Quality Improvement Agency

Teaching and Learning Programme

Improving teaching and learning in Mathematics

Learning Mathematics in context

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Foreword

I am delighted to introduce you to these new resources developed by the Quality Improvement Agency (QIA) as part of the Teaching and Learning Programme.

The Teaching and Learning Programme aims to support providers to improve the quality of teaching and learning by linking **organisational strategies** for quality improvement, **continuing professional development** (CPD) and the **Subject Learning Coach** model.

The focus of the Teaching and Learning Programme is on supporting **whole organisational approaches** to quality improvement with an emphasis on **helping the sector help itself,** knowledge transfer and building on what is already there.

Teachers, tutors and trainers in the further education (FE) system work with a very wide range of learners – in colleges, in work-based learning organisations, in adult learning, in prisons, in voluntary and community organisations and in the workplace. These resources have been developed in consultation with them and their learners as well as other subject and national experts.

These resources are designed to be used by those wishing to:

- explore more effective or different ways of teaching or planning learning in their subjects
- tackle 'hard to teach' or 'hard to learn' topics in their curriculum in new ways
- improve or extend their own professional practice
- construct dynamic action plans to meet the regulatory requirements for 30 hours (or pro rata) CPD.

In addition, I hope these resources will be used by:

- teacher educators working with teachers to gain initial teacher training qualifications
- Subject Learning Coaches working with their peers to improve teaching and learning
- curriculum, quality and Information and Learning Technology (ILT) managers working with their teams to improve practice.

I hope you will find these resources of real benefit to you and your organisation.

Markos Tiris
Programme Director, Teaching and Learning Programme, QIA

Introduction

This booklet introduces you to new teaching and learning* resources for Learning Mathematics in context in relation to Construction and the built environment (CBE), Creative and media (CaM), Engineering, Information technology (IT) and Society, health and development (SHD). The resources have been created with teachers and their learners who have worked collaboratively with Mathematics specialists in national trials and pilots.

The resources will interest you if you are:

- a subject or vocational teacher with learners who need to develop and apply some mathematical skills as part of their learning programme; in this role you might already be teaching Mathematics as part of the course, possibly through numeracy, Key Skills application of number or functional skills in Mathematics
- a teacher of Mathematics, numeracy, Key Skills application of number, or functional skills in Mathematics working with learners and colleagues in the vocational areas above to develop an understanding of mathematical concepts.

* We use 'teaching and learning' and 'teacher' as generic terms to include:

- teaching, training and learning
- teachers, tutors, trainers, lecturers and instructors in the further education (FE) system.

Our challenges

Teachers working with us considered these challenges:

- How do you identify and plan to teach the mathematical content in your subject or vocational areas?
- How do your learners perceive Mathematics?
- Are there areas of mathematical understanding that hold back your learners?
- Are there areas of Mathematics you find daunting to teach?

- Which specific mathematical skills do your learners need to acquire?
- Is there an area of Mathematics in your subject or vocational area that you would like to understand better?

If you recognise these challenges then this resource, Learning Mathematics in context, will interest you. Whatever your role, the ideas can help you to engage your learners in active approaches to teaching and learning Mathematics in your subject or vocational area. They aim to:

- help you to identify opportunities to improve the teaching of relevant mathematical concepts in subject and vocational programmes
- encourage you to explore a range of teaching and learning strategies and to adopt active learning approaches
- build your confidence in understanding and teaching Mathematics
- encourage collaborative professional development between subject and vocational area teachers and specialist Mathematics or numeracy teachers
- encourage you to become a reflective learner yourself as you develop your continuing professional development (CPD) plan
- provide you with templates and tools to help you build your CPD plan and meet the minimum 30 hours (or pro rata) CPD requirement.

Overview of components

The resources consist of:

1. Web-based resources for Learning Mathematics in context that can be found on QIA's Excellence Gateway

They include web-based activities, video sequences, images, downloadable resources and tools. As well as resources that are specifically designed for teaching and learning Mathematics in context, there are generic resources that you can use to:

- plan your CPD
- help your learners plan their own learning and develop as expert learners
- plan the curriculum with your colleagues
- plan learning and projects with your learners
- explore and extend pedagogy approaches.

Explore your resources: http://excellence.qia.org.uk

2. Resource box that contains:

- card and board activity
- booklet
- multimedia CD-ROM that emulates the web-based resources
- Planning for success: card activity and concertina leaflet.

Why is Mathematics important?

> "Advanced economies need an increasing number of people with more than minimum qualifications in Mathematics to stay ahead in international competitiveness and, in particular, to effectively exploit advances in technology. An adequate supply of young people with mastery of appropriate mathematical skills at all levels is vital to the future prosperity of the UK."
> **Professor Adrian Smith, Chair of the Post-14 Mathematics Inquiry, February 2004**

On behalf of the government and in response to the Smith Inquiry, Charles Clarke, then Secretary of State for Education and Skills, made a clear statement about the importance of teaching and learning Mathematics:

> "Mathematics is vital: it underpins research and development in the sciences, technology and ICT; it is a key driver of economic and labour market growth; and it provides a set of key skills to enable individuals to reach their full potential in terms of life and work. Getting the teaching and learning of Mathematics right is therefore a major education priority."

Mathematics is a critical skill for many professions and opens up a world of opportunity at work. Many occupations require a sound understanding of Mathematics. Doctors, plumbers, lawyers, care workers and others use Mathematics daily, as do accountants, engineers and managers. Examples of everyday tasks requiring Mathematics might include:

- using and handling a Bill of Quantities in CBE
- making and using scale drawings to create sets in CaM
- understanding distance-time and velocity-time graphs in Engineering
- comparing and selecting appropriate statistical representations in IT
- calculating a body mass index in SHD.

Doing Mathematics helps people to reason and organise complicated situations or problems into clear and logical steps. Thus, as you learn more Mathematics, you are better able to develop logical reasoning and thinking skills, to resolve difficult situations and to solve problems.

You will find the following themes running through the resources.

Confidence – developing teachers' confidence in their own mathematical knowledge, understanding and skills.

Embedding – supporting teachers in using effective approaches to teaching and learning Mathematics in their own practice.

Collaboration – teachers in vocational and subject areas and in Mathematics working together to develop a more stimulating and effective learning experience for their learners.

Challenging topics – taking a fresh look at topics that are underpinned by Mathematics and which learners find particularly challenging.

Contextualisation – exploring approaches to help teachers and learners identify and articulate mathematical skills used within specific vocational contexts.

Policy background

The national skills strategy and the challenge of progression

The national plan to develop world class skills (World Class Skills: Implementing the Leitch Review of Skills in England, DIUS 2007), sets out the actions the government will take to 'raise the nation's skills base, build productivity, increase social inclusion and improve economic competitiveness'. These are seen as key to helping 'to achieve our long-term aspirations of achieving 80 per cent employment, breaking the cycle of low-skilled and temporary jobs, and eradicating child poverty'.

For many learners, poor mathematical skills and the lack of deep understanding present major barriers to progression at all levels. This is reflected in a comment from Ofsted (2006).

> "[There is] a narrow focus on meeting examination requirements by 'teaching to the test', so that although students are able to pass the examinations they are not able to apply their knowledge independently to new contexts, and they are not well prepared for further study."
> **Evaluating Mathematics provision for 14-19 year olds**

These issues in learning Mathematics underpin successful progression from Level 2 to Level 3 qualifications in all subject and vocational areas, particularly since many learners targeting such qualifications have not always developed mathematical skills at those levels.

Science, Technology, Engineering and Mathematics

The Science, Technology, Engineering and Mathematics (STEM) strategy aims to secure and sustain a supply of scientists, technologists, engineers and mathematicians to support the science base and more.

The policies supporting the STEM agenda aim to deliver a step change in the effectiveness of the UK science and innovation systems, and establish the Department for Industry, Universities and Skills (DIUS) as the lead government department responsible for supporting innovation in these subjects.

Education has an important role to play in making sure that there is an adequate supply of people with high level skills in the STEM subjects and that young people are scientifically literate citizens capable in their use of information and communication technology (ICT) and functional in Mathematics. Where possible, learners should be equipped with the skills they need to achieve skills at Level 3 and beyond.

Collaborative professional practice

You will probably recognise the very real challenges the national strategies pose for you. If you are a subject or vocational specialist you may feel that you are less confident in addressing gaps or developing new skills in Mathematics. Yet you are extremely influential in motivating your learners to tackle new skills and you understand the contexts in which mathematical skills are relevant.

For specialist Mathematics teachers, there is an equal challenge to adopt effective teaching and learning approaches and ensure relevance. A collaborative approach to planning, embedding and contextualising Mathematics is essential.

There is no easy recipe for meeting these challenges but research (Casey *et al,* 2006) has pointed to collaboration as a strategy that has been shown to be effective.

In these resources you will find teachers from different subject and vocational areas working together with Mathematics teachers to identify the mathematical skills learners require to complete a set task and, in some examples, team teaching.

Developing confidence

The key to success is in your hands when you take control of your own CPD. These resources will help you:

- reflect on your own knowledge and experience of Mathematics and Mathematics teaching
- identify areas for professional development
- explore these areas with learners and colleagues
- translate proposals into practice
- reflect further on these areas to inform future planning.

In these resources you will find:

- stimulus materials to provoke reflection and discussion
- examples of effective practice to share
- materials to help you to try out and develop strategies for teaching and learning Mathematics in subject and vocational contexts
- guidance on and access to a range of approaches to teaching and learning Mathematics.

Continuing professional development: taking action

The Learning Mathematics in context resources include ideas for you and your colleagues to collaborate in undertaking your own professional development. Additionally, there are CPD resources that can help you and your organisation to adopt practice that has real impact on professional development as well as learner outcomes. There are three components:

- **Small steps – big difference:** a CPD activity to stimulate reflective practice.
- **Putting CPD into action:** a reflective tool that provides a framework for thinking about what you need to do and how you will do it. It offers prompts, questions and signposts to the Institute for Learning's CPD process. Use this to develop and carry out your professional development plan.
- **CPD builder:** this provides templates for, and illustrations of potential CPD routes through these resources and make links to other rich and wide-ranging resources and initiatives.

You can use these features to help fulfil your 30 hour (or pro rata) CPD requirement.

You will find a rich range of supporting resources for CPD in the Teaching and Learning Programme area on QIA's Excellence Gateway.

How can these resources bring about change?

The Teaching and Learning Programme model

The effectiveness of these resources as agents for change is based on the belief that only teachers themselves can bring about changes in their practice. While coaching and peer-to-peer support is important and helpful, each individual must make this journey themselves.

Use the CPD tools to stimulate and support reflection and to prompt action.

Use the CPD tools with a colleague or SLC to reflect on your experience and to help you record the evidence in your professional development record.

"That went well because… Next I'll try…"

- Use the CPD ideas and activities on your own, with your SLC, or with a group of colleagues.
- Explore the pedagogy approaches such as Assessment for learning or Co-operative learning.
- Try out a supported experiment; engage learners in your plan and get their feedback.

"I need to understand how and why this approach works. Next I'll do that…"

- Try out the activities with your learners.
- Get feedback from learners and colleagues.
- Compare your experiences with those of teachers and learners in the resources.

"That made a real difference. Learners were motivated and engaged. I wonder why."

Teachers will be at different stages in their 'change' journey. The aim of the resources is to provide inspiration, support and ideas for you as you reflect on your current practice and plan your own professional development programme. The resources, using a peer-to-peer model, present the vision and the real possibility of what 'change' might mean for you and your learners.

"Where am I starting from? Which knowledge and skills will I need to improve my practice? What are the priorities?"

- Watch a DVD or video that showcases effective practice and demonstrates the positive impact of change.
- Read a case study showing how teachers and learners made changes – and what they learned.
- Observe a colleague using the ideas with learners.

"I want to do that…"

- Look through some learner activities.
- Read the guidance notes and supporting resources, such as toolkits to give you confidence.

"I can do that…"

- Try out the learner activities with colleagues in your team or at a subject coaching network.
- Use or adapt learner-facing resources such as cards, storyboards and interactive media.

"I can use this, too…"

Effective teaching and learning approaches in Mathematics

These resources build on the principles of 'active learning' that were introduced in the programme's earlier resources. The term 'active learning' has been refined to embrace 10 key pedagogy approaches that we know can make a positive impact on the learners' experience. The aim is to help learners move from surface learning to deep and profound understanding.

The 10 approaches are underpinned by evidence from research and from teachers' and learners' experiences. They are:

Assessment for learning	Co-operative learning
Differentiation	Embedding literacy, language and numeracy
Experiential learning	Learning conversations
Modelling	Multi-sensory learning
Relating theory and practice	Using e-learning and technology

Quick start guides provide more in-depth information about the 10 pedagogy approaches and ideas sheets offer easy to use teaching and learning methods to get you started. You can explore some of the approaches in depth in four **pedagogy toolkits**:

Co-operative learning toolkit	Effective questioning toolkit
Peer review toolkit	Using case studies toolkit

An additional resource, **Talking teaching, training and learning**, is designed to stimulate discussion about effective approaches to teaching and learning. Teachers in the pilots have really enjoyed using this activity. They recognised that they already use some of the approaches and were keen to try out different ones. They found that they extended their pedagogic vocabulary and could build CPD programmes around the ideas they shared.

You will find additional resources to help you explore these pedagogies in the Teaching and Learning Programme area on QIA's Excellence Gateway.

Many of us learned our Mathematics at school or college by traditional 'transmission' methods. This is where the teacher explains the method, shows some examples and learners then complete an exercise which often mimics what the teacher has just demonstrated. This method does not promote a deeper understanding of the underlying concepts and learners may have difficulty in transferring and applying the skills to different contexts.

After many years of research into how learners understand and make progress in Mathematics there are two major projects in the FE system that promote active approaches to teaching and learning Mathematics. These approaches were developed in the Department for Education and Skills (DfES) Standards Unit resource, Improving learning in Mathematics and in the DfES resource developed through the Maths4Life project, Thinking Through Mathematics.

The evidence indicates that these approaches are more successful as learners using these methods are better able to understand and make links across different mathematical topics. Ofsted's 2006 report comments that learners and teachers seem to enjoy the subject more, and demonstrate more effective learning and improved success rates.

Furthermore, there are some mathematical topics that teachers and learners say are hard to teach and hard to learn. These can act as a disincentive to learners and teachers but they are often key to successful achievement. Teachers in the national pilot worked with some of these challenging topics:

- working with units of measurement
- working to scale
- order of operations
- representing data using binary, hexadecimal and binary coded decimal
- using ratio.

In these resources you can see how teachers who are not Mathematics specialists have used these effective approaches with learners in CBE, CaM, Engineering, IT and SHD in particular, to cover topics that challenge learners and teachers. They have also considered their own professional development and have worked collaboratively with Mathematics specialist teachers to develop the approaches.

Case study: Colchester Institute

In Colchester Institute there is an ethos of collaboration that is actively encouraged by managers. Teachers are well supported through a Subject Learning Coach (SLC) 'forum'. The SLC for Mathematics worked with vocational teachers to adapt the approaches from the Improving Learning in Mathematics resource and to develop new activities.

One of these activities was aimed at learners making vocational choices. Images of a variety of vocational areas were presented to learners who were invited to identify the Mathematics relevant to each, stimulating group discussion. They found the activity interesting and stimulating because "…it wasn't all just pen and paper". Talking about Mathematics helped them in "knowing that I do have some of the [Mathematics] skills".

There has been a significant impact in learner success as a result of the collaborative approach and the work of the SLC forum. Julia Smith gauges the success of the teaching approach by results and reported a dramatic increase in Key Skills success over the past three years.

Learning Mathematics in context: embedding and contextualising learning

Embedding mathematical skills and knowledge development within subject or vocational areas engages and enthuses learners, and develops their confidence. There is often some uncertainty about what the term 'embedding' actually means. Research (Casey *et al*, 2006) shows that a simple definition of 'embedding' is not possible as a range of effective models were found. However, four main groups of key features emerged where Mathematics was fully embedded into courses.

- **Organisational structures:** management policies and structures were in place to support embedding in principle and in practice.

- **Team work:** there was partnership between subject and vocational area teachers and Mathematics teachers who shared formal and informal planning time, team building and often team teaching. Effective timetabling was a critical feature.

- **Attitudes and beliefs:** subject and vocational area teachers and Mathematics teachers had a shared understanding about their work. Positive attitudes can be fostered through experiential CPD which can help to challenge staff preconceptions.

- **Teaching and learning:** teachers carried out effective curriculum planning and used resources and learning activities that develop subject content and mathematical skills.

Learners were less likely to gain Mathematics qualifications when their teacher was asked to take dual responsibility for teaching vocational skills and Mathematics. Learners benefited from being taught by teams of staff, each with different areas of expertise, working closely together.

There are also occasions when it is desirable to teach some Mathematics topics in separate sessions (for example, to develop underpinning concepts or to provide additional practice) for individuals or groups. Learning in this situation will also be more effective if the Mathematics and subject or vocational teachers have jointly planned their work.

These resources explore many of these areas. In particular they encourage you to work together to build a shared understanding of the nature of learning Mathematics in a vocational context. They encourage you to build up your mathematical and pedagogic skills through working with strategies that have been successfully employed elsewhere in the Teaching and Learning Programme.

In these resources you will see:

- teachers identifying opportunities to improve the teaching of relevant mathematical concepts within subject and vocational programmes
- learners exploring, developing and using Mathematics to solve vocational problems
- Mathematics and subject and vocational teachers working together in teaching sessions, as well as planning and reviewing the mathematical learning that is taking place.

Case study: City of Wolverhampton College

"Teaching Mathematics should be effective – and fun" says Key Skills facilitator, Angela Samuels, after reflecting on her experience of teaching Mathematics to Childcare Studies learners. This is not as simple an objective as it would seem, as Angela has found that her learners did not always have Mathematics on their agenda, and sometimes had a dislike, if not a hatred of the subject.

The challenge for Angela was to make Mathematics meaningful to them, and she achieved this by helping to reveal its relevance in their vocational setting. Learners discussed the impact of numeracy in a childcare setting by, for example, managing a budget for a trip and calculating the staff needed for the number of children. This required the learners to consider Mathematics areas such as ratio, percentages and fractions. Angela found that this was a good way to introduce the concepts, providing a grounding which could be elaborated through group discussion. The learners produced posters reflecting their ideas. Angela liaised with childcare specialists to ensure that she could help them detect as much of the Mathematics in their vocational settings as possible.

Contextualising learning really helped the learners embrace the subject. Angela describes how they can have 'eureka' moments where they would declare, "I can do it! I can do it! Give me another to do!" She advises, "It's very important to encourage the learner to explain their methods and processes, it helps them to understand it better, and helps me to assess their learning… The teaching and learning resources can help to encourage discussion, and through these discussions you can help to break down barriers and misconceptions."

Case study: Tower Hamlets College

Media teacher, Nigel Davey, found his main challenge was to incorporate Mathematics into sessions in a way that would engage learners who generally thought they didn't enjoy the subject.

Nigel worked with Aminul Islam, a Mathematics teacher, to plan and team teach a session with both media and Mathematics content. One activity required learners to review a newspaper article which contained statistics, and to analyse its claim that London classroom demographics had whites in the minority was true or whether it had been misrepresented. Learners engaged enthusiastically with this activity, investigating the possibility of media manipulation by interpreting and presenting the data in a variety of charts.

Reflecting on the impact of this session from a teaching and learning perspective, Nigel commented, "Maths can be used to reinforce learning about a subject and discover new things. Such an approach can help the media student to see the relevance of maths to their course and how, rather than an enemy, it can be a friend." Because he is working collaboratively with Aminul, Nigel says, "I am not afraid to use maths in the session any more, and thus a whole new area for creative thinking about my subject has opened up."

Using active learning approaches in Mathematics

This project has two significant mathematical learning aims.

1. To help learners to adopt more active approaches towards learning.

Research shows that many learners view Mathematics as a series of disconnected procedures and techniques that must be learned by rote (Swan, 2006). Instead, we want learners to:

- engage in discussing and explaining ideas
- challenge and teach one another
- create and solve each other's questions
- work collaboratively to share methods and results.

2. To develop more 'connected' and 'challenging' teaching methods.

Traditional 'transmission' approaches involve simplifying ideas and methods by explaining them to learners one step at a time. Teachers ask questions that lead learners in a particular direction or to check that they are following a taught procedure. Learners then practise. This approach does not promote robust, transferable learning that endures over time or that can be used in non-routine situations. It de-motivates learners and undermines confidence.

Case study: Warwickshire College

After being introduced to the Learning Mathematics in context pilot resources, Engineering teacher, Rosa Wells, realised she'd done too much "talk, do a problem … talk, do a problem" in her sessions, which weren't as varied as she would have liked. Since using these resources she's seen how the activities work and now creates her own.

A popular activity was the binary and hexadecimal jigsaw puzzle, which she discovered really helped her learners to 'click' with the Mathematics, enabling them to make connections and link the whole topic together. She said, "They'd got so much more out of the session where we used this activity than they had with any of the others sessions before it." She also found the resources worked for learners of different levels of ability and with different learning preferences, "all learners can get something out of it."

Although Rosa was already very confident in her own Mathematics ability, she found working closely with colleague, John Matusz, helped to her bounce ideas around on how to teach Mathematics in Engineering, try out new active approaches and to provide for individual learning needs. "Getting involved in teaching maths in this way allows you to see things from the learners' perspective and really helps them to tackle the subject."

The model of teaching adopted in this resource emphasises the interconnected nature of Mathematics. It is 'challenging' in that it seeks to confront common conceptual difficulties head on. For example, we reverse traditional practices by allowing learners opportunities to tackle problems before offering them guidance and support. This encourages them to apply pre-existing knowledge and allows us to assess and then to help them build on that knowledge.

"Subject knowledge is about understanding the right answers. Pedagogical knowledge is about understanding the wrong answers."
Malcolm Swan, 2006

The approach is based on research in the FE system (Swan, 2005), which shows that teaching Mathematics is more effective when it has the following characteristics:

- **it builds on the knowledge learners already have:** this means developing formative assessment techniques and adapting our teaching to accommodate individual learning needs (Black and Wiliam, 1998)
- **it exposes and discusses common misconceptions:** learning activities should expose current thinking, create 'tensions' by confronting learners with inconsistencies, and allow opportunities for resolution through discussion (Askew and Wiliam, 1995)
- **it uses higher-order questions:** questioning is more effective when it promotes explanation, application and synthesis rather than mere recall (Askew and Wiliam, 1995)
- **it uses co-operative small group work:** activities are more effective when they encourage critical, constructive discussion, rather than argumentation or uncritical acceptance (Mercer, 2000); shared goals and group accountability are important (Askew and Wiliam, 2000)
- **it encourages reasoning rather than 'answer getting':** often, learners are more concerned with what they have 'done' than with what they have learned; it is better to aim for depth than for superficial 'coverage'
- **it uses rich, collaborative tasks:** the tasks we use should be accessible and extendable, encourage decision-making, promote discussion, encourage creativity, and encourage 'what if?' and 'what if not?' questions (Ahmed, 1987)
- **it creates connections between topics:** learners often find it difficult to generalise and transfer their learning to other topics and contexts; related concepts (such as division, fraction and ratio) remain unconnected; effective teachers build bridges between ideas (Askew and others, 1997)
- **it uses technology:** computers and interactive whiteboards allow us to present concepts in visual, dynamic and exciting ways that motivate learners.

So what does this mean in practice?

The principles above are easy to state, but putting them into practice can be difficult. The resources include examples of activities for learners and guidance notes with suggested approaches for teachers.

The activities can be categorised into five 'types'.

1. Classifying mathematical objects

Learners devise their own classifications for mathematical objects, and/or apply classifications devised by others.

In doing this, they learn to discriminate carefully and to recognise the properties of objects. They also develop mathematical language and definitions. For example, learners might be asked to place cards showing geometric shapes into two-way attribute grids.

2. Interpreting multiple representations

Learners work together to match cards that show different representations of the same mathematical idea.

They draw links between representations and develop new mental images for concepts.

3. Evaluating mathematical statements

Learners evaluate given statements. For example, they might be asked to decide whether a particular statement is 'always', 'sometimes' or 'never' true.

They are encouraged to develop rigorous mathematical arguments and justifications and to devise examples and counter-examples to defend their reasoning.

4. Creating problems

Learners have the opportunity to devise their own problems for other learners to solve. When the 'solver' becomes stuck, the problem 'creator' takes on the role of teacher and explainer.

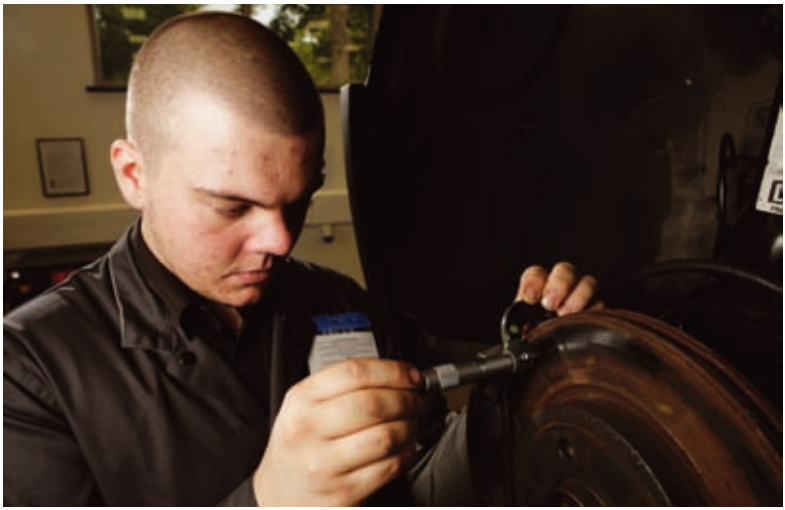
We often find that, in the process of explaining, learners come to understand the ideas more deeply. In these activities, the 'doing' and 'undoing' processes of Mathematics are vividly exemplified.

5. Analysing reasoning and solutions

Learners can compare different methods for doing a problem, organise solutions and/or diagnose the causes of errors in solutions.

They begin to recognise that there are alternative pathways through a problem, and develop their own chains of reasoning.

An activity of this type, for example, may involve giving learners a full explanation that has been cut up into parts. Learners then have to assemble the parts into a logical order. Alternatively, learners may be given some reasoning containing errors. They then have to correct the errors and write advice to the person who made them.



Getting started

To explore these approaches in your subject or vocational area we suggest you start by visiting the website to view our short introductory video and browse through the resources.

The resources have a number of themes but we suggest two ways that you can begin to explore them.

You might like to begin by reading the case studies to get a flavour of how teachers collaborated and adapted Mathematics activities for vocational contexts. You might then explore the 'Collaboration' theme of the CD-ROM, where you will see examples of vocational teachers working with Mathematics specialists. Vocational teachers identify where Mathematics occurs in a relevant context and Mathematics' specialists bring to the partnership knowledge of an approach to teaching Mathematics that we have just outlined.

As an alternative you might like to explore the themes with colleagues, in which case you could use the CPD session with a facilitator. This session includes an activity that models the reflective and collaborative approach to professional development that is illustrated in our resource.

Supporting resources

There are other resources that support Learning Mathematics in context which we encourage you to explore on the website:

1. Planning for learning in multiple environments

Teachers and learners in the subject and vocational pilots explored this theme and recognised that:

- learning takes place in many environments as well as the classroom and workshop
- learners are comfortable with, and expect to make use of, a range of technology and virtual environments
- learners need support to design and manage extended projects

- learning programmes are frequently planned in partnership with other providers and across several locations.

These factors mean that we need to plan learning programmes that exploit a wide range of learning opportunities. We need to encourage learners to take the 'driving seat' and become partners in planning learning. They uniquely 'hold the ring' on the whole learning journey and with careful planning we can avoid fragmentation and missed opportunities. The process of planning partnership also fosters the characteristics of the 'expert' learner.

2. Developing the expert learner

The concept of the 'expert' learner lies at the heart of these resources. When learners develop the ability to learn, they also develop skills that they can use every day for the rest of their lives. They learn how to find and interrogate new information, how to solve problems, how to co-operate with others and much more besides. Learning to learn means that they can learn more quickly, so you as a teacher will benefit too.

To explore what the concept might mean for you and your learners in more depth, look at Developing the expert learner web resources. You will find:

- teaching strategies that you can use immediately to engage your learners
- inspiration in the form of real life examples of what learning providers are doing already
- CPD activities to get you and your colleagues started
- links to relevant resources to interrogate further.

"I became very much the facilitator…they (the learners) were saying 'Look at this information that we have found…and they actually educated me on a lot of different things as well… it was just totally them empowered with the learning."
Helen Owen, Newcastle College

The resources include a Planning toolkit to support you and your learners as you plan effective, personalised learning. The toolkit features the SuccessPlanner, a web-based tool that offers:

- interactive planning, reflection and review features
- adaptable templates
- examples modelling ways of using the SuccessPlanner with learners and colleagues
- links to multimedia assets demonstrating how the principles illustrated in the SuccessPlanner are put into practice.
- guidance notes and ideas for activities that support planning, reflection and skill development.

3. For in-depth information and ideas, look at these two resources:

Improving learning in Mathematics. Department for Education and Skills Standards Unit (2005). You can download this from: http://teachingandlearning.qia.org.uk/#math

Thinking Through Mathematics: Strategies for teaching and learning. National Research and Development Centre (2007). This resource is available through the National Centre for Excellence in Teaching Mathematics (see below) and you can order a copy by visiting: www.maths4life.org

The National Centre for Excellence in Teaching Mathematics (NCETM) is the main source of ideas, information and resources for all teachers of Mathematics. It includes the latest news on developments in Mathematics education, communities and blogs where you can share your ideas with other teachers, a course directory, self-evaluation tools for you to reflect on your current strengths and areas for development, and an online portfolio where you can collect evidence of your professional learning: www.ncetm.org.uk/

Resources from the teaching and learning framework for Mathematics produced by the DfES Standards Unit were being used successfully in a number of colleges. These materials encouraged teachers to be more reflective and offered strategies to encourage students to think more independently. They encouraged discussion and active learning in GCSE, AS and A level lessons.

While some colleges were just dipping into the resources, a few had used the full package to transform teaching and learning across an entire Mathematics team. The new approach had enabled one of the colleges visited to accept students on to its AS courses with GCSE grade C or grade B at the intermediate tier, with the expectation that they would be successful. Success rates at all levels were impressive in this college.

The materials helped to expose students' common misconceptions and to develop their skills and interest successfully. In addition, students' individual needs were identified and appropriate activities selected for them. These colleges gave students sufficient time to develop secure understanding of key concepts and helped to achieve good progress.

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Acknowledgements

We wish to acknowledge the learners, teachers and managers from the following centres who assisted in the development and field testing of the materials.

Achievement Training

City College Manchester

City of Wolverhampton College

Colchester Institute

College of North West London

HMP Coldingley

Huddersfield Technical College

Liverpool Community College

Newcastle-under-Lyme College

Peterborough Regional College

Tower Hamlets College

Waltham Forest College

Warwickshire College

West Suffolk College

Wilberforce Sixth Form College

We would also like to extend our thanks to the Mathematics Subject Learning Coaches for their contribution to the research, development and field testing phases of the project.

Finally we would like to thank members of the Mathematics expert group and the National Centre for Excellence in Teaching Mathematics for the advice and guidance provided throughout the project and the National Research and Development Centre.

Notes

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at http://excellence.qia.org.uk

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These resources are delivered by the BDP Learning, Illumina Digital and Software Logistics consortium as part of QIA's Teaching and Learning Programme.

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