Making maths bear fruit for learners

Teachers need more opportunities to ensure this vital subject thrives

Boosting your knowledge to teach inspiring maths
SKILLSETS P6

Helping students with the most severe needs
SEND P10

How to seize the digital opportunities
TECHNOLOGY P14
Helping students improve their maths is a challenge, and the thought-provoking articles in this supplement aim to give you extra inspiration. By David Russell

Mathematics and quantitative skills are a necessary component of many disciplines, ranging from the sciences to humanities. The availability of large data sets is changing the way many disciplines approach questions and solve problems, all requiring greater levels of mathematical skill and confidence. Mathematics is also a rich discipline in its own right – with individuals working on both pure and applied mathematics.

The Royal Society has long appreciated the role of mathematics in education, instilling financial capability, problem-solving and tools for addressing real, practical issues. That’s why in 2014 the Society published its Vision for science and mathematics education, with the ambitious aim that all young people study mathematics up to the age of 18.

A levels will not suit all learners and the Society is pleased to be involved in developing the mathematical framework for the new T levels. We have heard industry call for greater mathematics and quantitative skills among its current and future employees. It is essential that the right messages are sent about the importance of mathematics during, and out of, school as well as the wide range of opportunities available to young people who are confident in maths.

As chair of The Royal Society’s Advisory Committee on Mathematics Education (ACME), I am privy to both industry and tertiary education concerns about mathematics and quantitative skills. However as more and more encouraging people to study maths must not be done in a silo. It will require a greater number of well-qualified and supported teachers.

In 2015 we published improving Teaching: best in class? It recognised that initial teacher education programmes varied greatly, so it detailed initial first steps towards a strategic plan for the ITE of teachers of mathematics:

* Investment in data collection, analysis and monitoring
* Development of clear lines of accountability
* Mapping initiatives and identifying gaps to develop an action plan

In 2016 the Society convened an expert panel to develop the report, Professional learning for all teachers of mathematics. The continued professional development and training of teachers is integral to the success of their pupils.

We divide the knowledge needs of teachers of mathematics into two categories: knowledge about the subject and knowledge about teaching it. Teachers need opportunities to continue to develop in each area to ensure they have the knowledge, skills and confidence needed to excel. Everyone involved in mathematics education has a role to play in ensuring they support the development of teachers.

FURTHER READING

The Royal Society’s remit covers all aspects of mathematics education policy, including supporting inspirational maths teaching, and professional development for maths teachers. The Society’s Advisory Committee on Mathematics Education (ACME), chaired by Professor Kelly, advises the Society on mathematics education policy.

ACME’s current priority areas include technical education and providing advice on the mathematical and computational skills components of new technical education pathways in England. A Maths Snapshot paper, Teachers of maths: supply, training and development, produced by ACME in 2014, noted several points about the training and development available to maths teachers, including:

* There are no guidelines about progression from novice to expert teacher of maths.
* Teachers’ access to multi-specific professional development is variable and geographically inequitable.
* There is no system-wide quality assurance of professional development.
* There is an urgent need to recruit and retain more maths teachers in secondary and further education.
* A strategy for recruiting teachers of maths to further education is needed.
* Salaries and other incentives, like job satisfaction, should reflect the growing market for mathematical skills.

Professor Frank Kelly is professor of the mathematics of systems at the University of Cambridge. He is a Fellow of The Royal Society and chair of the Society’s Advisory Committee on Mathematics Education (ACME). He was awarded a CBE for services to mathematical science in 2013.
Calculating the Benefits of ‘Teaching for Mastery’ in Further Education and Training

Teaching for Mastery (TfM) is making an impact in primary and secondary schools. Built on the premise that all students can achieve, could it work for under-achieving post-16 learners, asks Norma Honey.

If taught ideas are to be understood deeply, they must be thought about, reasoned with and discussed.

There is much interest in the Teaching for Mastery (TfM) approaches in mathematics, and in primary and secondary schools that use a mastery approach, significant progress is being observed.

The question for us is whether there is merit in TfM approaches in GCSE resit and other programmes post-16. It is well known that many students resitting their maths GCSE have a negative attitude towards the subject. Many feel like failures, and have poor attendance records and little commitment to ongoing study.

How might TfM support both teachers and students to effect some change in this situation?

At the heart of TfM is the belief that there is no such thing as a ‘maths gene’. The premise is that all students can achieve and that teachers, through careful planning of lessons and selection of resources, can support students in their learning.

Carefully drafting and planning lessons are key. Effective use of resources and questioning which support deeper understanding of topics, combined with using visual representations and manipulatives (physical aids to mathematical understanding), can help build confidence and understanding, as well as enrich formative assessment.

For instance, the Singapore bar model has proved to be very useful to illustrate basic maths (see diagram). The bar model helps build confidence in learners – doing things differently.

...and showing success, is important for students who feel like failures.

A small project for the Education and Training Foundation (ETF) is supporting a trial of mastery approaches, such as the bar model, in an FE college. While it is a small trial, early findings are promising. Feedback from students trialling an algebra resource appears positive in both sense of achievement and attitude. Students became more resilient when attempting different questions, where previously they would not have attempted them.

TfM, as implemented in schools supported by the National Centre for Excellence in the Teaching of Mathematics (NCETM), may not be perfectly adapted for existing students in further education and training. FE and training staff have just eight months to turn students around and make progress. However, there are certainly aspects of the TfM approaches which can help teachers to engage students with mathematical concepts they have been over many times. It does require a change in the way the resist is taught, and probably an end to schemes of work which attempt to retrace the whole specification.

The following five big ideas are the basis of the NCETM approach. They are developed over time in a school setting. While time is limited in post-16, an understanding of how these can be accommodated into the resist curriculum is helpful when considering how to structure the teaching and learning.

**Variation**
Varying the way a concept is initially presented to students, by giving examples that display a concept as well as those that don’t. Also, carefully varying practice questions so that mechanical repetition is avoided, and thinking is encouraged.

Some of these stand out as being relatively easy to incorporate into FE and training settings, and would provide a different ‘look’ at well-known topics which have given difficulties for students.

Representation and structure, for example, is an area which can be applied to most areas of mathematics, and students should be encouraged to draw pictures and diagrams when looking at problems. And careful selection of examples can determine the learning required and reduces the need for ploughing through worksheets.

In conclusion, I believe that there is a place for TfM approaches to be incorporated in GCSE resits. More investigation is needed and further trialling to develop an appropriate model for further education and training. There is, of course, a need for CPD for teachers to gain the most benefit for their students.

Norma Honey is an educational consultant and an ETF regional specialist lead for Mathematics (maths) for the East Midlands. She is a Member of SET.

MATHS JARGON-BUSTER

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Thanks to Norma Honey, Cathy Smith, Steve Pardoe and Sue Southwood for their contributions.
HOW TEACHERS CAN EXPAND THEIR KNOW-HOW TO TEACH POST-16 MATHS INSPIRINGLY

Experienced teachers can benefit just as much as beginners from mathematical knowledge for teaching (MKT), with big plusses for their expertise and professional development, says Dr Cathy Smith

When you have been teaching for a number of years, you will have got to grips with the initial knowledge you need as a teacher. This is when you might turn your attention to developing your mathematical knowledge for teaching (MKT).

In the research literature, MKT has mainly been studied to educate beginner teachers. But a more interesting question is how teachers can use this research to think about their own expertise and professional development.

One framework I have found useful is Deborah Ball’s ‘knowledge egg’ (named after an egg-shaped diagram, right, showing six categories of teacher knowledge (Ball, Thames, & Phelps, 2008)).

The framework was derived from studying hours of video of classroom teaching in the US. It starts from the initial knowledge you might turn your attention to developing your mathematical knowledge for teaching (MKT). These are all forms of specialist content knowledge (SCK), proposed three sub-categories: knowledge of content and students (KCS); knowledge of content and teaching (KCT), and knowledge of content and curriculum (KCC). Experienced teachers rapidly build MKT, but this can also come from wider reading. KCT comes from knowing the words and representations that are effective in the classroom, and how to sequence and organise them.

In the percentages example above, a coat costs £80. The shop then offers 30 per cent off. Work out the new cost. Knowing that most students prefer to calculate 30 per cent first, then subtract it, would be KCS (knowledge of content and students). However, knowledge of content and teaching (KCT) is knowing that one way to encourage students towards the one-step method is to set ‘undoing’ problems – 70 per cent of a number is 56, what is the number?

Finally, knowledge of content and curriculum (KCC) helps us focus our teaching on what is really needed. For example, students in (AQA) Core Maths and A level, both need to know about exponential functions. But Core Maths students will only meet e^x or e^x while A-level students could meet e^x.

Starting with mathematical content knowledge, the framework proposes three sub-categories: common content knowledge (CCK), specialist content knowledge (SKK) and horizon content knowledge (HOK). These are all forms of mathematical knowledge, but they are distinguished by their purpose.

CCK is what you learn by taking mathematics A level or an Open University mathematics module. It is mathematics for its own sake, to help you understand your subject.

SKK is the kind of mathematics that you need precisely because you are a teacher. For instance, being able to put mathematical expressions into words.

HOK is the mathematical knowledge that lies outside the curriculum, but which helps make sense of it by showing its developments or its applications. These kinds of teacher knowledge are closely interlinked but they are all mathematical. One way of enriching professional learning is to use these categories to audit the outcomes, making sure you have covered something in each of these areas.
HELP LEARNERS TO DEVELOP THEIR MATHS THROUGH EFFECTIVE EMBEDDING

Vocational tutors can really make a difference to learners’ maths skills and their overall success on courses. Gail Lydon discusses some practical steps and how teacher teamwork is so important.

We continue to debate the embedding of maths into programmes because it is a complex issue. Have vocational and other non-maths tutors the skills they need to support learners’ maths skills? Are they already busy enough getting through their own course objectives? Isn’t it the job of the maths specialist staff to do this? There are even discussions about the word ‘embedding’ itself because people prefer supporting and developing.

What we do know from research is that vocational tutors (often a shorthand for all those who are not maths specialists) can have a significant impact on learners’ maths skills. We also know that when vocational tutors support maths skills development their learners do better in their vocational context.

So what to do? Remember, said Dylan Wiliam, that “small changes are better than big changes because when you make big changes things go wrong, classroom discipline falls apart and you go back to doing what you know how to do, so you have to make very small incremental changes and not change more than one or two things”. Embedding may mean some of the following.

- Presenting positive messages to learners about maths within their courses and in their future careers.
- When maths is seen as an important element of a learner’s programme, then learners perform better. To give positive messages a tutor must be positive themselves and many non-maths specialists are nervous about being explicit.
- Math and vocational tutors sharing their schemes of work – a collaborative approach.
- Vocational tutors being clear about the maths skills their learners need to be successful as they move forward together Collaboratively. It can transform the learning environment.

InTUITIONMATHS

By Nicola Tomlinson

Adult Education Wolverhampton has a strong culture of staff development and quality improvement. Many opportunities to develop English skills in a natural way are already available to staff and students. Staff can clearly see where English is present in everyday life. However, this is not the case with maths.

We decided to work on making maths relevant with our CPD module, ‘Maths and Where to Find It’. We had to reflect on the critical practice guidelines used to support these key messages.

But once I started to speak with people who understand how people learn and read a little about the theories behind those perceptions of maths, I was able to implement simple changes in the classroom. As a result, we’ve improved outcomes for some of our learners and it’s enabled us to understand why our working harder in the classroom might not always equate to a better lesson.

Discovering the mastery concept of teaching maths and developing our ‘Essential 8’ programme has enabled me to connect with colleagues using the resources and to present our research in the UK and Finland. Differentiating by depth, rather than difficulty, means learners can move forward together collaboratively. It can transform the learning environment.

However, to understand more about my learners and appraise teaching approaches in an informed way, take a look at Dr Helen Druy’s work on mastery learning. The more we know, the more effective we can be. And that has to be a good thing for our learners.

CASE STUDY

THE MORE WE KNOW, THE MORE EFFECTIVE WE CAN BE AS TEACHERS

By John Cooper

Being a maths teacher, I was rather trepidatious when the opportunity arose to engage with research through the Education and Training Foundation (ETF) and SUNCET. But once I started to speak with people who understand how people learn and read a little about the theories behind those perceptions of maths, I was able to implement simple changes in the classroom. As a result, we’ve improved outcomes for some of our learners and it’s enabled us to understand why our working harder in the classroom might not always equate to a better lesson.

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CASE STUDY

MAKING MATHS ACCESSIBLE FOR BLIND SCHOOL LEARNERS

By Albert Pitcher

When I first went to the Royal National College for the Blind (RNC) hereford in 2016 to find out more about being a mathematics teacher for the visually impaired, I asked how you teach a blind student about quadratic waveforms.

Kate Stevenson (my future mentor) smiled and, without fuss, demonstrated how it was done with the tactile method, using a raised centimetre grid, pins, cardboard, elastic bands and wikki-sticks.

Simple but effective, and it appealed to my technical background. I duly applied for the maths teacher job and got the role and the team then set up a very deep learning curve for me to be able to enhance my teaching and technical skills to the level needed to assist students access and succeed in mathematics at RNC.

Mathematics is taught from entry level to A level at RNC and it is fair to say that each student has their own unique challenges to access, understand and successfully use the maths they are learning. Yet (visual impairment) ranges from students who have some useful sight to those who have no sight. Some students also have other challenges in the form of being on the autistic spectrum, hearing impairment and physical impairment.

So the challenge is RNC is not just helping students learn and use the mathematics but also adapting standard texts and resources into a medium they can use to learn from.

Here are a few approaches.

- Producing practical resources in large print up to font size 36 (Arial is the normal font used).
- Using adaptive software like JAWS, Supernova, assistive technology.
- Producing tactile diagrams that interpret mathematics diagrams.
- Producing models of 2D shapes.
- Producing text resources in Braille.

It is common practice to have a class of five students who use a range of adapted resources as the lesson progresses.

The same approach applies when examinations come around and it is a major logistical exercise to ensure the students have all they need (including readers and scribes) so they can have the best chance of success.

Yes, it is very busy, but totally worth it as the students want to succeed and very often do. I have one student (having gained A* in maths last year) potentially going to Oxford University after this year.

CASE STUDY

FIGURING IT OUT IN A FUN AND INFORMATIVE WAY

By Gail Lydon

The Yorkshire and Humber regional Specialist Lead (RSL) for maths and English, and she has supported teachers in the development of maths and English since 2000.

The case study explores a few approaches.

- Presenting positive messages about embedding, taken from a 2013 research report from the former Institute for Learning (IIL) that fed into the Commission on Adult Vocational Teaching and Learning (CAVTL). “Embedding, for many vocational tutors, means teaching by stealth, disguising the functional skills – this carries a strong possibility that the skills disappear altogether.”

- Maths skills need to be made explicit if learners are to be able to apply them in a range of contexts. This is where the teamwork of vocational and maths specialists is key.

- If you are concerned about your maths knowledge and skills and feel you need to brush up, then visit Foundation Online for some practical steps and how teacher teamwork is so important.

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A PARTNERSHIP TO HELP STUDENTS WITH THE MOST SEVERE NEEDS

The Achievement for All charity is working to develop teaching practices that benefit young people whose life chances may otherwise be limited.

By Professor Sonia Blandford and Lainy Russell

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ince January 2015 Achievement for All has been working with 22 further education colleges, including specialist provision, such as some general FE colleges. Our Achieving Further Programme is specifically designed for the post-16 sector and focuses on students with the most severe and complex needs, students whose life chances may otherwise be limited and those who are disengaged with education in some way.

Delivery is through a strong partnership between an achievement coach and a nominated college leader, working closely with the staff teams and developing teaching and support practices.

Key findings in maths teaching and learning:

• Maths can be affected greatly by language and comprehension difficulties. Effective communication between deliverers of both maths and English is essential to learners’ success.
• Teachers must learn about their learners’ needs and deficits early on to plan delivery and support. If learners have a disability or learning need hindering sequencing, logical reasoning and spatial awareness, these can impact on maths ability and learning strategies.
• Your speed of delivering is crucial to understanding. But if learners have comprehension challenges and/or delayed language, then this really is a basic need for learning.
• Learning support should be supportive but also encourage as much independence as possible. Often if learners look as though they are struggling to solve a problem, a learning support assistant (LSA) can step in too quickly or give too much help, which can hinder learning/progress and give a ‘false reading’ of capability (in both directions).
• Absence and missing vital building blocks in maths can render other lessons useless. The gaps need to be closed, and you must not assume learners will be able to pick it up.

Generic findings:

• LSAs vary greatly in ability and we need to focus on this area. Support goes from too hands-off to too hands-on. Learners, particularly in post-16, need to gain as much independence in all areas of their education and life as possible, especially as we want them to progress further in education and training. Many senior leaders feel this is an area of concern.
• Written work needs to be adapted appropriately for learners with poor hand function both in handwriting and use of a keyboard. This can slow learners down, and often the correct equipment may not be accessed. Negotiating education, health and care plans (EHCPs) at the outset is essential. The set-up for a learner with SEND must start from pre-enrolment. But too often mainstream or vocational teachers are nervous of adaptations and their uses as they are not trained or fully supported.
• Verbal communication for some learners may be challenging and teachers tend to learn as they go, with little training in speech and language therapy (SLT) or communication techniques. This can leave learners and teachers frustrated.

Evaluative feedback

Here are a couple of comments from nominated college leaders involved in the Achieving Further Programme.

“According to the Adult Numeracy and Literacy Audit 2014, one in five adults in England struggle with basic maths skills. This impacts significantly upon their confidence and resilience when working with numbers. These learners struggle to work with number skills beyond counting using fingers or objects and rely heavily on these strategies to accomplish any given calculation. This limits development of higher-level number skills such as grouping, comparing, doubling and multiplication – limiting learners’ ability to develop many transferable skills required in independent life. For the past two years, we have been involved in Education and Training Foundation (ETF) research projects with Sunderland University, tailoring the Numicon system as an approach to boost basic maths skills for learners with SEND. Commonly used within the primary curriculum, Numicon is designed to strengthen learners’ understanding of basic mathematical concepts through the use of different coloured shapes used to represent numbers. Each number from 1 to 10 has an individual shape, colour, size and weight, which the learner can internalise more readily than the abstracts of digits and the linked words we use to name them. There are only 10 Numicon pieces, which makes internalisation of the system simpler. Any number higher than 10 is a combination of the pieces, which helps to reinforce how larger numbers are made up (adding, doubling, multiplying).

We use scales to reinforce value, as learners can place pieces in each side and see which one is worth more or less. Learners can also progress on to adding and checking their answers, using the scales.

For example, Jimmy thinks 5 and 4 make 10, so we put a 1 piece in one side and try to balance it with a 5 and 4. This way he can see that he has come up short and needs to try again, or experiment. This exploratory approach is much better than the failure of incorrect counting or the answer ‘no’.”

Iain Evans is a Functional Skills maths lead. Both work at Derwen College, which is a specialist independent college for learners with learning difficulties and disabilities. In 2016, Derwen became the first specialist college to receive an Ofsted Outstanding Grade 1.

Professor Sonia Blandford is chief executive of Achievement for All. Lainy Russell is their post-16 programme manager.

REFERENCES

• Sir Peter Williams (2008). The Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools is available at goo.gl/SXmzA4
• Some free resources on Numicon from the Oxford University Press are available at goo.gl/uhhB4Y

Case study:

Boosting ‘send’ learners’ skills

By Iain Evans and Tim Galashan

The mainstream maths curriculum assumes that all children entering the education system already have an innate sense of number value which is used to underpin further acquisition of numeracy skills. Within our Functional Skills sessions at Derwen College we have recognised that many adult learners with SEND do not possess this innate sense of ‘numerosity’, and have significant gaps in their basic maths skills. This impacts significantly upon their confidence and resilience when working with numbers.

These learners struggle to work with number skills beyond counting using fingers or objects and rely heavily on these strategies to accomplish any given calculation. This limits development of higher-level number skills such as grouping, comparing, doubling and multiplication – limiting learners’ ability to develop many transferable skills required in independent life.

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Case study:

A themed maths week

By Ruth Perry

Each year, during the spring term, Natspec (the national membership organisation for organisations offering specialist further education and training for students with learning difficulties and/or disabilities) runs a themed Maths Week.

The event offers post-16 specialist providers the chance to share ideas and effective practice. Learners from across the sector are also invited to enter a competition, as individuals or groups, which allows them to showcase their maths skills.

Now in its fourth year, our Maths Week was originally introduced in response to providers’ concerns that, at times, they were struggling to make maths meaningful and accessible to learners with SEND, and to find creative ways to embed maths into the curriculum.

A themed week, where the spotlight is turned on maths, allows practitioners to promote maths across their organisation and the curriculum, making colleagues more aware of the rich opportunities for maths learning. It also helps learners understand the relevance of maths to their learning and their lives.

The focus this year is on developing maths skills in and for the workplace.

We wanted to use the week to get three broad messages across:

• Maths skills are invaluable in the workplace.
• Being effective in a work-related context can help learners realise their potential in maths.
• If more young people with disabilities are going to gain employment, providers need to equip them with a wide range of maths skills.

The week, called ‘Work it Out’, ran from 5 to 9 March and practitioners used social media to share what they and their learners were up to. The range of maths skills and work-related contexts shared was truly varied. They included interpreting timetables, handling money at the till, and counting and sorting eggs from a chicken coop.

Over the four years Maths Week has been running, practitioner confidence in developing learners’ maths skills has grown, and the event is now as much about celebrating the diverse range of good practice in the sector as it is a chance to tackle challenges together.

Congratulations to this year’s winner of the Maths Week competition, who were students from Royal College Manchester, part of The Seashell Trust.

Providers interested in taking part in next year’s Maths Week should send their contact details to info@natspec.org.uk.

Ruth Perry is policy officer for Natspec.

InTUITIONMATHS

Notes

Achievement for All is a not-for-profit charity that aims to improve outcomes for carers and others.

The Achieving Further Programme framework is structured around four independent and interrelated elements: Leadership and Management Teaching and Learning Engaging with learners, their parents or carers and others Widder outcomes and opportunities including employability skills.
**Turning Results Into A Rewarding Experience**

Students facing having to retake GCSE maths need a big boost to their confidence, so teachers must make lessons enjoyable and inspiring, says Fiona Allan

**Motivation**

Students who are resitting GCSE maths often arrive at their new further education and training providers feeling pretty demoralised about the subject. They probably spent the last year being told that they must pass this GCSE. They may have spent some of the Easter holiday in school having extra lessons. Their parents may have paid for coaching. Then they receive disappointment when the GCSE results arrive in August. Added to this, when they had their interview to decide on their post-16 course they were told that they would need a pass at GCSE for their hoped-for career. So what do we do to them? We test them. The test often tells us that they aren’t even a 3 or a D, and it tells the student that they are even more inadequate than they thought.

So, why give them a test during the first few days? Instead, why not assess them in the term – give them a fairly easy test in the class everything from first principles. You won’t have time – assess them at the start of each topic and then teach them the parts they all need. You can then concentrate on teaching small groups while the others do routine questions or tackle exam questions.

And some do!

Let them enjoy success early on in the term – give them a fairly easy test in which they will score high marks. Praise them! Tell them that research shows that everyone can improve in maths when they work at it. Show them that maths is useful by looking at pictures or videos and finding the maths that’s being used. Make maths lessons interesting fun by including maths jokes, fun videos etc.

Remember to find out what they know before starting each topic, and confront their misconceptions.

Finally, make them work hard by giving the class activities in which everyone has to take part.

**Case Study**

**Puzzles Could Be the Answer**

By Emma Bell

Engagement in maths in further education is a problem. The students who are working towards a GCSE maths resit or Functional Skills are not, on the whole, there by choice. They would rather be anywhere else but a maths classroom, especially when they see their peers working solely on their main vocational subject.

Our aim at Grimsby Institute of Further and Higher Education is to change perceptions about maths, for students, for staff, and for the public as a whole.

Using the hashtag #MathsMatters, I have begun a social media and marketing campaign. I post puzzles on our internal social platform, Yammer, for staff to enjoy. These puzzles have proved popular, and staff have been overheard talking about them in the cafeteria queue.

The puzzles aim to show that we can have some fun in maths. I’ve been sharing the puzzles on Twitter, Facebook and Instagram too, and now they are being used in schools and colleges around the country.

Our Friday puzzles are just the start. The Chartered College of Teaching is supporting us to start a #MathsMatters network where I hope to share research and good practice on a national scale. I’m visiting college departments to investigate how they use maths in their courses.

On Friday 18th May we had our first National Maths Week. Our Friday puzzles are just the start.

The proof of the pudding will be in the GCSE results. If we had planned five or six weeks’ work based on learners’ gaps and misconceptions, then teaching only the skills that most of the group needed. The learners set themselves individual targets specific to their needs. The learners, teachers, senior leadership team and Ofsted like the process. DQ concentrates on misconception, e.g. marking and giving teachers flexibility, moving away from a linear scheme of work. A typical question might be:

Questions are designed to identify common misconceptions that learners hold. This enables us to know learners’ thinking behind their incorrect answer; they also write an insight into their reasoning.

Learners have made an average improvement of a grade from pre to post-test over all five units. The proof of the pudding will be in the GCSE results. If our predictions are correct most learners will be making progress through the grades and there should be an improvement in high grades for grade 3 learners.

**Further Reading**

- The ENGMA project at Manchester College is a practitioner-led initiative that includes collaborative thinking to approach English and maths across the curriculum goo.gl/188QfB
- Ideas for teaching communication skills in other subjects goo.gl/3pZPrB
- There are a number of case studies here, detailing how subjects can be taught in mathematics and what exists in your course.

**By Lisa Jane Ashes**

As a vocational teacher, you know only too well the real-life industry situations that can allow your former students to finally understand the purpose and importance of mathematics.

But how do you support your students during their course when they ask the age-old question: “When am I ever going to use this?”

If mathematics is a required part of your course, stop tagging it on as an added extra and look for ways to bring it to life in the work that students are preparing to do every day.

At the very least, make a regular habit of asking the question, “Where’s the mathematics in this?”

Cross-curricular communication between mathematics tutors and tutors of vocational subjects is the ideal. Clearly, electronically accessible course plans are also helpful. Being able to see what is being taught in mathematics can help you make links between mathematics teaching and what exists in your course.

For example:

- Catering involves ratios and food portions, pricing and menu margins, event running costs and competitor comparisons.
- Plumbing involves measurements, area, volume, ratios, the radius of effect on pressure, force per metre and density fitting costs.
- Collaboration between maths and vocational departments can support confidence and understanding. And collaboration works both ways as mathematics tutors can also link back to your course for concrete examples to support their teaching.

Where the maths exists, highlight it! Make it obvious to your students when and where they are using mathematics. Look beyond the requirements of your final assessment and bring in inspiration from their potential futures.

**By Emma Bell**

I am the maths enhancement manager and a teacher educator at Grimsby Institute of Further and Higher Education. The Institute won the Association of College’s 2017 Beacon Award for Staff Development, sponsored by City & Guilds.

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@maths_matters #MathsMatters

Fiona Allan is assistant director of the National Centre for Excellence in the Teaching of Mathematics (NCETM).

Emma Bell is the maths enhancement manager and a teacher educator at Grimsby Institute of Further and Higher Education. The Institute won the Association of College’s 2017 Beacon Award for Staff Development, sponsored by City & Guilds.

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By Lisa Jane Ashes

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By Martin Newton

The GCSE results for the 16 to 18 cohort at Stoke on Trent College were below national average in the 2016/17 academic year.

This was due to a variety of external and internal factors and influences. However, it did offer us the opportunity to rip up the rule book and start again from scratch. For searches for a ‘silver bullet’ had drawn a blank.

We had been working with MEI (Mathematics, Education, Innovation) on a more individualised approach, funded by the Stoke Mathematics Excellence Partnership.

I found Mr Barton’s ‘Diagnostic Questions’ (DQ) online. A colleague, Dave Walker, and I trialled the diagnostic questions resource with great success. We split the curriculum into five areas: number, proportional reasoning, geometry, algebra, and statistics & probability.

For each area I compiled a pre-topic test and a post-topic post. When the pre-topic test was completed, the data was presented by DQ in such a way that we could use it in a meaningful way for learning (AND) approach.

We then planned five or six weeks’ work based on learners’ gaps and misconceptions, thus teaching only the skills that most of the group needed. The learners set themselves individual targets specific to their needs. The learners, teachers, senior leadership team and Ofsted like the process. DQ concentrates on misconception, e.g. marking and giving teachers flexibility, moving away from a linear scheme of work. A typical question might be:

Martin Newton is maths development lead at Stoke on Trent College.
Exploring the Opportunities of Digital Technology

A one-day ETF-funded course shows teachers how to develop digital techniques in Maths. But using technology needs to be shaped by good teaching practice, not just trying to engage ‘reluctant learners’. By Bob Read

In the past two years the Education and Training Foundation (ETF) has funded the development and delivery of a one-day course for maths teachers, Digital Technology: Developing Your Impact. This reviews the key tools and teaching approaches on the course and the impact they have had on practitioners.

Throughout the course participants are regularly prompted to consider how the use of technology needs to be shaped by good practice in maths teaching, and not just by a concern to tick a box on aOfsted checklist or by a desperate attempt to engage ‘reluctant learners’. They are encouraged to reflect critically on established research by Malcolm Swan, and more recent findings in cognitive psychology, when considering the value of digital tools and websites. For example, the importance of exploring common misconceptions in maths is highlighted when participants are introduced to the Diagnostic Questions website and its extensive bank of online resources. Participants also evaluate different ways in which collaborative problem-solving can be enhanced and captured by the use of online ‘corkboards’, such as Padlet, which enable learners to share ideas using their smart phones.

At the same time, for those topic areas where direct instruction and the modelling of calculation strategies are valuable, there is now a wealth of video material available on YouTube and websites, such as HegartyMaths and Corbettmaths, which can be used as the basis of blended learning delivery models.

The course provides participants with opportunities to evaluate such resource banks and explores ways in which teachers can give learners easy access to online material by using QR codes on worksheets and posters. It also demonstrates how teachers can convert video tutorials into interactive teaching resources using annotation tools such as Edpuzzle. But what does this all look like in practice?

A recent ETF video case study (see References, left) features Liam Alderton, a Functional Maths teacher at East Coast College, who explains how his use of digital technology has greatly enhanced the collaborative atmosphere of his classroom and provided new forms of revision opportunities for his learners. The video shows how Liam uses Padlet to organise his course materials in an online format that learners can easily access with a single click on a mobile device and without time-consuming log ins and passwords. It features some of the whiteboard resources Liam creates using tools on the Triptico and GoConqr websites to promote classroom interaction. But he also explains how he uses Google forms to develop quizzes for learners to complete between sessions as they provide valuable data on learner performance that he can use to plan follow-up lessons.

If you would like to find out more about using digital technology in maths teaching, contact your ETF regional specialist lead for Maths, who can provide resources Liam creates using tools on the Triptico and GoConqr websites to promote classroom interaction. But he also explains how he uses Google forms to develop quizzes for learners to complete between sessions as they provide valuable data on learner performance that he can use to plan follow-up lessons.

Bob Read is the ETF regional specialist lead for Maths and English in the East of England. Bob is a training and development adviser for ACER, the Association of Colleges’ Eastern Region organisation.

Resources

If you have questions about the type of support and professional development you feel you may need in maths, then the Education and Training Foundation’s (ETF) regional specialist leads are here to help. They are all experienced practitioners and can advise you on, and signpost you to, courses and activities that will best suit your needs.

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One of the many benefits of SET membership

As the only membership body for professionals working across further education, teaching and training, we are here to support you in your career. Membership grants you access to the latest research in maths and English in addition to opportunities to achieve excellence and to gain recognition in your profession and community.

Not yet a member? Join now at set.etfoundation.co.uk or call 0800 093 9111