



K E E L E
UNIVERSITY

COGNITIVE ACCELERATION IN MATHEMATICS EDUCATION (CAME)

CAME@KEELE

This is a two-year course for schools and is intended to help give a new impetus to mathematics departments and help improve examination results. Mathematics departments who would like to join CAME@Keele need to understand the level of involvement and commitment required. It is fully in line with the new mathematics curriculum for September 2008 and will help deliver key processes in mathematics.

Taster afternoon on Monday 9 March at Keele University from 1:30 – 3:30.

A contribution to teaching

The CAME project aims to contribute to the teaching of mathematics in years 7 and 8 and provide pupils with rapid intellectual development in the context of mathematics with the help of specialist teachers. This development is achieved through cognitive stimulation using carefully selected challenging classroom tasks over two years. The emphasis in these tasks is on 'big' ideas rather than on procedures and algorithms.

The CAME approach helps to underpin the notations and algorithms stipulated in the mathematics syllabus with real understanding through pupils effectively reconstructing the underlying concepts for themselves. This complements the other ingredients in students' mathematical experience: instruction and practice and investigations. This balanced diet of mathematical experience, delivered with forethought and co-ordination, significantly raises the whole of the thinking capacity of the students, with a lasting effect that creates a stable basis for higher achievement in later school years, whether for exam or for further learning. The aim, therefore, is cognitive development, permanent and general, as well as meaningful learning of mathematics.

The *Thinking Maths* activities were initially trialed, revised, further trialed and finally adapted into their present form. They have now been further revised.

The *Thinking Maths* approach

The CAME approach to teaching involves mediating students' work through group and class interactions.

Thinking Maths lessons are characterised by two distinctions from existing good practice. While each lesson has a clear agenda involving fundamental concepts in mathematics, the lesson does not focus directly on pupils learning these concepts, but rather on them 'struggling on the way' towards these concepts. The emphasis is on pupils in small groups, individually or in whole-class discussion, producing formulations and gaining insights at different levels of complexity, all related to the concepts. The outcome of the lesson is the thinking process and the sharing of ideas rather than the specific knowledge and skills themselves.

Thinking Maths lessons are an addition to the normal mathematics diet. Experience suggests that departments need to work together in planning and de-briefing sessions in the early phase of this work.

The thinking behind *Thinking Maths*

The work has been developed from the theories of Piaget and Vygotsky. CAME intends to move pupils from the 'concrete operational process' (a descriptive process) to a 'formal operational process' (a reasoning process). Much of the secondary mathematics syllabus (level 6 and upward) requires formal operational thinking. This suggests that without implicitly using this process pupils are unlikely to achieve a grade C at GCSE. The CAME project was started originally to help increase the proportion of year 10 pupils (currently about 28%) who demonstrate some ability to think formally.

Typically a CAME lesson starts with a concrete introduction which is followed by a challenge which cannot be solved using concrete operations alone. The pupils know what the problem is about, know what the words mean, but need to accommodate their thinking to a higher level in order to cope with the new problem.

How to use *Thinking Maths*

The main target population for *Thinking Maths* is pupils between the 70th and 25th percentile in years 7 and 8. The lessons may require modification for use with less able pupils.

Within each strongly structured context the emphasis is on collaborative learning. Pupils are first asked, in their own language, to describe the task that they are presented with, and to suggest strategies. Then in small-group work they are asked to work together so they can present their solutions or problems to the rest

of the class. In whole-class discussion individuals and groups are invited to contribute their ideas, and finally the class is asked to summarise each of the important points.

The 30 activities are intended to be used at a rate of 4 - 5 a term, as this is believed to be the minimum which can have a substantial long-term effect on cognitive development. It is recommended that the *Thinking Maths* activities are kept separate from regular content curriculum lessons and taught in the order presented (at least in the first year). Each *Thinking Maths* activity lasts from 60 to 90 minutes, though first time through they may take longer.

Maximising impact

Teaching style and a full understanding of the approach are considered to be essential to the success of the CAME project. It is not considered sufficient just to go through the 30 activities as normal class lessons. The essential feature of *Thinking Maths* is its concentration on pupils' thinking. The CAME@Keele course is designed to help teachers learn to work effectively with the material and understand the processes required to help pupils improve their thinking abilities.

Research findings indicate that when the implementation of the *Thinking Maths* approach is co-ordinated to involve all members of the department in collaborative activity and the sharing of ideas and responsibilities, this in turn leads to even greater success. Such a *Thinking Maths* programme includes the delivery of the lessons, teachers observing others teaching (or team teaching) the lessons, and departmental meetings which focus on the sharing of experiences. Each of these contributes to accelerating the learning of all those involved in the programme, both pupils and teachers.

Starting CAME@KEELE in July 2008

The first day of the course is Tuesday 1 July. Dates are as below.

Friday 3 July 2009

Thursday 1 October 2009

Friday 20 November 2009

Wednesday 24 February 2010

Thursday 13 May 2010

Friday 26 November 2010 (provisional)

Monday 28 February 2011 (provisional)

Friday 6 May 2011 (provisional)

In the first year the CAME@Keele team will visit each school twice, while in the second year there is one school visit. All schools will be provided with 6 copies of the *Thinking Maths* resources (additional copies can be ordered via Keele).

Two members of each mathematics department will be nominated as the school's CAME representatives. They will both be expected to attend all the Keele meetings and take the lead role in developing CAME in their school. Following each meeting it is anticipated that the training will be discussed within mathematics departments and the school's representatives will undertake any necessary training of school staff. Mathematics departments will be expected to meet regularly to discuss progress: this should be allowed for when you sign up for CAME.

Schools can only be involved with the whole 'package' CAME@Keele. In the unlikely event that any school wants to withdraw, all fees will still be payable.

The total fee for CAME@Keele for Keele University Initial Teacher Training partnership schools is £2500. The total fee for non-partnership schools is £2700 (**both include 6 copies of *Thinking Maths***).

Note that mathematics departments need to be committed to the CAME idea, it is not something that they should be sent on!

A limited number of places are available, so schools will be accepted in the order of receipt of the signed headteacher's document. **The final date for receipt of such documents is Friday 13 June 2008.**

Want more information?

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APPLICATION FORM

School name:

Address:

Telephone:

Fax:

CAME

representatives 1:

and 2:

I agree that my mathematics department can become involved in the CAME@Keele project for two years 2009-2011 and that the school will pay the full amount(s) shown at the times specified below (even if the school decides to withdraw).

Signed: _____ (Headteacher) Date: _____

The total fee for Keele ITT partnership schools is £2500 (includes 6 copies of *Thinking Maths*). The total fee for non-partnership schools is £2700 (includes 6 copies of *Thinking Maths*).

There are three payment methods, please tick on of the boxes below.

Method 1	Partnership	Non-partnership	Tick here
Please invoice my school in September 2009 for a single payment of:	£2500	£2700	
Method 2	Partnership	Non-partnership	Tick here
Please invoice my school in September 2009 for a single payment of: Please invoice my school in September 2010 for a single payment of:	£1500 £1000	£1600 £1100	
Method 3	Partnership	Non-partnership	Tick here
Please invoice my school in September 2009 for a single payment of: Please invoice my school in both September 2010 And April 2011 for a single payment of:	£1500 £500	£1600 £550	

Provisional seminar dates

Friday 3 July 2009

Thursday 1 October 2009

Friday 20 November 2009

Wednesday 24 February 2010

Thursday 13 May 2010

Friday 26 November 2010 (provisional)

Monday 28 February 2011 (provisional)

Friday 6 May 2011 (provisional)

Please return to Sarah Newton (tel: 01782 733434, fax: 01782 734069) or post to Sarah Newton, School of Public Policy and Professional Practice: Education, Keele University, Keele, Staffordshire, ST5 5BG.