

## IPMA CONCLUSIONS

### 1. Coordinators' Conferences

The International Project on Mathematical Attainment (IPMA) is a longitudinal comparative study in primary mathematics, implemented in a number of countries around the world. The overall aim was to find the factors that give rise to good practice in mathematics teaching and learning.

The group of coordinators met on a regular basis throughout the project.

All the meetings were held in a positive cooperative spirit but this did not prevent us discussing controversial issues and hearing from coordinators about particular national problems affecting progress.

At each meeting, each coordinator presented a verbal report on progress. This was often backed up by a written report and, in the most recent meeting, by video evidence of good teaching. For some of the participating countries, illustrations of good practice are available on DVD from CIMT; details are given on the IPMA website.

These coordinators' meetings were vital for us as they enabled issues such as queries regarding data to be resolved; more importantly, they gave all of us the opportunity to appreciate the successes and problems of particular strategies in mathematics teaching and learning in countries other than our own.

### 2. Country Questionnaires

One of the early tasks for any participating country was to complete a *Country Questionnaire*, from which we aimed to gain an understanding of the key pointers concerning primary mathematics in each country. We have included a summary of each country's detailed responses in the Appendix. It should be stressed that each country completed this at the start of their participation in the programme (for most this was at the first Coordinators' Conference held in 1999): some of the information is now out of date. Countries that entered the project later obviously completed this questionnaire at a later date than 1999.

There is a wealth of information that can be read from this questionnaire; we will just highlight some of the significant differences here.

- In some countries, notably China and Singapore, there are specialist teachers for mathematics, whereas in many countries, teachers teach all primary subjects.
- There is considerable variation in the starting age for Primary School; for example, 4+ for Ireland, 5+ for USA and England, 6+ for most countries and 7+ for Russia, Finland and Poland.

- The school day has considerable variation ranging from morning or afternoon (Singapore); just morning (Russia) to most of the day (England) and all of the day (China).
- There is a similar wide variation in teaching time for mathematics, with England now having 5 lessons per week but some countries having only 3.
- The length of time that a teacher stays teaching one class varies from just one year (e.g. England) to four or more years (e.g. Poland).
- The number of pupils in a class varies considerably (e.g. about 40 or more in South Africa and Singapore; no more than 25 in Greece).
- The balance between 'whole class', 'individual' and 'group' work varies considerably with, for example, in Estonia, Poland, Hungary, Ireland and China only 5% of teaching time devoted to group work but in England at the time of this questionnaire, about 50% of the lesson time was spent in group work. It should be noted that in China and Greece, whole class work very much dominates but in Hungary there is an almost even balance between whole class and individual work.
- Many countries, including Hungary, Ireland and China, have no national tests until age 18, whilst England has national tests throughout the school age range and Singapore from age 10.
- There are also significant differences in the entry requirements for primary teacher training, with only England and Singapore requiring a minimum maths qualification at age 16; in other countries, future teachers have studied mathematics at school up to at least age 18.
- The time spent in schools during training also varies considerably with England topping this list by a considerable margin.
- One other key difference is the action taken when a class teacher is absent. In most countries either the class will be combined with others or another colleague will take the class. In contrast, in England, supply cover (i.e. hired agency staff) will be bought in to look after the class in the absence of their usual teacher.

### 3. Overall conclusions

Many of the country coordinators have given their national recommendations and advice and these have already been written up in the individual country reports in Part B. We also, though, wanted the outcomes of the project to include suggestions for good practice in primary mathematics teaching and learning on an international basis, using the available data, including observations and the coordinators' discussions.

We were fortunate to be able to make international observations of mathematics teaching as well as using some of the video evidence shown at coordinators' meetings which have

given us an unique overview of the current issues in primary mathematics. In a similar way to the Kassel Report (see Monograph 3 in this series) we have used the available evidence to reach conclusions about good practices that are, in the main, independent of country and culture.

Some of the factors highlighted below are really just common sense but they are nevertheless important (and their absence contributed in part to the negative valued added scores in classes). It should also be stressed that these are the conclusions made by experienced mathematics educationalists, using all the available evidence. There is no precise 'proof', though, to support these statements. We can only suggest, indeed believe, that any other academics, given the same experiences, data, etc. would come to the same conclusions!

We have divided our recommendations into four distinct but overlapping areas, namely

- *School policy*
- *Curriculum*
- *Teaching*
- *Training*

#### ***School policy***

- Pupils should start formal primary school at age 6.
- Pupils not quite ready for the start of primary school should be able to spend one extra year in kindergarten before moving to primary school.
- Special needs children, mentally handicapped or those with behavioural problems, should not be in mainstream lessons; they should be educated in either special units at mainstream schools or in special schools.
- Seating at desks/tables for mathematics should be conducive to whole class interactive teaching, with
  - easy eye contact with/from the teacher to all pupils
  - pupils should be able to get to the front of the classroom easily (to demonstrate and articulate their solutions, etc.)
  - teachers should be able to get to all pupils easily to monitor and help with individual work.
- IT, including interactive whiteboards, should be used only when they will enhance teaching and learning, and computer work should be integrated into the lesson plans and scheme of work.
- Classroom assistants should be used to give extra support for weaker pupils and/or extra support should be available outside lesson time.

- Pupils should have their own set of pencils, workbooks, rulers (and manipulatives in early years), etc.
- Teachers should, where possible, stay with their class for 2 or more years to provide continuity.
- Agency supply cover should not be used when teachers are absent.
- National tests and school league tables are not appropriate throughout the primary age phase.

### ***Curriculum***

- Mathematics should be an integrated course, built on strong mathematical foundations at an early age; for example, fractions, decimals and percentages should be taught together, and related to the number line.
- Schools should have an integrated scheme of work that operates throughout primary and links directly into the secondary phase.
- There should be consistency in approach throughout the school with teachers being aware of what has been taught and what will be taught.
- There should be a relatively slow but rigorous start (using zero from the start) but with rapid progress in the later years of primary, building on the initial foundation.
- A spiral curriculum should be implemented, continuously revising and adding to concepts and relating topics to real life contexts and to the pupil's experiences.
- Problem solving and investigations should be used alongside practice of skills and techniques.
- Trial and error methods should be discouraged as a first strategy for solving problems.

### ***Teaching***

- Teachers should have high expectations of what pupils can achieve and clear objectives for lessons.
- Lessons should usually have pace and varied activities, often incorporating a number of mathematical activities, and using resources effectively.
- Most activities should have an introduction through whole class interactive teaching followed by individual or paired practice, and whole class interactive review and discussion.
- Teachers should use humour, be friendly, give praise and encouragement as deserved.

- Lessons should be exciting and interesting.
- Creativity and logical thinking should be encouraged and praised.
- Teachers should give clear directions, but allow time for pupils to explain their thinking and should listen to what pupils say.
- Pupils (of all abilities) should regularly demonstrate in front of the class, writing on the board, drawing diagrams and explaining their reasoning.
- Correct notation and language should be used throughout by both teachers and pupils.
- Lessons should be well prepared, including prepared board work (and small boards) with all necessary resources for teachers and pupils readily available.
- All pupils should be actively involved throughout the lesson, being both challenged and supported, with regular individual monitoring of work (including the use of small boards for pupils to display answers and solutions).
- Key mistakes made by pupils should be discussed by the whole class and pupils encouraged to correct written mistakes.
- High achieving pupils should be encouraged to help others including writing solutions on the board (hidden initially from other pupils), create their own questions and be challenged with extension questions.
- Visual aids, including number lines and manipulatives, should be used by the teacher and pupils, with alternative methods discussed and evaluated.
- There should be a limited use of calculators, but only when pupils have achieved number sense; ICT should be used only when it is more effective than normal practice.
- Homework should only be set in later primary years and then interactively reviewed at the start of the next mathematics lesson.

### ***Training***

#### (a) Initial teacher training

- Trainee teachers should like teaching, pupils and mathematics.
- They need to be well qualified mathematically (and in their national language).
- Interviewers should assess interviewees' potential for teaching, for example, by getting them to present a mathematical topic to the interviewing panel.

- Schools and teacher training institutions should work closely together in the training of teachers.
- Trainee teachers should have opportunities early in their training to observe expert teachers, sharing and discussing their experiences.
- There should be a cycle of planning, implementation, discussion and review, feedback and learning for teaching practice, with trainee teachers initially working together or as a group with an expert teacher.
- School mentors used for initial teacher training should be expert teachers.
- Trainee teachers should be trained to use resources, including IT, effectively.

(b) In-service and support for established teachers

- This should in the main be school based, with teachers able to see each other teach.
- There should be a regular cycle of joint planning, demonstration, in-depth review and discussion, revising and refining lesson plans.

#### **4. Postscript**

We hope that this work will be helpful for teachers, researchers and education officials. We have tried to report the project results without fear or favour and to base our recommendations for good practice on the evidence before us.

We will always be grateful for the inspirational work of the country coordinators and the many teachers and pupils who have participated throughout the duration of the project. There would be no project without them!

Mathematics at primary (and secondary) schools is taught throughout the world so the problems and issues raised in this monograph are pertinent to so many people. We hope that some of our suggestions will be useful but above all, we hope that this research will encourage more people to discuss, share and evaluate ideas and strategies across country divides.