used in the Ukraine by comprehensive, secondary and high schools as well as in geometry courses at university level).

6. **Creating interactive, educational resources in Mathematics based on intelligent professional Mathematics packages** such as Computer Algebra Systems (CAS) and Dynamic Geometry Systems (DGS). Such a package based on DG and developed at Kharkov National State Pedagogical Skovoroda University may be an example of an effective prototype.



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