
ACME and two relevant meetings

The Advisory Committee on Mathematics Education (ACME), established in January 2002, is an independent committee which acts as a single voice for the mathematical community, seeking to improve the quality of education in schools and colleges. It advises Government on issues such as the curriculum, assessment and the supply and training of mathematics teachers. ACME was established by the Royal Society and the Joint Mathematical Council of the UK with the explicit backing of all major mathematics organisations, and is supported by the Gatsby Charitable Foundation.

ACME has five members who commit 10% of their time to work on the committee, and a Chair who attends at least quarterly meetings. The current membership of ACME is as follows:

- Professor Sir Chris Llewellyn Smith FRS (Chair)
- Chris Belsom (Ampleforth College, Yorkshire),
- Annie Gammon (Sir John Cass Foundation and Redcoat CofE Secondary School, London),
- Professor Celia Hoyles (Institute of Education and Chair of the Joint Mathematical Council),
- Professor Chris Robson (University of Leeds)
- Dr Sue Sanders (University of Wales, Swansea)

ACME's main role is to act as an independent two-way communication channel on matters of concern for mathematics education in schools and colleges between the mathematics community and Government. It is project-based with a remit including curriculum,

assessment, supply and training of mathematics teachers, and consideration of national and international developments.

At a DfES/ACME Conference on international best practice in continuing professional development (CPD) for mathematics teachers held on 13 March 2003 in London, Charles Clarke, Secretary of State for Education and Skills, announced that the Government would be creating a National Centre for Excellence in Mathematics Teaching, the details of which would be finalised by Professor Adrian Smith FRS, Chair of the Post14 Mathematics Inquiry. Sir Christopher Llewellyn-Smith FRS, ACME Chair, said: "We are pleased by the Government's rapid moves to create a National Centre for Excellence in Mathematics Teaching, which ACME recommended in December 2002 in a report on CPD for maths teachers."

DfES/ACME International Conference on CPD for teachers of maths

QE II Conference Centre, London, 13 March 2003

Report by: Neville Davies

This day conference comprised a morning seminar, where we were presented with international models for Continuing Professional Development (CPD) for teachers of mathematics, and an afternoon conference, the highlight of which was a presentation by Charles Clarke, Secretary of State for Education and Skills.

The day was organised in response to the December 2002 Advisory Committee on Mathematics Education (ACME) report *Continuing Professional Development for teachers of mathematics*. See, for example, www.acme-uk.org.

Professor Jeremy Kilpatrick (University of Georgia, USA) delivered a session on CPD for primary maths teachers, Dr Ruhama Even (Weizmann Institute of Science, Israel) talked about CPD at the lower secondary level and Professor Michele Artigue (University of Paris, France) focussed on higher secondary levels.

Professor Kilpatrick reviewed the spending on, and approach to CPD in the US and reported the results from a national survey on the topic (www.horizon-research.com). Key issues included: methods of transforming maths into the content needed; making

practice both the focus and setting; helping teachers support each other; organising time and resources.

Dr Even expounded the need to: define concepts; analyse learning materials; discuss assessment of students' work; provide explanations; and develop teacher mathematics knowledge. Other key issues included a discussion on the need to recognise different forms of knowledge and understanding.

Professor Artigue described, amongst other things, the present system of CPD in France that involved both national and regional activities. The annual *regional* program for teacher training (PAF) is complex, but teachers are allowed up to 5 days of training in work time, subject to head teacher approval. Teachers have a free choice of courses and no charge is made for them. However, the system was reported to be less than ideal and it does not seem to improve teaching practice in mathematics! A new project was described that: promotes collaborative work between teachers; gives due regard to the fact that CPD should be a long-term activity; and helps to have real impact on teaching practice.

Many will have already heard of the announcement concerning the establishment of a (school) *National Centre for Excellence in Mathematics Teaching* made by Charles Clarke during his afternoon presentation. The setting up of a national academy for teachers of mathematics together with a network of local mathematics centres was one of the recommendations in ACME's CPD report. Mr Clarke spoke eloquently and, to this attendee at least, answered the many question from the floor with refreshing clarity! Wearing my statistical education hat, I noticed he did single out the subject *statistics* as needing to be a key component in mathematical studies, especially with the increasing need to be able to get trustworthy information from data so that, potentially at least, evidence-based decisions can be made.

An extract from the press release follows:

Mr Clarke said that the new National Centre for Excellence in Mathematics Teaching will build on improvements made in maths' teaching and learning since 1997. It will:

- Cover all ages from pre-school through to universities and adult learning
- Provide teachers with professional support, training and development
- Work with teachers to produce specific curriculum support, exciting classroom materials and opportunities to explore different teaching approaches
- Work with the Numeracy Strategy in primary schools and the maths strand of the Key Stage 3 National Strategy.
- Link closely with specialist schools, local partner schools and universities to create strong and innovative subject specialist networks

- Support and enhance projects for the benefit of mathematically gifted young people

Adrian Smith, as Chair of the Post-14 Maths Inquiry, has been asked to advise on the costs and options for the new Centre and will report back to the Secretary of State by autumn.

A Personal view

I believe that it is CRUCIAL that the new Centre for Excellence in Mathematics teaching is NOT set up without due regard to the MSOR part of the new (proposed) Academy for Learning and Teaching in HE. It is a wonderful opportunity to link the school and HE sectors through CPD, in fact joined-up excellence in mathematics teaching and support? It is about time the two sectors linked together to take a big picture view of learning and teaching. I believe that we should be *proactive* in trying to link the MSOR part of the proposed Academy for HE and the schools' Centre for Excellence in Mathematics Teaching.

Indeed, the new HE Academy should have a specific role in helping to provide/recommend *quality* CPD for mathematics teachers, both qualified and non-qualified. CPD is going to be a vital ingredient in the attempt to stop the haemorrhaging of students and teachers from our profession – in both HE and schools.

Just as every town/city has at least one solicitor's office, so every region should have a one-stop mentoring, advice and consulting centre for matters mathematical and/or statistical. Why not call the professionals who might run these offices *Solicitors of Mathematics and Statistics*? The regional development agencies (RDAs) could help, with part-funding coming from them/businesses, especially with regard to outreach into the workplace. But that's another project...

ACME/Post 14 Mathematics Inquiry Workshop 1 - 'Post 14 Mathematics Education: towards a Baccalaureate?'

Royal Society, London, 2 April 2003

Report by: Joe Kyle

This, the first of two workshops ACME will be hosting on the Post 14 issue, was an extremely useful and informative meeting. This focus of this workshop was on developing long-term aspirational models of Post 14 mathematics education. Informed by examples of existing baccalaureate systems outside the UK, the question was explicitly put: could a baccalaureate model be the way forward for the UK?

Sir Chris Llewellyn-Smith's introductory comments emphasized that the Post 14 agenda will dominate

ACME's work in 2003. He saw the two workshops as quite different in nature: this meeting was more aspirational and should look at broad structural issues, the second (in May, 2003) will concentrate more on "nuts & bolts" issues. He himself admitted to becoming increasingly attracted to the baccalaureate model as one way of halting the decline in numbers of those studying mathematics later in their school careers. For as long as maximizing A-level points was a key influence, this problem was, in his view, likely to persist.

Programme for the day

Introduction	Sir Chris Llewellyn-Smith, ACME Chair
The Post 14 Mathematics Inquiry	Professor Adrian Smith, Inquiry Chair
The Government's Working Group on 14-19 Reform	Mike Tomlinson, 14-19 Working Group Chair
The French System	Catherine Dufossé, Commission de Réflexion sur Enseignement des Mathématiques (CREM), France
International Baccalaureate and Australian systems	Roger Brown, IB Research Unit, University of Bath
The German system	Professor Gabrielle Kaiser, University of Hamburg, Germany
Vocational Mathematical Training in Europe	Professor Alison Wolf, Institute of Education, University of London
Break out groups	
Feedback and plenary discussion	
Summing up and close of meeting	Sir Chris Llewellyn-Smith, ACME Chair

Adrian Smith then added a few words about the current state of play with the Post 14 Mathematics Inquiry. The recent announcement of the National Centre for Excellence in Mathematics is seen as an "early win" and the fact that the Inquiry has an extended deadline (September 2003) and will now report directly to the Secretary for State (rather than through ministers) is seen as a clear sign that the issues are being taken seriously within the government.

The Government's Working Group on 14-19 Reform

Of course mathematics can only form part of a baccalaureate-style qualification if there are broader structural changes. It was therefore particularly useful to hear the thoughts of Mike Tomlinson, currently charged with reviewing the whole of 14-19 education. He made it clear that he has not been told to deliver a baccalaureate system but pointed out that the recent Green Paper (**14 to 19 Opportunity and Excellence**) contains the following clear signal:

"Baccalaureate-style qualifications of this kind work well abroad. We believe that this model, designed to suit English circumstances, could tackle long-standing English problems."

MT remarked that this must be the first time that anyone had been asked to look at 14 to 19 as a continuum without having been told to "keep off" certain areas.

The Working Group has to:

- Look at ways to strengthen vocational provision
- Examine assessment practices and whether the burden (both on pupils & teachers) can be lightened (Do we need a public examination at

GCSE in an era of "mass staying-on"?)

- Consider the possibility of a unified framework.

After touching on some of the issues of principle, MT concluded by stating that we had a "once in a lifetime opportunity" to produce a framework that will give every young person the chance to achieve.

In response to questions, MT:

- Admitted that HE institutions would almost certainly have to adjust to an intake with different skills,
- Agreed that mathematics had special features, but added that he would likely hear similar pleas from other disciplines and rather ominously commented that *"difficult choices will have to be made and you can't have everything"*.

The French System

The French system was described in great detail by Catherine Dufossé (CREM). To say that this system has remained the same since the days of Napoleon would be a falsehood (if for no other reason than the fact that each new minister for education seems to add yet another topic to the scheme). Nonetheless there is a grain of truth in the claim. The overwhelming impression is of a very tightly prescribed, centrally controlled system that has dominated the French education system for decades. The French baccalaureate operates at three levels - pupils can elect to take a general baccalaureate, a specialist technical or a professional baccalaureate. (The latter two are more vocational, but all three can be used for university entrance.) The general baccalaureate may be:

- Baccalaureate L, which focuses on literature,
- Baccalaureate ES, featuring economic and social sciences
- Baccalaureate S, concentrating on science

From 16 to 17, regardless of the specific baccalaureate course they are undertaking, students will study French, history, geography, a foreign language, philosophy, mathematics, and science. Marks are weighted towards their specialist areas.

Examinations play a prominent part in this system; all over France pupils will sit down at the same hour on the same day to take the same exam! As advantages, CD mentioned:

- Baccalaureate seen as a symbol of equality
- Pupils will put in the effort
- Anonymity of processes
- Maintenance of standards

Possible disadvantages:

- Pupils and teachers driven by exams, so tend to teach to them
- Complexity – overall some 3-4 weeks are “disrupted”, nationwide
- Expense
- Poor preparation for HE

International Baccalaureate and Australian Systems

In Roger Brown’s talk on the Australian approach, we were presented with a quite “un-French” system. There is no national curriculum (but a national “framework”), each state has responsibility for its own education, and university entrance is determined by rank within the entire Australian cohort. We saw three states with very different models. For example, from 14 to 16 the results are summarised in Table 1

For these years, possible advantages of the Australian model might be - breadth, wide participation in mathematics, and school testing can emulate the 18-19 award. Possible disadvantages – lack of rigour, lack of setting, and comparing different systems. Moving on to the assessment at age 18/19 we see Table 2

For these years, possible advantages of the Australian model might be - breadth, wide participation in mathematics, statistics given parity with pure mathematics, and moderated coursework. Disadvantages might be lack of rigour (again!), problems with university entrance, and authenticity of coursework. RB then offered some comments on the International Baccalaureate Diploma which featured four “levels” in the mathematical provision ranging from the (compulsory for all, 150 hours over two years) Math Studies to the Further Maths SL (for high fliers, 150 hours over two

State	Certificate?	Maths subjects	Assessment
New South Wales	School Cert	5 stages with some differentiation at 16	2 exams at 16
Queensland	Year 10 Cert	Mathematics	school based
Victoria	None	Mathematics – possible setting/acceleration	no formal exams (but most schools would have their own)

Table 1 Australian System: 16-18 year olds

State	Certificate	Maths subjects	Assessment
New South Wales	Higher School Cert	Maths Maths Ext1 Maths Ext2	One exam + coursework
Queensland	Senior Secondary Cert	Maths A Maths B Maths C	Moderated coursework + Queensland core skills test
Victoria	Victorian Cert of Edu.	Further Maths Math Methods Specialist Maths	Three written exams + coursework

Table 2 Australian System: 18-19 year olds

years). An interesting feature of this model was an extended essay at the core, which could be far more substantial than might be possible when studying different topics on their own.

In the subsequent questioning, the point emerged that one consequence of such a system might be more mathematically literacy in the general population at the expense of fewer specialist mathematics graduates.

The German system

Gabrielle Kaiser presented the main characteristics of the German system which are shaped by the federal constitution of the state. Thus we see statewide regulation of curricula, textbooks, professional requirements, etc with overall co-ordination in the hands of a Standing Conference of Ministers. Schools are organized into:

- A tripartite lower secondary system (ages 10 to 16)
 - Hauptschule – lower level and vocational
 - Realschule – intermediate
 - Gymnasium – academic, access to university
- A dual upper secondary model – general versus vocational training
 - General education – 31 % of cohort, three years training, university entrance
 - Vocational education – 69% of cohort, two or three years, vocational qualification

A striking feature of this system is the extent to which teaching and assessment are seen as a unit with a large part of the assessment being teacher-based.

The role of mathematics is two-fold – as a theoretical study and as a toll for solving problems. The weightings of these two goals vary throughout the system from a rather algorithmic, example-bound approach in Hauptschule to an emphasis on proof and insight in the Gymnasium. Upper secondary students aiming at university will face the Abitur examinations (at age 19) which, in mathematics, compulsory at least at the Basic level, tests the “three pillars” of mathematics – calculus, linear algebra/analytical geometry, and probability & statistics. At the other end of the spectrum, mathematics appears to be well-integrated into the vocational schemes with a clear focus on every-day, real world reasoning and elementary modelling.

Vocational Mathematical Training in Europe

The final presentation of the afternoon was fascinating round up of “non-UK Europe” by Alison Wolf. She drew out a number of Oddities of the UK approach as opposed to the general model on mainland Europe. In England &

Wales we see an academic stream in which students either specialize in mathematics or do none at all alongside a vocational stream of integrated mathematics, which at times may seem to be “*integrated to the point of invisibility*”! This is in stark contrast with Mainland Europe where the academic route always has some mathematics (with the amount varying depending upon programme) alongside a vocational model which usually has compulsory separate mathematics as well as the “integrated” provision. After discussing these issues in greater detail AW came to the conclusion that any solution must recognize:

- The need for new *academic* pathways
- The need for new *vocational* pathways
- The need to deliver for adults, apprentices, full time 16-18 year olds
- The competitive nature of university entrance in the UK

As a possible way forward, AW made a persuasive case for the current Swedish system. In Sweden, all programmes offer (among other subjects) mathematics. The model offers multiple academic and vocational options within which there is an overarching mathematics syllabus with a progressive structure.

Furthermore it is possible to return to this syllabus in later adult life possibly up to university entrance level. To realise such a model in the UK would require:

- Professional development
- Commitment to mathematics teaching
- Schools sufficiently large to mount all options
- Sufficient lead-in time followed by a period of stability (a sentiment which clearly struck a chord among the audience).

Break out groups

The meeting then split into smaller groups to consider, in the light of what had been presented, five questions:

- Which aspects of the systems described by the speakers might be feasible in this country?
- What would be the implications for the teachers of mathematics?
- What would be the implications for HE?
- How long would it take to change in the direction you would like?
- What would be the first steps in such a change?
- In addition, it was suggested that consideration be given to a sixth point:
- What price change?

Typical of the responses were those of the Lilac (!!)
Group, chaired by the author.

Summarised Answers:

1. *Which aspects of the systems described by the speakers might be feasible in this country?*

- None! But...
- Swedish models are attractive (flexible ways of traversing one route)
- Swedish/German approach to vocational issues had merit
- Existing system decoupled from present exam structure might work (but some disagree!)
- Incorporate much more teacher-based assessment (eg Sweden & Victoria, Aus models)
- Check existing offering from Cambridge Board?

2. *What would be the implications for the teachers of mathematics?*

- A demand for many more teachers
- Much, much more CPD will be needed
- Go for the big vision (ie change over a substantial time-scale)
- Realise the size of the practical problems (work for second workshop?)

3. *What would be the implications for HE?*

- Offer inducements (“bribes”??) to new undergraduates to get into the classroom
- Develop new types of UG programmes that might help above
- Be prepared for knock-on curriculum changes in HE programmes
- Drift towards a 4 year degree
- Is the Bologna Declaration a problem??

4. *How long would it take to change in the direction you would like?*

- Rather depends on how you interpret question!
- But consensus was that this will take a substantial period – say 5 yrs planning/discussion then 5 yrs trialling/evaluation
- “Two parliaments”

5. *What would be the first steps in such a change?*

- Review whether there is a minimal critical size for a school
- Money for short term “sticking plaster” devices (eg pay students to take A-level!)
- Because....in answer to extra question..

6. *What price change?*

- Take the time to get it right

Feedback and plenary discussion

As they break-out groups reported, there were a number of points of clear agreement:

- The need to prepare many more teachers of mathematics,
- The subsequent demand for much more CPD for teachers
- The need to avoid a quick fix and take enough time to generate a real consensus on change.

A straw poll of those remaining at the end of the meeting indicated support for a baccalaureate-style approach in the UK, but opinion was by no means unanimous.

With these last thoughts the workshop closed leaving this participant at least with the clear view that there will be a baccalaureate operating in the UK eventually, but it will not appear overnight.

More details on this meeting can be found at the Maths Inquiry web-site
<http://www.mathsinquiry.org.uk/workshop>