

The National Strategies' Programmes of Support for the National Challenge

National Challenge Core Plus mathematics programme

Element 3: Improving mathematics subject pedagogy
and the climate for learning

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Rationale

Most mathematics departments have a considerable spread of subject knowledge and pedagogic expertise. Some non-specialist teachers require support to develop both subject knowledge and subject-specific pedagogies. Other non-specialists have a well developed range of teaching strategies but lack the subject-specific confidence to translate this into their mathematics teaching. Typically, such teachers replicate their own mathematics education, teaching in a didactic way, leading to long explanation and demonstration without allowing pupils to engage with mathematics.

In comparison, there are some teachers with a good knowledge of mathematical techniques who have a restricted range of teaching strategies; often demonstration, followed by practise of standard procedures. These teachers are effective in showing students what to do, but mathematics becomes an apparently endless series of algorithms for pupils rather than a coherent and interconnected body of knowledge. The result is that lessons do not develop sufficiently the pupils' ability to reason and discover solutions for themselves.

Teachers who understand how children learn mathematics can plan and manage the effective delivery of purposeful and engaging learning opportunities. They are able to ensure that pupils make appropriate progress through motivating them with relevant activities. All teachers can benefit from reflecting on and further developing their knowledge, skills and expertise in mathematics-specific pedagogy in order to improve young people's learning experience.

As a significant external examination approaches, a more rapid and responsive approach will be needed. At this point, much of the teaching is revision and the choice of teaching strategies is even more important. By definition, these sessions include areas which have been 'covered' many times before and, for too many pupils, involve endless exam question practice. In order to maintain motivation and improve understanding, it is helpful to approach an old topic using new pedagogies. This will involve choosing different activities to revisit a topic and teaching using new strategies. For example, taking a more creative approach to exam question practice – see Help sheet 4, HS4: *Creative ideas for examination question practice.* (See Element 1b.)

The approaches described below will support teachers working together to develop sequences of learning, focusing on developing a particular aspect of pedagogy

Quality standards

The following principles have been shown by research to underlie effective teaching. As teachers work together to plan, they should seek to include sequences of learning designed around these teaching principles:

- build on the knowledge pupils bring to a sequence of lessons
- expose and discuss common misconceptions

- develop effective questioning
- use cooperative small group work
- emphasise methods rather than answers
- use rich collaborative tasks
- create connections between mathematical topics
- use technology in appropriate ways.

For a fuller description see the *Secondary mathematics guidance papers*, pp. 19–26.

Exemplification

One way to establish a focus for this work is to select one or two of the teaching principles described above and to work together on a cycle of plan-teach-review. To start the thinking about which aspects to choose, it is helpful to read a few case studies describing how other departments have worked in this way.

Improving teaching and learning in mathematics: Case studies (00478-2008BKT-EN) is a booklet designed to support subject leaders (SLs) and teachers to work together to develop aspects of pedagogy. The 'Exploration task', p. 9, in this booklet describes how a department might choose and explore one or two of the case studies. It also includes getting to know the teaching principles by reading and discussing the section Teaching and Learning Approaches, pp. 19–26 of the *Secondary mathematics guidance papers*. Through discussion, teachers establish how the case study uses and develops the teaching and learning principles.

Implementing the plan-teach-review cycle

Pedagogy is best developed by teachers working together in and out of the classroom to explore some mathematical ideas themselves and then plan the teaching of the mathematics. The selection of working pairs or trios will be more effective if it takes account of levels of confidence and experience.

<p>Actions for the mathematics department</p> <p>Weeks 1 and 2: plan</p>	<p>Related leadership and support: senior leadership team (SLT), SL, key teacher, advanced skills teacher (AST), consultant</p>
<p>Link this development to the department's priorities for accelerating pupils' progress by focusing on an aspect of mathematics that is a curricular weakness for target groups of pupils.</p> <p>Select a rich task to use in the classroom and do the task together. This will strengthen teachers' understanding of the mathematics subject content, the progression in thinking and the purpose of the activities. An excellent source for the tasks would be the Standards Unit materials available in the 'rich tasks' folder of the <i>Secondary mathematics planning toolkit</i>.</p> <p>Select one or two teaching and learning principles to be developed.</p> <p>In pairs or trios, plan how to use the rich tasks over a short sequence of lessons developing the particular teaching and learning approaches.</p> <p>Identify those social and emotional learning outcomes which could also be developed through this approach, for example 'work cooperatively'.</p> <p>Use the <i>Teaching and learning review: lesson/unit</i> available from the <i>Secondary mathematics planning toolkit</i>, 'adaptable templates' folder. Adapt the template to suit the development focus. It can then be used for personal planning and reflection, as an agreed vehicle for peer planning and observation, or for observation by a senior leader.</p> <p>Specify resources and other organisational requirements.</p> <p>Consider the role of the supporting consultant, teachers or TAs.</p> <p>Agree a date for a review meeting at which everyone will share their experiences.</p>	<p>Decide who is providing the strategic lead at each stage and for each activity.</p> <p>Identify where in the department the teaching principles are part of embedded practice and use the relative strengths and knowledge of relationships in the department to help decide support partnerships. Maintain a strategic focus on target groups of pupils.</p> <p>Organise the joint planning and teaching, securing sufficient time for groups of teachers and teaching assistants (TAs) to meet and plan (part of a regular cycle).</p> <p>Meet with the teachers and agree the delivery requirements, expected outcomes and review date.</p> <p>Decide how whole-school behaviour for learning strategies can be developed within the teaching cycle.</p> <p>Lead the planning; ensure that templates are prepared using the <i>Teaching and learning review: pupil views</i> available from the <i>Secondary mathematics planning toolkit</i>, 'adaptable templates' folder. Adapt the template to suit the development focus. It can then be used by a senior leader to gather pupils' feedback into the review of impact.</p>
<p>Actions for the mathematics department</p> <p>Weeks 3 and 4: teach</p>	<p>Related leadership and support (SLT, SL, key teacher, AST, consultant)</p>
<p>Teach the lesson sequence, working together</p>	<p>Organise in-class support, including support</p>

<p>using coaching, team-teaching or peer observation.</p> <p>Liaise on planning so that each lesson builds on the learning emerging from the previous lesson.</p> <p>Use the template to keep a brief log, detailing intentions and experiences, and the observed impact on pupils' progress and understanding. This will help to structure feedback and inform next steps.</p> <p>Teachers share the findings on the benefits and problems of using the selected teaching and learning strategy.</p>	<p>for behaviour for learning.</p> <p>Ensure non-specialists feel supported. This should include provision of additional preparation time working on the mathematics of the task.</p> <p>Gather evidence of impact through observations, using agreed prompts and templates. Include observation of improved social and emotional outcomes, such as greater resilience.</p> <p>Ensure that observation of pupil progress feeds back and informs planning of the next lesson. Monitor lesson punctuality and attendance in order to identify improvements.</p> <p>Support and encourage teachers as they try new strategies, offering constructive practical solutions for improvement.</p>
<p>Actions for the mathematics department</p>	<p>Related leadership and support (SLT, SL, key teacher, AST, consultant)</p>
<p>Weeks 5 and 6: review</p>	
<p>Review the work in pairs/trios to share expertise and collaboratively plan some further lessons.</p> <p>Consider the impact of the adopted approach on pupils' understanding and progress.</p> <p>Note suggested improvements. For example, would an alternative strategy or approach have better suited this particular aspect of mathematics?</p> <p>Celebrate the successes and identify further support needs.</p> <p>Establish the next steps for each teacher's personal development of pedagogy and the focus of the next collaborative cycle. The focus is likely to remain the same for a few cycles. At some stage, another may be selected after further exploration of the case studies in <i>Improving teaching and learning in mathematics: Case studies</i>.</p>	<p>Organise and lead the review of impact using the evidence provided by pupils' and teachers' views using the templates.</p> <p>Feed, into review meeting, evidence of impact on progress, engagement and perceptions. Include evidence of improved lesson punctuality and attendance.</p> <p>From the review, summarise all evidence of impact. Use summarised outcomes to inform the Raising Attainment Plan (RAP) evaluation.</p> <p>Consider alternative staff groupings in light of successes with particular partnerships, approaches/principles.</p> <p>Ensure an appropriate focus is selected for the next cycle. Bear in mind that teachers may need a few cycles before they feel confident to continue to use and develop new aspects of pedagogy.</p>

Review

Review against quality standards.

After six weeks of implementation make a judgement about the extent to which:	Specify exactly who will make the judgement – choose from: SLT, SL, key teacher, AST, consultant	Specify how this will inform the RAP and next steps
Pupils work collaboratively and engage in mathematical talk.		
Pupils express interest and enthusiasm as learners of mathematics.		
Pupils are given the opportunity to work in a variety of ways in lessons: <ul style="list-style-type: none"> – group work – making choices and selecting the mathematics to use. 		
Teachers are better able to assess pupils' understanding and attainment levels.		
Teachers have planned for and use: <ul style="list-style-type: none"> – more open and probing questioning – real and/or purposeful mathematical context. 		
Exposing and discussing common misconceptions is increasingly a part of the teaching repertoire.		
Teachers are seen to be using technology effectively to improve learning.		
Collaborative working is increasingly a part of departmental practice.		
Discussion of the teaching and learning principles is featured in departmental meetings.		

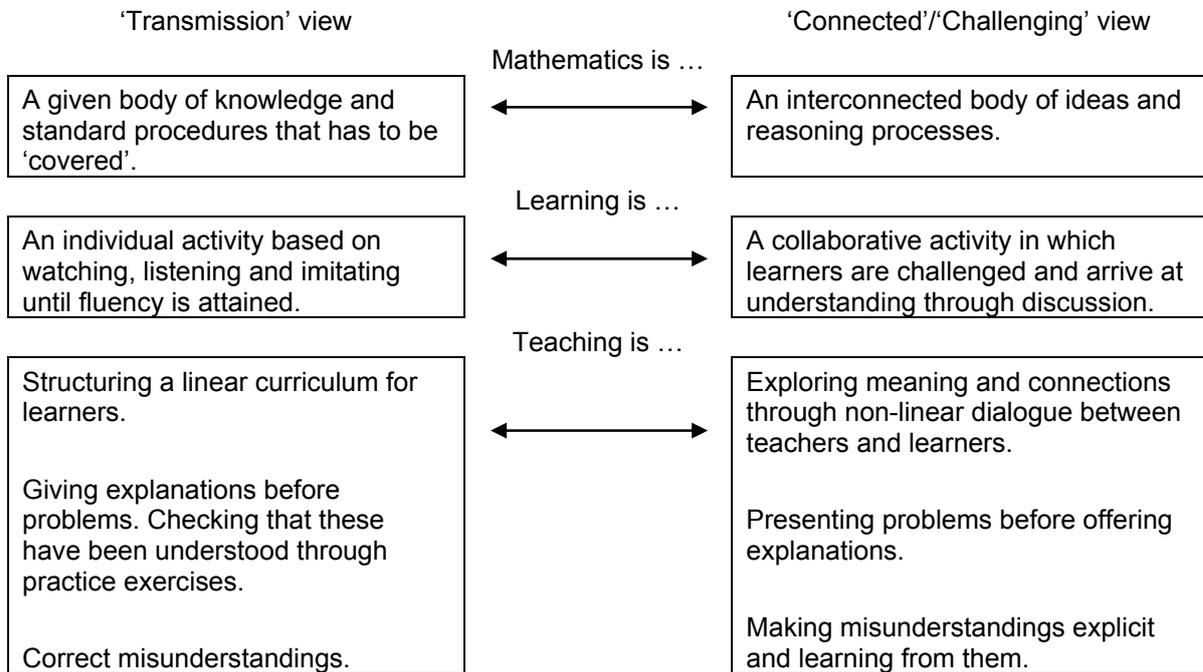
Case studies

Case study A: sharing beliefs about teaching and learning

One department decided to start discussions around teaching and learning by using a professional development session from the Standards Unit materials. They drew the resources from the *Secondary mathematics toolkit*, 'pedagogy and subject knowledge' folder. Using PD1, 'Getting started' and the associated guidance booklet *Improving learning in mathematics: challenges and strategies* they shared views of teaching and learning and agreed that they needed to move more towards:

- connectionist: emphasising the interconnected nature of mathematics
- challenging: common difficulties are addressed rather than avoided.

They found the distinction summarised in the diagram below especially helpful



Case study B: the proof of the pudding (is in the teaching!)

This example from *Improving teaching and learning in mathematics: Case studies*, offers an insight into reflective practitioners focusing on three of the teaching principles and describes collaborative work by teachers in two different schools working with an LA consultant.

One teacher aims to develop these principles while working with a group of Year 11, borderline C/D students on circle theorems. Though this is a new topic, it offers a readily accessible area of mathematics to ‘borderline C’ pupils and one on which they should pick up marks in the examination.

Case study C: using ICT in mathematics

Opportunities provided through using ICT mean teachers can reconsider the most appropriate ways of teaching mathematics and hence involves teachers in rethinking their pedagogy. Concepts, structures and processes can be represented in new and revealing ways, often using dynamic images, and this permits insights and understandings that were difficult to convey previously. One department used *Using ICT in mathematics: Algebra: functions and graphs* (the link is given below under *The ICT pilot: improving learning in mathematics*), to develop pupils’ understanding of the relationships within and between coefficients, constants and equations.

The spreadsheets offer an easy way to quickly display and make the links between the algebraic, tabular and graphical representation of an equation. As the notes suggest, pupils worked in pairs or small groups to investigate for themselves the relationships between the coefficient and the gradient, the constant and the y intercept. Using such dynamic interactive images allows pupils the freedom to discover ‘what happens if...’. As well as using technology in an appropriate way, this is an example of how classroom activities can be designed to create connections between mathematical topics.

Resources

Improving teaching and learning in mathematics: case studies (DCSF ref: 00478-2008BKT-EN)

Available as part of the autumn 2008 subject leader development materials in the mathematics 'Subject leadership' area at:

www.nationalstrategies.standards.dcsf.gov.uk/secondary/mathematics

Secondary mathematics planning toolkit (DCSF ref: 00342-2008CDO-EN),

- Guidance on planning folder, Secondary mathematics guidance papers
- Adaptable templates folder, Teaching and learning review templates: lesson/unit, Teaching and learning review templates: pupil views
- Pedagogy and subject knowledge folder, SU improving learning in mathematics

A copy of this CD-ROM could be obtained from the LA mathematics consultant or ordered from DCSF Publications T: 0845 60 222 60, email: dcsf@prolog.uk.com

Help sheet available as optional downloads from the same source as this paper: *HS4: Creative ideas for examination question practice*.

Continuing Professional Development (CPD)

Secondary mathematics planning toolkit: (DCSF ref: 00342-2008CDO-EN) (see above)

- Pedagogy and subject knowledge folder, SU improving learning in mathematics, Improving learning in mathematics: a professional development guide

The ICT pilot: improving learning in mathematics

- Mathematics SL development materials, autumn 2008, (DCSF ref: 00224-2008CDO-EN). An interactive DVD guiding SLs and teachers in a discussion about how to improve mathematics pedagogy using a sample of resources from the ICT pilot. Available in the mathematics 'Subject leadership' area at www.nationalstrategies.standards.dcsf.gov.uk/secondary/mathematics
- A more extensive collection of the ICT resources and guidance developed from the ICT pilot: improving learning in mathematics

Social and Emotional Aspects of Learning for Secondary schools: Guidance Booklet, Ref: 00043-2007BKT-EN, The website to support Social and Emotional aspects of learning can be found at

www.nationalstrategies.standards.dcsf.gov.uk/secondary/behaviourattendanceandseal