



# Standards Unit

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## Improving learning in mathematics: introduction



# mathematics

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Success for All website:  
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# Foreword



**By Jane Williams**  
Director of Teaching  
and Learning  
Head of  
Standards Unit

## **We are committed to the following principles which underpin all our work:**

- We will recognise and celebrate excellence in the post-16 sector.
- We will recognise and celebrate diversity.
- We will be open and participative in our approaches to development.

Success for All is a partnership between the DfES Standards Unit and the Learning and Skills Council (LSC). The Standards Unit leads on Themes 2 and 3 and the LSC on Themes 1 and 4:

- Theme 1 – meeting needs, improving choice.
- Theme 2 – putting teaching, training and learning at the heart of what we do.
- Theme 3 – developing the leaders, teachers, training and support staff of the future.
- Theme 4 – developing a framework for quality and success.

The Standards Unit was set up in January 2003 to embed excellence in teaching, training and learning and to modernise and upgrade the sector's workforce. It acts as a catalyst, selecting priority curriculum areas for action and harnessing the work of partners to improve quality in the post-16 learning and skills sector – in FE and sixth form colleges, sixth forms in schools, work-based learning, adult and community learning and the prison service.

The Unit's staff includes officials and expert practitioners seconded from colleges and other providers and the inspectorates. This core team is supported by call off

- We will recognise barriers to excellence and be supportive of those working in challenging contexts.
- We will challenge under-performance.

consultants, whose expert knowledge enables delivery in a range of areas. The work of the central team is supported by nine regional offices who are crucial to the national dissemination of the teaching and learning resources and the delivery of step improvements across the country. The Unit selects curriculum areas because of their importance to the economy and social inclusion and because inspection outcomes show there is room for improvement.

To support the improvements required, the Standards Unit is also providing national free training in coaching for teachers and trainers who have been nominated as Subject Learning Coaches by their managers. The programme is designed to provide professional training for Subject Learning Coaches so that they can work confidently with colleagues to further improve teaching, training and learning in their subject area. It is a new and exciting programme which is being embedded through subject networks, where Subject Learning Coaches from different backgrounds meet to share best practice and develop their coaching skills. If you would like to know more about becoming a Subject Learning Coach, why don't you speak to your Standards Unit Regional Director or look at [www.successforall.gov.uk](http://www.successforall.gov.uk).

# Rationale

**“The students were relaxed and confident as they discussed their solutions and explained concepts to each other.”**

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OFSTED (2004)  
Wilberforce College  
Inspection Report

**“In the prison service, this approach has taken the demon out of mathematics. They come hating mathematics and now enjoy it.”**

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Jackie Napier,  
HMP Drake Hall

The aim of this resource, and the approach it exemplifies, is to improve learning in mathematics. The approach is based on two main principles.

## **(i) From ‘passive’ to ‘active’ learning**

We aim to make the learning of mathematics more effective by challenging learners to become more active participants. We want them to discuss and explain their ideas, challenge and teach one another, create and solve questions and work together to share their results.

## **(ii) From ‘transmission’ to ‘challenging’ teaching**

In traditional ‘transmission’ teaching, the teacher or trainer explains a mathematical method, asking questions only to check that learners are following the taught procedure. Learners practise the given methods, on their own, by doing graded exercises. Our approach is based on a different model of learning. It is ‘challenging’ and confronts common difficulties, encouraging learners to work together to arrive at understanding through discussion. It explores questions, presents problems before offering explanations, and encourages learners to learn from their mistakes.

**“The good thing about this was, instead of like working out of your textbook, you had to use your brain before you could go anywhere else with it.”**

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Learner,  
High Pavement  
College

**“Working through a problem with a partner, and not being dictated to about how to solve it, increases your confidence in your own ability.”**

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Learner,  
Bognor Regis  
Community College

The teacher or trainer has a different but still proactive role, which we explain more fully in the book *Improving learning in mathematics: challenges and strategies* which you will find in this resource.

## **Some underlying principles**

In developing this resource, therefore, we have been guided by the following principles:

- Build on the knowledge that learners bring to lessons.
- Expose and discuss common misconceptions.
- Develop effective questioning techniques.
- Use cooperative small group work.
- Emphasise methods rather than answers.
- Use rich collaborative tasks.

And, throughout the trialling and pilot period, we have sought to:

- emphasise connections between mathematical topics;
- use technology appropriately.

# The resource

This resource includes the following:

## a DVD-ROM

Improving learning in mathematics:  
exploring the approaches

This offers the opportunity to learn about the approaches by exploring the work of the teachers, trainers and learners involved in the pilot. You can reflect on aspects of effective practice, such as questioning techniques, discussion and assessment, as well as viewing case studies of teachers, trainers and learners taking part in sessions, and listen to their reflections on their work. You can access ideas for sessions, learning activities, and the supporting software where appropriate.



## six CD-ROMs

These contain the same materials as the DVD-ROM, for those without access to a DVD drive.

## a DVD video

Improving learning in mathematics:  
an overview

This gives an overview of the work on the pilot and an introduction to the approaches.



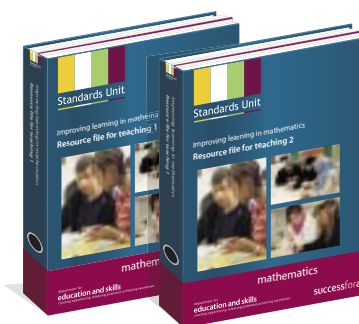
## a VHS videotape

This has the same content as the DVD video.

## a short book

Improving learning in mathematics:  
challenges and strategies

This explains the rationale of the approaches, outlines some of the issues and gives practical advice on ways forward.



## two folders of teaching and learning materials

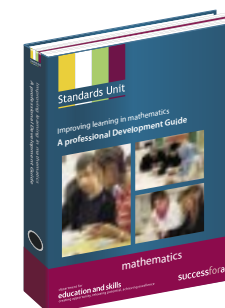
Improving learning in mathematics:  
resource file for teaching 1 and 2

These contain 51 'sessions' for use with learners, with learning materials, guidance on how they can be used, photocopiable resources etc.

## a professional development guide

Improving learning in mathematics:  
a professional development guide

This offers further ideas for using the resource and for sharing the approaches with your colleagues.



# Using the approaches



Steve Woodward,  
S & B Training Ltd

Steve trains young people who are aiming to achieve NVQs in the maintenance and repair of motor vehicles, mainly at Levels 2 and 3. There is plenty of mathematics involved, but learners' prior achievement at GCSE ranges from Grades B to U, and Steve has to work with them all in a single group, mainly in a classroom setting.

The trainees attend in 6-week blocks. The main focus is on vehicle technology so there is little time for specialist mathematics lessons, which in any case the trainees would not welcome. It is essential that the mathematics is embedded in the vocational context and that the trainees can see its relevance, especially for Key Skill Application of Number.

At first, Steve found it hard to relate the approach to his area of work, but now he thinks that the materials provided in the pilot period of the mathematics project are "fantastic". However, he emphasises that, for him, it is the approach that is important, rather than taking the materials "off the shelf". For example, he finds that small group work helps him to create the rapport and atmosphere that trainees are used to in the workshop.

**"I've actually used my brain for once in this lesson."**

Trainee,  
S & B Training Ltd

**"It's no harder than traditional teaching methods but you have to stay constantly engaged."**

Steve Woodward,  
S & B Training Ltd

"Also", he says, "with a small group, you can always tell when they're not working on the task. They can't switch off the way they can in a whole class situation. And anyway they don't want to switch off."

Steve himself is working towards his Cert. Ed. and has valued the opportunity that this project has given him to explore different approaches to teaching and learning.

His advice? "Give it a go and see what happens."



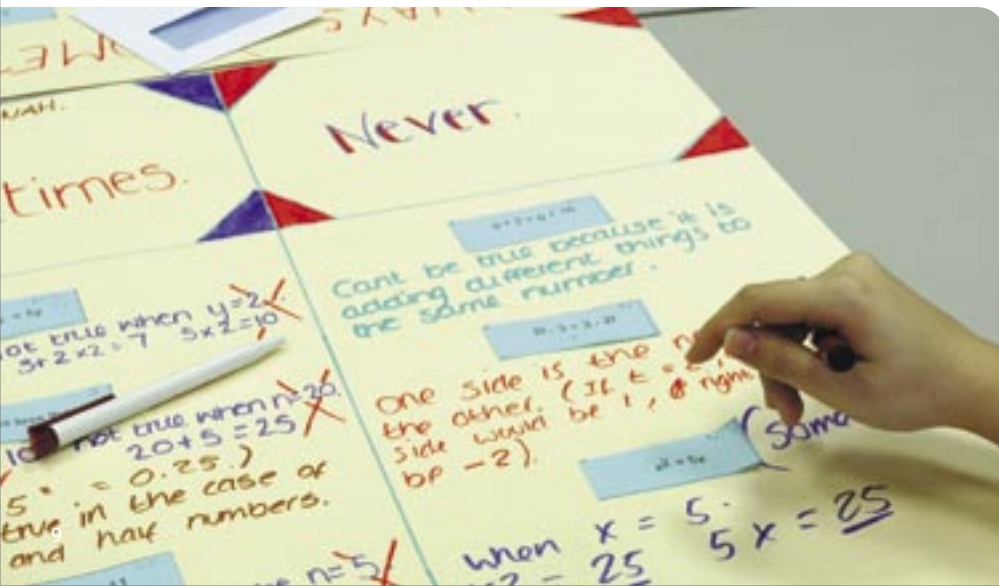
# Using the approaches



Margaret Ballantyne,  
Bognor Regis  
Community  
College

"We were looking for a way to build on what we'd been doing at Key Stage 3 and now we use the Standards Unit approach from Year 9 right through to A2", says Margaret. "It also fits nicely with our policy of having 'study partners' from Year 7 onwards."

She finds that the approach has really livened up mathematics in the sixth form. It felt a bit revolutionary to ask A2 learners to work in pairs, sort out cards, make posters etc but, after some early resistance from traditionalists, the learners have really taken to it. They are developing the confidence to explore new ideas and are willing to 'have a go', make mistakes and learn from them,



rather than wait for the teacher to give them the 'right answer'. In fact, some insist on using mini-whiteboards in class and have bought their own to use at home.

**"They don't have to be taught something when they have found it out for themselves."**

"Mind you", says Margaret, "questions come at you from all angles. You have to listen to them really carefully and think on your feet more than before. The students can see that you are still learning yourself and the speed at which they make connections can leave you reeling!"

**"When students are working on an activity, the only problem is getting them to stop."**

She uses the approaches and the materials both for first-time learning and for revision sessions, but revision takes less time than it used to.

Margaret Ballantyne,  
Bognor Regis  
Community College

Margaret and her colleagues find that they use the materials in different ways but they are developing new resources and setting up a central storage system. The Standards Unit pack is only the start.

# Using the approaches



**Michelle Gray,  
North West Kent  
College**

At North West Kent College they have been using the approaches with GCSE resit learners and engineering apprentices, as well as with adults on 'return-to-study' and Access courses. Following a disappointing OFSTED report in 2002, they have been focusing on their approaches to teaching and learning mathematics and this project provided an ideal framework to develop this area of their work.

When she first saw the materials, Michelle thought they "looked OK" and was attracted by the apparent simplicity of some of the activities and the relatively low-tech approach. Then, once she and her colleagues tried out some of the activities for themselves, they began to see the full potential.

Michelle has found that her 16-19 learners respond very positively to the whole range of activities, including using mini-whiteboards, sorting and matching cards, working through problems, creating their own exam questions, and using computer simulations. After a while, she says, "You don't feel guilty about the fact that they haven't produced much writing by the end of the lesson, because you know they have really learned something."

**"They learn more than they realise when they talk things through with each other."**

**Michelle Gray,  
North West Kent  
College**



**"We achieved a grade 3 at our re-inspection of science and maths in November 2003. The team were very encouraged by the new approaches; it gave them the confidence to try something different."**

**Jane Freeman,  
Director of Faculty  
North West Kent  
College**

When working with adult learners, Michelle found that they expected a traditional teacher-centred approach and, at first, lacked the confidence to expose their misconceptions. However, once they became used to working in pairs, they began to overcome this resistance and learned how to learn from each other.

The biggest single difference for learners? "They participate in the lessons; they have to think things through." And for teachers? "It's much more enjoyable, but it's demanding – you can't 'coast' through a lesson!"



# Using the approaches



**Richard Tarry,  
Tower Hamlets  
College**

**“It’s much easier to identify who understands the work and who is struggling.”**

With 20 years’ teaching experience, Richard welcomes what he sees as a return to active investigative learning and a problem-solving approach.

He particularly welcomes how the materials help to differentiate learners, making them more self-reliant and able to work cooperatively, whether they are in Level 1 vocational programmes, revising for A level exams, or anything in between.



**Nash Parmar,  
Solihull College**

**“It’s the methodology rather than the materials.”**

At Solihull College they are taking a ‘whole team’ approach to the mathematics project and have found that the approaches can be used in FSMQ, GCSE, Adult Numeracy, AS and A2, and Application of Number.

Nash has ensured that there is cross-college support for the initiative, which has been actively promoted to senior management and to governors. Effective staff development is crucial.

# Using the approaches



**Selvin Batchelor,  
HMP/YOI Moorland**

**"I used to lecture.  
Now it's a two-way  
dialogue; they're  
involved in their  
learning."**

Selvin works with men aged between 20 and 50 who are held in secure conditions. They are working towards Adult Numeracy at Level 2, GCSE and A level. At first, he thought that his learners might think that the approaches and materials were too "childish" for them. In fact, once they had got over an early phase when pairs and groups tended to compete with each other, he is finding that they work together and help each other to learn. Selvin is working with coordinators in other prisons in the Manchester area to introduce these approaches more widely.



**Barbara Hutton,  
Peterborough  
Regional College**

With many years' experience in teaching basic skills and Skills for Life, Barbara was already familiar with active learning techniques. However, she has found that working with the Standards Unit materials has helped her learners, including trainee teachers, to take more responsibility for their own learning.

**"You don't ask  
'What's 2 + 2?'.  
You ask 'How many  
ways can you think  
of to make 4?'"**





**Marion Dovey,  
Selby College**

**“They stick with it. They’re interested. You don’t get that stony silence.”**

Marion teaches GCSE and A level and also works with trainee teachers at Level 4. She has been involved in the project from day one but says she is still learning. She finds that the pace of lessons is more varied and that learners are more willing to take part and ‘have a go’.



**Hugh Campbell,  
Derby College**

**“I come in as a referee. I prompt them to think again, rather than say ‘that’s wrong’.”**

Hugh was impressed when he first heard about the aims and the approach of the project but he reserved judgment until he had seen some of the materials. Now, based on the response of his GCSE resit learners, he is very positive. He says that learners are more engaged than “if I just stand at the front and talk at them” and that they sort out their misconceptions in their own terms.



# Acknowledgements

We wish to thank the following people and organisations.

The learners, teachers, trainers and managers from the centres who assisted in piloting these approaches:

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<b>Blackpool and The Fylde College</b>	<b>Joseph Chamberlain College</b>
<b>Bognor Regis Community College</b>	<b>Josiah Mason College</b>
<b>Bournville School and 6th Form Centre</b>	<b>Mid-Kent College</b>
<b>Bridgwater College</b>	<b>North Devon College</b>
<b>Bromley College</b>	<b>North West Kent College</b>
<b>Bury College</b>	<b>Oxford and Cherwell Valley College</b>
<b>Cadbury College</b>	<b>Park Hall School</b>
<b>Cambridge Regional College</b>	<b>Peterborough Regional College</b>
<b>Carmel College</b>	<b>Regent College</b>
<b>Chesterfield College</b>	<b>Richmond Adult and Community College</b>
<b>Chichester College</b>	<b>S and B Training Ltd</b>
<b>City of Sunderland College</b>	<b>Selby College</b>
<b>College of North East London</b>	<b>Solihull College</b>
<b>College of North West London</b>	<b>South Hunsley School</b>
<b>Derby College</b>	<b>Stockton Sixth Form College</b>
<b>Exeter College</b>	<b>Tower Hamlets College</b>
<b>Furness College</b>	<b>Wilberforce College</b>
<b>High Pavement College</b>	
<b>HMP Drake Hall</b>	
<b>HMP Hewell Grange</b>	

**Malcolm Swan, University of Nottingham**  
**Susan Wall, Head of Mathematics, Wilberforce College, Hull**

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**The MARS team at the SHELL Centre, University of Nottingham**

for their work in developing some of the approaches and materials and for allowing us to use some of their resources.

**The Learning and Skills Development Agency (LSDA)**

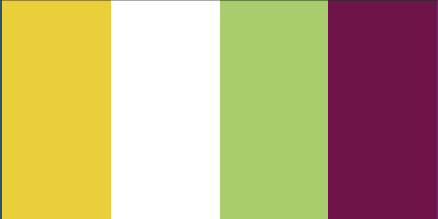
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**The Freudenthal Institute, Utrecht University**

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**Professor Celia Hoyles, OBE**  
**Professor Adrian Smith, FRS**

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