Subject specific mentoring: Making mathematics the focus of mentor-mentees conversations

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Aims of this session:

1. To justify the focus on mentoring;

2. To justify the focus on subject specific mentoring;

3. To describe effective subject specific mentoring (research-informed mentoring);

4. To present and discuss the various components of a PD course, designed to support a research-informed approach to mentoring, with mathematics at the heart of mentor-mentees conversations.
Getting to know each other

Which of the following describe your professional role:

- Mentor (secondary school mathematics)
- Mentor (primary school mathematics)
- Prospective mentor (secondary) ... thinking about taking on this role
- Prospective mentor (primary) ... thinking about taking on this role
- None of the above
Aim 1: Why a focus on mentoring?

- the shortage of mathematics teachers and the increasing non-specialist phenomenon;
- teachers coming into the profession through other current routes such as: Returners to Teaching, Early career teachers, NQTs, School Direct (unsalaried), Overseas teachers, Career Changers, etc. will also benefit from unlimited access to specialist mentors in their department;
- practicing mathematics teachers are expected to contribute to the CPD of their less-experienced colleagues;
• the shortage of mathematics teachers and the increasing non-specialist phenomenon;

• teachers coming into the profession through other current routes such as: Returners to Teaching, Early career teachers, NQTs, School Direct (unsalaried), Overseas teachers, Career Changers, etc. will also benefit from unlimited access to specialist mentors in their department;

• **practicing mathematics teachers** are expected to contribute to the CPD of non-experienced colleagues – but are they supported in this role?
Assumptions about the mentoring role

A teacher’s wisdom of practice

Mentor
Wisdom of practice …and what else?

However, even when mentor teachers are experts in mathematics teaching, they are not necessarily able to conceptualize their view of the knowledge required for mathematics teaching (Asikainen et al., 2013), and most frequently they do not articulate the principles that underlie their pedagogical reasoning to their preservice teachers (Hudson et al., 2013).

CPD opportunities?
The limited professional development afforded to experienced teachers who undertake the role of a subject-specific mentor has been recognized to be an obstacle to the quality of mentor preparation.

Poll

What PD opportunities were available to you to develop as a maths mentor?

https://www.menti.com/iftc69m8hm
Aim 2: What do we know about the subject-specific mentoring provision in England?

there is an ever increased demand of new mentors in schools, a demand for support for mentors that is subject specific;

subject-specific (CPD) that focuses on enhancing teachers’ understanding of the subjects they teach; how pupils learn in those subjects; and how to teach them, is more effective in terms of its impact on pupil outcomes, than generic pedagogic CPD;

subject-specific school-based mentoring by mentors who have a deep understanding of the specialist subject required for high quality teaching of the subject and understanding of how teachers develop this knowledge;

The gap

• the CPD opportunities for mentors are limited;

• most of the courses ‘out there’ are of generic nature, where the subject specific needs of teachers are not addressed;

• in schools that work in partnership with teacher training institutions, mentors are offered CPD support that is subject specific. However, this training is limited to one or two twilight sessions in a year;

• the ever increasing routes into teaching has also led to an increased demand of mentoring in schools;

• the commitment to introduce a strengthened QTS means that a stronger mentoring provision for all new teachers will be needed.
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- the commitment to introduce a strengthened QTS means that a stronger mentoring provision for all new teachers will be needed.

These new mentors need careful support and development opportunities to maximise their effectiveness.
A teacher’s wisdom of practice

*Tends to be context dependent*

- school context
- department ethos (including access to and accessibility to resources)
- mentor’s own experiences as a learner of maths
- mentor’s own views/believes of what maths is
- Perceptions of curricular constraints (such as NC)
- …

Informs the practice of

Mentor
Effective mentoring is research-informed

A teacher’s wisdom of practice

Research informed knowledge base for effective teaching of mathematics

Leads to the development of a maths teacher as an:

Effective mathematics mentor (Research-informed mentor)
Research-informed teaching

The key finding at teacher level was that **most teachers valued research**;

Despite seeing it as potentially important, evidence-informed teaching was underused due to lack of time and **difficulty in interpreting and translating research findings into practice**;

Mentors have an important role to play in enabling Early Career Teachers or less experienced colleagues to **access, utilise and interpret robust educational research to inform their teaching**.

About KIMMT

Key ideas in mentoring mathematics teachers

This short online course contributes to the development of experienced mathematics teachers as mentors of early career mathematics teachers or less experienced colleagues through engagement with robust and up-to-date mathematics education research.

Enhance your mentoring: towards a research-informed practice

• 5 weeks duration
• 4 hours of study time per week at your own pace
• 2 optional live taught sessions

✓ Led by experienced maths teacher educators and researchers
✓ UCL/FutureLearn certification
About KIMMT

Who is the course for?

This course is designed for:

- maths teachers with 3 or more years experience, aspiring to become mentors;
- mentors of mathematics teachers seeking research-informed professional development opportunities for their teaching and mentoring practices.

What will you achieve?

By the end of this course you will have:

- improved your subject knowledge for teaching mathematics to 11-18 year old students;
- engaged with relevant educational research and understood how it can be applied to your own teaching practice, and that of your mentees.
Course Content

The overarching aim of the course will be to promote:

a) a view of school mathematics as a network of interconnected ideas, and
b) pupils’ engagement through and in mathematical reasoning.

The participants are engaged in four carefully chosen powerful pedagogical inter-connected themes:

- *Fostering Algebraic thinking*
- *Fostering Geometric thinking*
- *Fostering Numerical Reasoning*
- *Fostering Functional Thinking*
1. A Mathematical Situation
2. What does the research say?
3. Return to the Mathematical Situation in the light of reading of research
4. Mentor-Mentee in conversation
5. Act out the role of a research-informed mentor
KIMMT – week 4
Working with negative numbers: language and notation

Dealing with negative numbers in the school curriculum is particularly difficult in terms of both teaching and learning.

Difficulties with negative numbers

Negative numbers are notorious in that mathematicians themselves have historically struggled with accepting, understanding, and using them. In his treatise, *Arithmetica*, Diophantus (200-300 BC) stated that when solving quadratic equations, if more than one solutions was yielded by whatever calculation, only the first was to be considered. Similarly he called the solution to the equation \( 4x + 20 \) 'absurd' because mathematicians had not yet developed a way to understand numbers less than zero! Although known to Indian mathematicians in the 7th century, the concept of negative numbers was only accepted by Western mathematicians in 17th century.

Many centuries later, 12-14 year-old students in Mexico also had difficulties in accepting negative solutions when solving linear equations (Gallardo, 1995). Grade 7 students in Sfard's study (2007) also had difficulties in coming to grips with operations on negative numbers.

In the Discussion area of this step we would like you to consider the implications of language and notations used for negative numbers. In particular, we would like you to think about the many different ways you could orally communicate (read aloud) the expressions below:

\[
7 - (-4) \\
7 - 4 \\
-4 - 7
\]

Your task

Make a note of the pedagogical implications of the language involved and share your thoughts in the Discussion area. What difficulties do you envisage students having in their understanding of what they need 'to do' mathematically as a result of different terminology used in reading these expressions?

When you have responded, identify the answer of another learner and offer your views or opinions on what they have said.

References


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7 - - 4
7 - -4
7 - (-4)
(+7) - (-4)
7 - 4
-4 - 7

Your task

Make a note of the pedagogical implications of the language involved and share your thoughts in the Discussion area. What difficulties do you envisage students having in their understanding of what they need ‘to do’ mathematically as a result of different terminology used in reading these expressions?
Prior to engaging with each activity, participants are encouraged to share from their own pedagogical experiences related to the specific mathematics topic under scrutiny.

Here is Mark’s posting: **Negative numbers is very confusing for students. The issue is understanding that minus, subtract and negative have the same meaning. The minus minus they find it confusing, but they get better at it at GCSE and A level.**

Samir responds to Marks’ posting, confirming that indeed, **Students struggle adding and subtracting negative numbers, especially when they see two operations next to each other (--, +-, -+). The challenge for students is figuring out what to do with the signs.**

Similarly, Amos shares from his experience: **Pupils will use a number of words and have numerous understandings of what they mean. So we have a mish-mass of minus, take away, less, remove, subtract, negative, less than etc. Students seem to be stuck with their previous learning as correct and struggle to move onto a wider understanding.**
Step 2: What does research say?

Working with negative numbers: language and notation, the participants are given the opportunity to familiarise themselves with a number of research findings (Vlassis, 2008 – about understanding the minus sign in three senses: unary, binary, and symmetric) and recommendations around implications of the language and notations around negative numbers (Bofferding, 2014).

https://www.futurelearn.com/info/courses/key-ideas-in-mentoring-mathematics-teachers/0/steps/73630

Here is Mark’s posting after trading the research post:

*It is better in my opinion to start with subtracting a negative number instead of minus minus. Only when they understand that we can move on to minus minus, then I will move on to rules: --=+, -+=-…*

Nishi’s summarises his learning in terms of how he would use this knowledge when mentoring others: *Teachers should be very careful with terminology if students are learning about negative numbers for the first time. The idea that minus and negative are equivalent will mature with time in their minds. In the beginning, visualizing minus and negative separately will help them a lot.*
A scenario: “A beginner teacher seeks your advice on how to tackle some frequently-occurring mistakes he has noticed his pupils make when checking the answers to the homework. Pupil A is surprised by the teacher’s feedback on his incorrect answer. “But sir, I am right. \(-3 - 2\) does equal 6 because minus and minus makes a plus and since there is nothing left between 3 and 2, you times them together.”

Samir explains: Pupil A is very confused, possibly using a combination of binary and symmetric understanding. I would suggest changing the language to Negative 3 Subtract 2 and displaying how this would work on a number line. I would suggest that the first number is your starting point,

while Mark replies to Samir’s contribution and suggests: First of all, I would ask the BT [beginner teacher] to clarify the vocabulary to be used (where to use ‘negative’ and ‘minus’) and the functions of ‘-‘ sign in this case ( unary, binary and symmetrical).
About the learning on the KIMMT course

I have a clearer idea about what a mentor should do and [how] I need to use backed-up advice, check some key areas understanding, continue to be enthusiastic about my teaching, continue to read up-to-date research (Imelda, 20 years of teaching experience)

Becoming explicit about one’s teaching practice

As a mentor, I’d like to be able to provide help that is grounded on effective theories and principles. I’d like to be the kind of mentor that really gives an impact on other's teaching and be able to contribute in improving the teaching of mathematics (Amelia)

Mentors are a source of experience for sharing this knowledge to new teachers and are able to guide them during their development. I believe that mentors should expose mentees to many different aspects of teaching mathematics so that they develop their own style. New teachers need to be able to critique and reflect on their performance and challenge old techniques in order to improve. Mentors play a major role in guiding them through this process (Darren)
An international Study: Focus on *Subject Specific* Mentoring

3 research groups:
- ROSE - University of Karlstad, Sweden
- HuSoEd - University of Helsinki, Finland
- SSRG – UCL Institute of Education, England

KOSS Network - Knowledge and Quality across School Subjects and Teacher Education

Research questions

- What knowledge for teaching a specific subject do (experienced) mentors foreground when supporting novice subject teachers?
- How is that knowledge negotiated between mentor-mentee?
Reflections on own mentoring – generic in nature

- **Passion/Love of subject:** so you need to bring the love of your subject across to the students. Luckily I’ve successfully done that. I’ve tried to promote maths to especially girls.

- **Enjoyment in working with adults**
- **New learning/ keeping up with new developments**
- maybe doing things differently, see what the new developments are, what the new aspects of teaching are, what the new theory behind teaching as well

- **observe each other’s practice**
- when we discuss either a lesson I had observed or they have observed me delivering, be open and be critical and do tell me.

- **Feedback**
- **Pedagogical Knowledge**

- **Modelling**

- **Personal**

- **System Requirements**

- **Attributes**

- **Enthusiasm**
- Caring
- Growth mindset
- Supportive

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- Caring
- Growth mindset
- Supportive

- **You can’t mimic other people. It has to be your own.**
- However, ...
- I have to show them.
- we share our lesson plans with them; We’ve got loads and loads of resources in school.
- Don’t reinvent the wheel but take things which you can find either through the resources we have or from the internet but tweak it to suit yourself

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**Figure 1. Five-factor mentoring model**
Towards subject-specific reflections

However, even when mentor teachers are experts in mathematics teaching, they are not necessarily able to conceptualize their view of the knowledge required for mathematics teaching (Asikainen et al., 2013), and most frequently they do not articulate the principles that underlie their pedagogical reasoning to their preservice teachers (Hudson et al., 2013).
Related references


The KIMMT course: https://www.futurelearn.com/courses/key-ideas-in-mentoring-mathematics-teachers