Secondary Magazine 111

National Centre for Excellence in the Teaching of Mathematics

Welcome to Issue 111 of the Secondary Magazine

The sun is out! During the warmest half term of the year, do take time to sit in the shade with a long cold drink and sip the delights of our latest issue of the Secondary Magazine. And by the way 111 x 111 = 12321 – which seems pleasing!

Contents

From the editor: Being an educator of mathematics teachers

How do you develop your professional expertise? And how do you plan to develop the expertise of other teachers in your department? Recently schools have played an increasingly prominent role in supporting the professional development of teachers in other schools. The NCETM has a wealth of resources to support school-to-school support, which includes the Mathematics SLE Toolkit and the microsite, Schools Working Together.

The following article has been written by Anne Watson, Emeritus Professor of Mathematics Education, University of Oxford. In it, she considers the developing role of what she terms the mathematics teacher-educator and also draws attention to a new Masters course at the University of Oxford aimed at people in this role.

What is a mathematics teacher-educator? This description could apply to a mentor in school, a tutor in a university, an advisory teacher, a lead teacher in a group of schools, or someone providing continuing professional development. These roles are crucial to the quality of future teaching.

In most countries, people coming from school or from research into positions which involve educating mathematics teachers do not have courses to help them do this. Most of us learn 'on the job', possibly starting by thinking about what we might do ourselves in certain situations, or what research tells us is 'best'. Then gradually we learn that this is not a good way to support other people in their efforts to become good teachers, nor to enable them to adopt new practices, or new curriculum ideas. In this country, the Association of Mathematics Education teachers (AMET) was funded to produce web-based materials to help new teacher educators, but at the same time the National Strategy, with its inferred assumptions about how to teach mathematics, was taking a hold in schools and 'becoming a teacher' or 'doing professional development' became – for a while – a process of fitting in with what schools were doing rather than learning to make professional, subject-based, decisions.

Meanwhile, internationally, mathematics teacher education has grown as a research field, with two international journals devoted just to that, and many conferences to share ideas and research. At the same time, concerns have increased everywhere in the world about mathematics teachers' own mathematical knowledge, and in the UK about how school-based routes can undertake the work that needs to be done to prepare teachers fully for flexible decision-making about mathematics teaching as well as focusing on mathematical knowledge.

Mathematics teacher education is now a practice about which there is substantial research knowledge. This knowledge includes deeper understanding of professional learning, knowledge about the complex nature of the mathematics we use when we are teaching, myriad examples of tasks that are most effective in teacher education, and knowledge of how and why teachers do or don't act in certain ways in the classroom. In addition, there are some major theories about classroom practice that enable teacher-educators to identify critical foci for the improvement of teaching and learning. All this is specific to the teaching and learning of mathematics.

Why is this knowledge important? Because a one-size-fits-all approach does not work equally well in all subjects. For example: many teachers who teach mathematics are insecure about areas of their own knowledge. This has to be a factor in all approaches to teacher education. Another example: a school may use a particular structure for formative assessment, but in mathematics it may matter more what you assess than how you assess. This kind of thinking has to be a factor in mathematics teacher education and development.

The University of Oxford has created a new Masters course especially for people who are educating mathematics and science teachers. The course is designed for those working in school or university contexts, and introduces them to the vast body of research and research methods relevant for mathematics teacher education. New teacher-educators will find much to stimulate their practice and also to embed their planning in well-researched knowledge. Experienced teacher-educators can use the course to reflect on their practice, and consolidate and adapt it in the light of recent research. The course is part-time and mainly online within a learning community, and with the guidance of experienced tutors who are also active researchers and subject specialists. The focus throughout will be on improving student learning of mathematics through supporting teachers to make professional decisions based on robust and profound subject knowledge. For example: the process of lesson study is understood to promote the sharing of practice, but how does a teacher-educator know what aspects of a lesson are the most crucial in students' learning, and should a teacher-educator direct collaborating teachers towards these aspects?

We think this course is the first of its kind in the world and are expecting it to appeal to mathematics teacher-educators in other countries so that all of those associated with the course will benefit from multiple perspectives.

Our aim in setting up this course is to expand knowledge and capacity for mathematics teacher education, and we are expecting employers to recognise the value of this for their own organisations and institutions.

Focus on...research

The Secondary Magazine has previously included articles that mention recent research in mathematics education. In Issue 99 the latest proceedings of the British Society for Research into Learning Mathematics (BSRLM) were featured. In this issue we concentrate on the most recent day conference held at King's College, London on 1 March 2014.

The website for the British Society for Research into Learning Mathematics (BSRLM) states:

> *BSRLM is for people interested in research in mathematics education and provides a supportive environment for both new and experienced researchers to develop their ideas.*

BSRLM holds three, one-day conferences a year which give researchers an opportunity to present their current research. You can view the papers from the most recent day conference, or you may wish to read the abstracts first in order to inform your future reading.

You may like to start by looking at the paper Calculating: What can Year 8 children do? by Alison Borthwick, Micky Harcourt-Heath, and Rose Keating from Norfolk LEA.

The paper reports on the findings from a sample of 985 Year 8 pupils who were given calculation questions considered suitable for their age-group, and examines the range of strategies they used. You may be surprised to read that only 74% of the 985 pupils in the sample could complete the addition calculation (44.8 + 172.9) correctly. This number reduces dramatically to 22% completing a multiplication calculation (23.4 x 4.5) correctly and 23% completing a division calculation (91.8 ÷ 17) correctly. You can find out the strategies that pupils used in the paper.

What will you do now?

- read this paper or another from the latest proceedings of BRSLM?
- if you are interested in research into mathematics education, you could look at the NCETM Research Study Modules. Any one of these would provide a good focus for a departmental CPD session
- the NCETM website also hosts a Research Gateway which allows you to search for mathematics-related research papers.

Previous issues of the Secondary Magazine have also featured research: have a look at Issue 85, which features another article about BRSLM.

A resource for the classroom – World Cup 2014

As the 2014 Football World Cup is taking place in Brazil this summer, this issue features a resource to engage pupils mathematically in the tournament (you may have seen the publicity surrounding Professor Stephen Hawking's 'algorithm for winning'). The resource is a simulation that allows pupils to 'play' and 'score' the tournament for themselves a good example of functional mathematics. Although it is a straightforward activity, you may take the opportunity subsequently to investigate specific aspects of the activity from the shared context.

When you complete this task with a group of pupils, here are some things to consider:

- how will the pupils work on the task - individually, in pairs or as part of a small group?
- how will they score the games? Will they throw a dice, or generate a random number from a spreadsheet or calculator, or simply flick a coin to determine a winner and a loser?
- what will you be doing as the pupils are working? Will you choose to work with an individual or a pair? What will you ask other adults in the room to be doing?
- what sorts of questions will you ask? You could consider:
    - have all teams got an equal chance of winning (in the simulation and in the real tournament)?
    - how many teams are competing at each round of the tournament?
    - why is the first round of the tournament played in groups rather than a straight elimination?
    - what is missing from this simulation exercise? What aspects of a real tournament does it not fully describe?
    - how many matches would be played in each group if there were three teams in the group? Five teams in the group?
- you may like to follow this activity by investigating different forms of tournaments: Tournament Scheduling (NRICH) could be useful
- your pupils could design a tournament to run in the class according to pre-agreed success criteria (eg giving everyone a theoretically equal chance of winning or keeping as many people involved as possible throughout the tournament)?
- you may like to consider an alternative (and more complex) Football World Cup Simulation (also NRICH).

5 things to do

You may have missed the Google Doodle for Friday 16 May, celebrating Maria Gaetana Agnesi's 296th birthday.

Think about applying for a Bowland small grant. The Bowland Trust is making a number of small grants, up to £500, available to schools and/or individuals with the aim of stimulating activities that extend the use and understanding of Bowland Maths and its materials. The grants will be available for project activities in the school year 2014/15. For more information and how to apply, go to the Bowland Maths website.

The Further Mathematics Support Programme (FMSP) has reviewed the A level entry requirements for over 500 STEM-related degree courses. This article in a recent issue of our FE Magazine reports on the findings.

NRICH is currently featuring a set of problems under the title Freedom and Constraints. Using problems like Combining Lengths and Walking Down the Stairs could develop skills of mathematical enquiry in your pupils.

Explore 60-Second Adventures in Thought. These animations from the Open University, voiced by David Mitchell, illustrate six questions in Physics, Maths and science.

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Tales from the classroom: why do you do it?

I'm writing this at "that time of year" - again. It is the most feared time of year for me, second only to the "September first day back" when I have the sickening rush of blood to the head that tells me "it's another 47 weeks to you'll feel like a normal human being again - why do you do it?"

It was the start of my Friday morning teaching, Year 11a, Year 11b, break, Year 10r (my tough lads about whom I've written before). This was on the back of a 5:30am train to London the previous day, followed by a two-hour delay on the return leg, due to the collapse of an elderly lady in the carriage I was travelling in. (I've felt pretty unhelpful a few times in my teaching career - classes beyond control, parents who have let control slip so far they don't feel able to get it back, and teachers who just can't go on. However, never as helpless as I felt staring at this unconscious lady. In a train of nine carriages no medically-trained train passengers "came forward" - we just had to wait and hope. It all turned out fine, but I very quickly saw why paramedics "do it"...).

My Fridays always start with Year 11 assembly. It's a chance to share common goals, and get all our students feeling they are part of a team that is capable of and secure in achieving. There has been a bit of a rash of what my key Year 11 teachers have best described as "faffing". Lots of chat and worry about exams and spurious detail, all to avoid the inevitable need to actually do some work. One of the reasons I most fear this time of year. Assembly needed to address that in a positive way. Thankfully I'd received three emails from my English teachers all gushing with praise for the commitment and dedication of their iGCSE students the previous day in both the pre-exam briefing and the exam. I had been given the seed, now all I had to do was water and feed. Praising seems so much more effective as an assembly technique than the moan and groan.

I was totally dismayed to arrive to find the hall locked and all the exam desks still out. My head of year said "I guess that's assembly cancelled". I twiddled with my cut out mask of J F Kennedy, with his quote "things do not happen - they are made to happen". It is has been one of our meta-narratives throughout the year with this cohort. JFK's eyes looked into mine - make it happen!

We moved to the canteen and within five minutes we had just enough space. I had my explanation ready for confused students... My head of year had found a PE bench that was to become our soap-box. As Year 11 entered they were welcomed to a BBC Three Swansea call centre style Friday Morning "Nev Shout". And they loved it. No more subservient regimented rows. They were about to become adults, part of the wider community, they could be trusted to behave as if they were in the world of work, and they did. Emphasising they were in control and able to take control, I could not have planned a better metaphor. There was a definite buzz in the room, and the feeling that change was happening: there was a task ahead for all too. Thinking back 12 hours to the amazing paramedics I wondered... Is that why I do it?

I'd asked my maths class to remain behind at the end of the assembly and put the canteen straight. They'd done a great job, so I was in good spirits as I walked into my classroom. For the second time in half an hour my heart sank. Just one student was working - and that was History revision! If I'm honest, at that moment I was heartbroken. I'd worked so hard with these particular students. They have individual revision packages, personalised video support, and I'd given up four days over Easter with small group revision sessions. And as a whole year group I have invested so much energy in developing a focused attitude to work -"things don't just happen, they are made to happen". Within twenty minutes all but four of the students were working productively, but I had worked very hard to get to that point. It certainly felt that

I'd hit that time of the year where I always seem to have to work so much harder than them. It is exhausting. Why do I do it?

The light at the end of my morning tunnel was the knowledge that after break my challenging Year 10 lads would almost certainly be well engaged in the "building houses" activity from the Standards Unit. I'd booked a computer suite, and asked the IT guys to check the software. They hadn't got back to me so all should be well. I checked in with them at break time. "Yep it's fine now. We had to change the version of Java running on the PC, but it's going now." I thanked them, knowing it must have been quite a lengthy task. As they looked across to each other it was clear a misunderstanding was about to be revealed. "Ah, we only did the teacher PC - it won't run for the students'". My heart sank again. It really was proving to be a testing morning. The whole point of that software was the students' own engagement, and the ability for THEM to experiment and "view" the problem from different angles.

There was little for it, but the five cubes lesson. How many different ways can five cubes be arranged, draw in isometric then the plan, front and side view? It hadn't come out for a few years, and I was worried. Most of the lads in the group can't cope with the excitement of a ruler... This would be step into the unknown...

As the TA walked in and saw 26 sticks of five cubes arranged on desks around the room, her disbelief was palpable. I'd never seen such a good metaphoric moonwalk. She was actually getting further into the room but apparently reversing out, and fast. Already noticeably irascible, I took the stance "best form of defence is attack". I threatened that any cube-throwing, cube-flicking or cube-chewing was an immediate detention. "Steady on Sir, we do like you" was their counter. And then the lesson was over. Not a cube thrown, no need to nag any single student to work. Yes, a few times I had needed to support and encourage. We had also looked at exploded diagrams of remote controlled cars and, of all things, a washing machine. They could all do the front, side and plan easily, but for most the isometric was a real challenge, but they stuck at it. My parting comment to them was "Thanks guys, that is about the best hour I've had in the last month - and you've all learned something new!" And I think that is one of the draws of being a maths teacher: the affirmation of purpose often comes from the most unexpected places. I might not have saved an unconscious lady, but, for at least a minute, I did feel really useful.

The author is a mathematics subject leader and assistant principal working in the South West