Mathematics Education and Teacher Education in England

Particularly for the 11-18 age range , and in the Catholic sector

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Mathematics at school today and tomorrow

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Self Referential Numbers

- 8 two fours
- 5 a hand
- 21 seven and seven and seven
- 13 unlucky number
- 100 (one and)^{15} eighty five
- 23 sixty nine divided by three
- 16 eighteen minus two

- YOUR NUMBERS?

"I see trouble with algebra."

The English state school system

R	age 4-5	Reception	Pre-school	Tests/Examinations
Y1	5-6	Key Stage 1	Infants	
Y2	6-7			SATs
Y3	7-8		Juniors	
Y4	8-9			
Y5	9-10			
Y6	10-11	Key Stage 2	Primary schools	SATs
Y7	11-12		Secondary schools	
Y8	12-13	Key Stage 3		
Y9	13-14			SATs
Y10	14-15			
Y11	15-16	Key Stage 4		GCSEs
Y12	16-17		Secondary schools	AS level
Y13	17-18	Post-16	and Sixth-form colleges	A2 level

Types of secondary schools

- The majority of schools are state maintained, secular, comprehensive (all-ability) schools, 11-16 or 11-18, some with specialist subject status; mainly mixed, but many single-sex
- There is then a diversity of other state schools – especially:-

  Grammar schools – requiring passing an examination at 11

  Academies – often partly privately financed, rebuilt, formerly failing schools in socially deprived areas
- There is an increasing number of faith schools, especially

  Church of England, Roman Catholic, Jewish, Muslim, Hindu, Sikh..

  There is a thriving independent, private, fee-paying sector of schooling

Curriculum and Assessment in schools

- State schools have to follow the National Curriculum, a set of guidelines for the compulsory, 5-16, age range; both what should be taught (but not how) - and also how to assess the performance of pupils on what should be taught
- There are National Standardised Assessment Tests, SATs, at end of Key Stages, (which are used to compare schools); in between these times, teachers assess using the National Curriculum Attainment Targets
- At the end of Key Stage 4 are nationally set GCSE - General Certificate of Secondary Education - examinations

Mathematics in the National Curriculum

- Mathematics is now a compulsory subject up to age 16.
- The first National Curriculum for Mathematics came out in 1989, and has been revised regularly.
- The current version splits the subject into 4 areas

  Using and Applying Mathematics;

  Number and Algebra;

  Shape, Space and Measures;

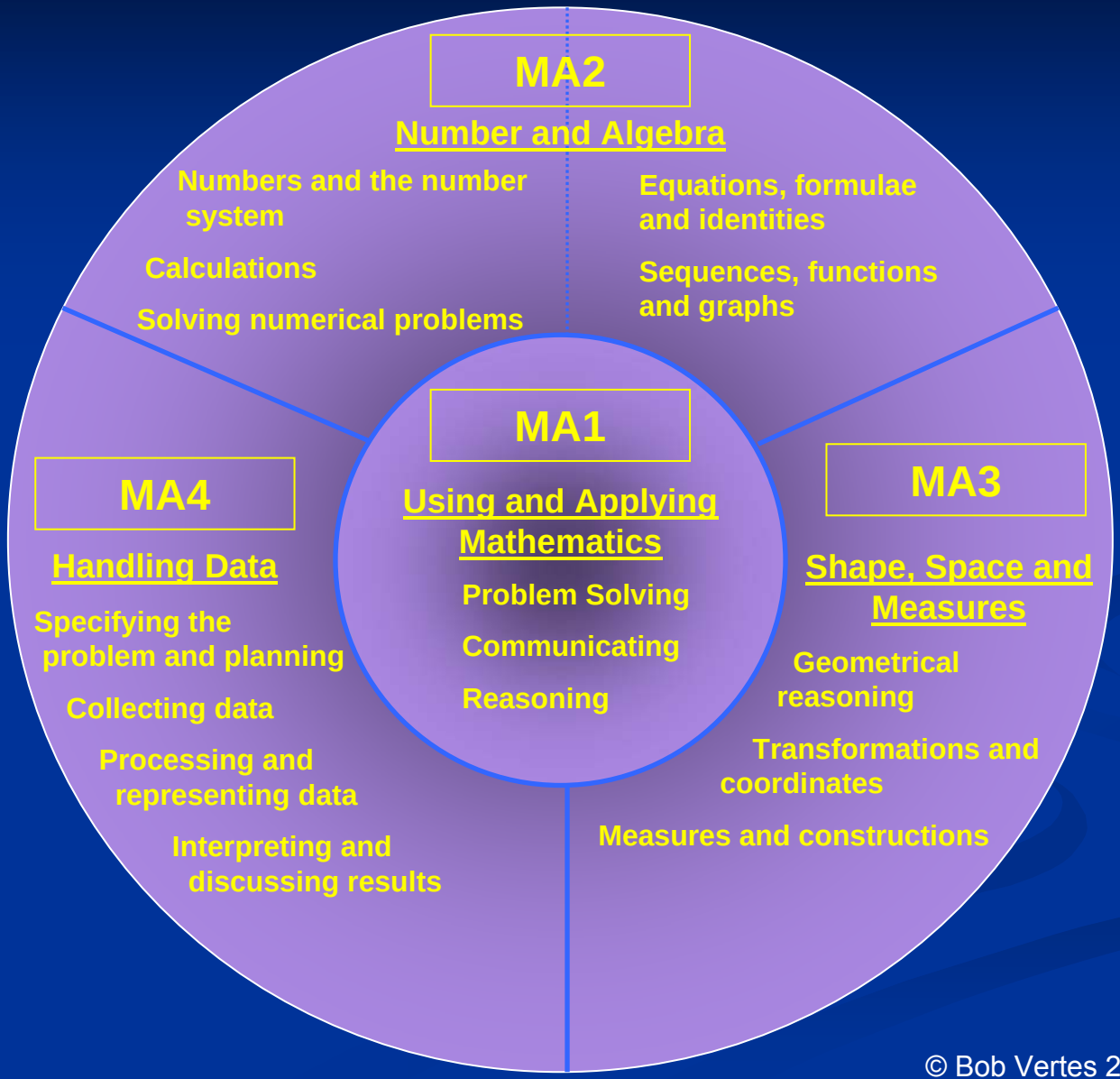
  Handling Data

  These should be seen as interlinked.

- There is also a National Strategy, developed with teachers, which guides how to teach the topics, at least in Key Stages 1-3.

Mathematics in the National Curriculum (2000)

Key Stages 3 and 4 Attainment Targets and Strands



www.nc.uk.net

- The programmes of study set out what pupils should be taught in various key stages and provide the basis for planning schemes of work
- The Knowledge skills and understanding in the programmes of study identify the main aspects of mathematics in which the pupils make progress
- Currently there are KS1, KS2, KS3, KS4 foundation and KS4 Higher PoS.

- The attainment targets in mathematics set out the Knowledge, skills and understanding that pupils with different skills and maturities are expected to have by the end of each key stage
- There are 8 level descriptions of increasing difficulty plus a description for exceptional performance of above level 8
- Each level description describes the types and ranges of performance that pupils working at that level should characteristically demonstrate

The National Strategy

- The Department for Education and Schools, recently renamed the Department for Schools, Children and Families, brought out a series of documents, for Key Stages 1-3, to help develop areas of the curriculum and some cross-curricular issues in school
- Initially the mathematical guidance section was called the National Numeracy Strategy, it now has Mathematics as a clearer focus.
- See www.standards.dfes.gov.uk/secondary/keystage3

Mathematics Examinations

- At 16 (normally) GCSE Mathematics could until recently be taken at 3 levels, Higher, Intermediate or Foundation – with grades A*, A, B, C, D, E, F, G available.

  Of these a minimum C grade is needed to continue to study, and for entry to a teacher training course or many employment routes.

  From this year 2007, only Higher and Foundation levels available.

- At 17 and 18, AS and A2 examinations are available, making up an A level (alongside normally two or three other subjects, pre-university); combining papers in Core (Pure Mathematics), Statistics, Mechanics, and Decision/Discrete Mathematics.
  Currently so many people are gaining A grades that an A* grade is proposed.

Two important Mathematics reports

There are two particularly important government-organised reports connected with mathematics education, which have affected :-

- what mathematics is taught in English schools, and how;
- what mathematics is assessed, and when and how;
- how teachers are trained and continue their professional development

They are the Cockcroft Report and the Smith Report.

Mathematics Counts Paragraph 243

"Mathematics teaching at all levels should include opportunities for

- exposition by the teacher;
- discussion between teacher and pupils and between pupils themselves;
- appropriate practical work;
- consolidation and practice of fundamental skills and routines;
- problem solving, including the applications of mathematics to everyday situations;
- investigational work."

"Mathematics Counts" The Cockcroft Report 1982

Mathematics Counts Paragraph 202

- “The sort of teacher appreciated by many pupils is one who can control the class, expects pupils to work hard, explains things briefly and clearly, gives plenty of practice and is prepared to help pupils individually.”

- Any teacher who can make maths interesting must be a good teacher”

Mathematics Counts Paragraph 345

- During every mathematics lesson a child is not only learning, or failing to learn, mathematics as a result of the work he is doing but is also developing his attitude towards mathematics.

- In every mathematics lesson his teacher is conveying, even if unconsciously, a message about mathematics which will influence this attitude.

Mathematics Counts Paragraph 421

- No child has ever grown taller because it was measured

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Making Mathematics Count

The Report of Professor Adrian Smith's Inquiry into Post-14 Mathematics Education

February 2004

www.dfes.gov.uk/mathsinquiry/

Smith Report:- Terms of reference

- *To make recommendations on changes to the curriculum, qualifications and pedagogy for those aged 14 and over in schools, colleges and higher education institutions to enable those students to acquire the mathematical knowledge and skills necessary to meet the requirements of employers and of further and higher education.*

Smith Report – an overview

- The Post–14 Mathematics Inquiry has identified three key issues of major concern:
- the shortage of specialist mathematics teachers, particularly in England and Wales;
- the failure of the current curriculum, assessment and qualifications framework in England, Wales and Northern Ireland to meet the needs of many learners and to satisfy the requirements and expectations of employers and higher education institutions;
- the lack of resources, infrastructure and a sustained continuing professional development culture to support and nurture all teachers of mathematics.

Mathematics Teacher Education in England

- Initial Teacher Training is now only for graduates, but it is not essential to have a Mathematics degree, provided there is sufficient accredited knowledge.
- Most teacher training courses are roughly 36 weeks, fulltime from September, with two-thirds based in school. There are also "flexible" courses, usually taking longer [and sometimes shorter if having experience without recognised qualification, or if qualified overseas]
- By the end of the course most trainees are teaching over 50% timetables.
- There are around 33 "Standards" for Qualified Teacher Status; every one of which must be achieved to be successful.
- Most ITT courses now enable teachers to gain Master's level credits.
- After the training year, an "induction" year must successfully be completed, to confirm QTS and become members of the General Teachers' Council.
- Given the huge shortage of mathematics teachers, there are special funds to persuade people to train - and to stay, and continue their professional development. There are standards to achieve at various levels.

The SWELTEC model of ITT

- SWELTEC is a consortium of 4 teacher training providers in SW London
- Brunel, Kingston and Roehampton Universities & St Mary's University College
- We recruit between us some 140 trainees for the 1 year PGCE(S)
- While trainees are in school, a qualified and experienced mentor gives an hour a week for a training session with each trainee, as they progress through Foundation, Development and Consolidation phases, increasing the proportion of contact time for which they are responsible for planning, delivering and evaluating lessons.
- Mentors and class teachers observe and comment on lessons seen, and on plans and assessment records kept by the trainee. A tutor from the home HEI visits a minimum of 4 times in the year, observes the trainee and gives feedback, but also monitors the quality of in-school training provided.

Coaching Conversations

- Encourage trainee to think deeper about action to be taken through questioning
- Encourage trainee to take responsibility for their own learning
- Encourage trainee to investigate different ideas and decide which fits best - do not feel that you have to give a solution

Three important questions:

- What mathematics do we want children to learn?
- How do we help them to learn it?
- How do we know when they have learnt it?

R N Vertes, St Mary's University College

A lesson for learning

- There is more than one teacher in this classroom

The Mathematics Teacher's Creed

- Thou shalt not teach topics without first finding out what they already know how to do.
- Thou shalt not tell them things when asking a question can make them think for themselves.
- Thou shalt not require lengthy written solutions to problems which can be solved mentally.
- Thou shalt not teach vertical layouts to calculations until you have a good reason for doing so.
- Thou shalt not encourage them to use the phrase "times it by" in place of "multiply it by".
- Thou shalt frequently encourage them to talk about their work to each other.
- Thou shalt always seek to make activities meaningful and purposeful.
- Thou shalt always listen carefully to what they say and respond appropriately.
- Thou shalt regularly ask them "How did you do that?".
- Thou shalt frequently ask them why it works.

Mathematics Teaching (ATM) September 1998

The Catholic Sector of English schools

- The Catholic Education Service is the umbrella organisation for England and Wales, working with 19 diocese in England

  www.cesew.org.uk – also www.ces.eteach.com for jobs etc.

- The Consortium of Catholic Higher Education Institutions (HEIs) in England are
  - St Mary's University College, Twickenham www.smuc.ac.uk
  - Liverpool Hope University www.hope.ac.uk
  - Trinity & All Saints College of HE, Leeds www.leedstrinity.ac.uk
  - Newman College of HE, Birmingham www.newman.ac.uk

Catholic Schools

- About 10% of all maintained schools in England are Catholic
  - 1723 out of 17762 Primary schools
  - 352 out of 3435 Secondary schools
- Recent Ofsted surveys demonstrate that Catholic Schools have an excellent reputation for high performance in value added, pupil achievement and leadership.
- At Key Stage 1 (age 7), KS2 (age 11) , KS3 (age 14), and KS4, (age 16) results in RC schools are higher than in schools nationally.

Catholic Schools in a national context

		RC Schools	Nationally
Primary Schools	Ethnic minority	18.2%	16.7%
	Language other than English	7%	9%
	Pupils with SEN	16%	19%
Secondary Schools	Mean size	913	976
	Ethnic minority	20%	15.6%
	Language other than English	7%	9%
	Pupils with SEN	16%	14%

There are more black and fewer Asian pupils in RC schools than nationally

Subject professional associations

There are two main mathematics teachers' groups

- ATM - The Association of Teachers of Mathematics www.atm.org.uk

  Publishes "Mathematics Teaching" (7 p.a.), produces many resources and software, and is especially interested in encouraging and developing practical, kinaesthetic, non-textbook, games and puzzles, fun mathematics, collaborative learning approaches.

- MA - The Mathematical Association www.m-a.org.uk

  Publishes "Mathematics in School" (4 p.a.) "The Mathematical Gazette", "Plus", and other items; more likely to appeal to teachers who are very good mathematicians, or working with high ability pupils and learners who like competitive learning.

Each of these has an annual conference at Easter; next year (2008) there is a joint conference at Keele University 2-5 April.

New Testament Maths 1

- Start with any number divisible by 3
- Find the sum of the cubes of its digits

e.g. if choosing 24, then find $2^3 + 4^3$ (= 8 + 64) = 72

- Now find the sum of the cubes of the digits in your new answer e.g. $7^3 + 2^3$ (= 343+ 8) = 351
- Continue. What happens?

Try with another number divisible by 3. Explain.

New Testament Maths 2

St John Ch 21 v11

"Simon Peter went up and drew the net to land full of great fishes,

One hundred and fifty three of them:

and for all there were so many, yet was not the net broken"