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Making *mathematics* the focus of mentor-mentee conversations

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In this presentation I will:

- describe the design of a short professional development course for prospective mentors of mathematics teachers;
- present and discuss the various components of this course, designed to promote a research-informed mathematics teaching practice;
- provide some evidence for how such a design served the purpose of supporting the participants to become introspective of their ability to provide explanations and examples in future mentor-mentee discussions, that place subject matter at the heart of such conversations.

The KIMMT course – *Key Ideas in Mentoring Mathematics Teachers*

Evidence-informed teaching: an evaluation of progress in England

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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;**

How can teachers be supported in this respect?

*****Coldwell, M., Greany, T., Higgins, S., Brown, C., Maxwell, B., Stiell, B., ... & Burns, H. (2017). *Evidence-informed teaching: an evaluation of progress in England. Research Report*. Department for Education.

Evidence-informed teaching: an evaluation of progress in England

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How can teachers be supported in this respect?

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**.

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.

*****Coldwell, M., Greany, T., Higgins, S., Brown, C., Maxwell, B., Stiell, B., ... & Burns, H. (2017). *Evidence-informed teaching: an evaluation of progress in England. Research Report.* Department for Education

Evidence-informed teaching: an evaluation of progress in England

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undertake the role of a[illegible]
obstacle to the quality [illegible]

Rationale for our *KIMMT course* →
supporting research informed approaches to mathematics-specific mentoring

*****Coldwell, M., Greany, T., Higgins, S., Brown, C., Maxwell, B., Stiell, B., ... & Burns, H. (2017). *Evidence-informed teaching: an evaluation of progress in England. Research Report.* Department for Education.

About KIMMT

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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

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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.

UCL Future Learn

Design considerations

A three-part approach to supporting active online learning: *An Architecture of Engagement*

- Architectural Element 1: Syllabus Communication and Engagement Policy
- Architectural Element 2: Course Orientation
- Architectural Element 3: Modular Course Structure

* Riggs, S. A. and Linder, K. E. (2016). Actively Engaging Students in Asynchronous Online Classes. *IDEA Paper* No.64.

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Architectural Element 1: Syllabus Communication

Architectural Element 2: Course Orientation

WEEK 1: INTRODUCTION TO THE COURSE

Welcome and course overview

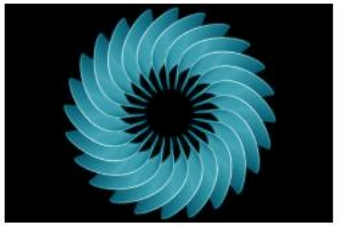
A welcome to the course and overview of the content in each week, followed by a justification of how this course supports the development of a research-informed approach to mentoring.

1.1 WELCOME TO THE COURSE VIDEO (01:53)

1.2 COURSE CONTENT ARTICLE

1.3 RESEARCH-INFORMED MENTORING ARTICLE

Getting the most from the course



For many, studying online and asynchronously may be a new experience. With these steps we offer some guidance around studying online with us and the tools you'll need. Image: Jimwrenholt CC BY 2.0

1.4 LEARNING WITH US ARTICLE

1.5 PREPARING YOURSELF ARTICLE

1.6 USING COURSE MATERIALS ARTICLE

*Riggs, S. A. and Linder, K. E. (2016). Actively Engaging Students in Asynchronous Online Classes. *IDEA Paper* No.64.

Architectural Element 3 Modular Course Structure

*Riggs, S. A. and Linder, K. E. (2016). Actively Engaging Students in Asynchronous Online Classes. *IDEA Paper* No.64.

*Laurillard, D. (2014): Anatomy of a MOOC for Teacher CPD, Technical report. UCL Institute of Education.

WEEK 1	WEEK 2	WEEK 3	WEEK 4

Week 2: Fostering Algebraic Reasoning

- Mathematical relations;
- Algebraic language;
- Solving equations.

Week 3: Fostering Geometric Reasoning

- Working with diagrams;
- Visualising;
- Invariance.

Week 4: Fostering Numerical Reasoning

- Negative numbers and the minus sign;
- Fractions.

Week 5: Fostering Functional Reasoning

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Architectural Element 2: Course Orientation

Key Ideas in Mentoring Mathematics Teachers - 4 hours per week (Times are approximate)

In FutureLearn, you can learn in a variety of ways:

- by watching videos (V)
- by reading articles (A)
- by discussing the topic with each other and the educators of this course (D)
- by adding your comments - every article and video has a space to allow you to comment and ask questions.

About Week 3	Activity One	Activity two	Activity three	Summary
Introduction to Fostering Geometric Reasoning • Overview of the week (V) • Overview of the activities (A) (10:00)	**Working with diagrams** • Labelling and notations (D) • What does research say? (A) • A pupil's solution (D) • Analysing pupil's work (A) • Research-informed teacher-support (V) (60:00)	**Visualising** • Visualising beyond just 'looking at' (D) • What does research say? Analysing Student A's statement (A) • Your analysis of Student B's statement using research (D) • Using research to analyse and interpret Student C's statement (A) (60:00)	**Invariance** • Towards convincing and proving (D) • What does research say? (A) • Research-informed mentoring: about inscribed quadrilaterals (V) (60:00)	**Reflections and concluding remarks** (20:00)

Architectural Element 1: Engagement Policy

Online **Co**mmunity of practice for prospective **M**athematics **M**entors (OCoMM)

Join the community of prospective maths mentors

33 comments

We recommend that learners move through the course at approximately the same pace, taking time to review and reflect on the week's content and solidify their learning before progressing to new material. The course will provide you with many opportunities to share your insights with other learners and the lead educators through the course discussions, and we very much encourage you to do so!

Your task

Introduce yourself. You might want to describe the type of educational establishment you teach in at the moment, the age range that you teach, and tell us and other learners on the course what you hope to gain from it.

Demographics - 11th May 2020 presentation

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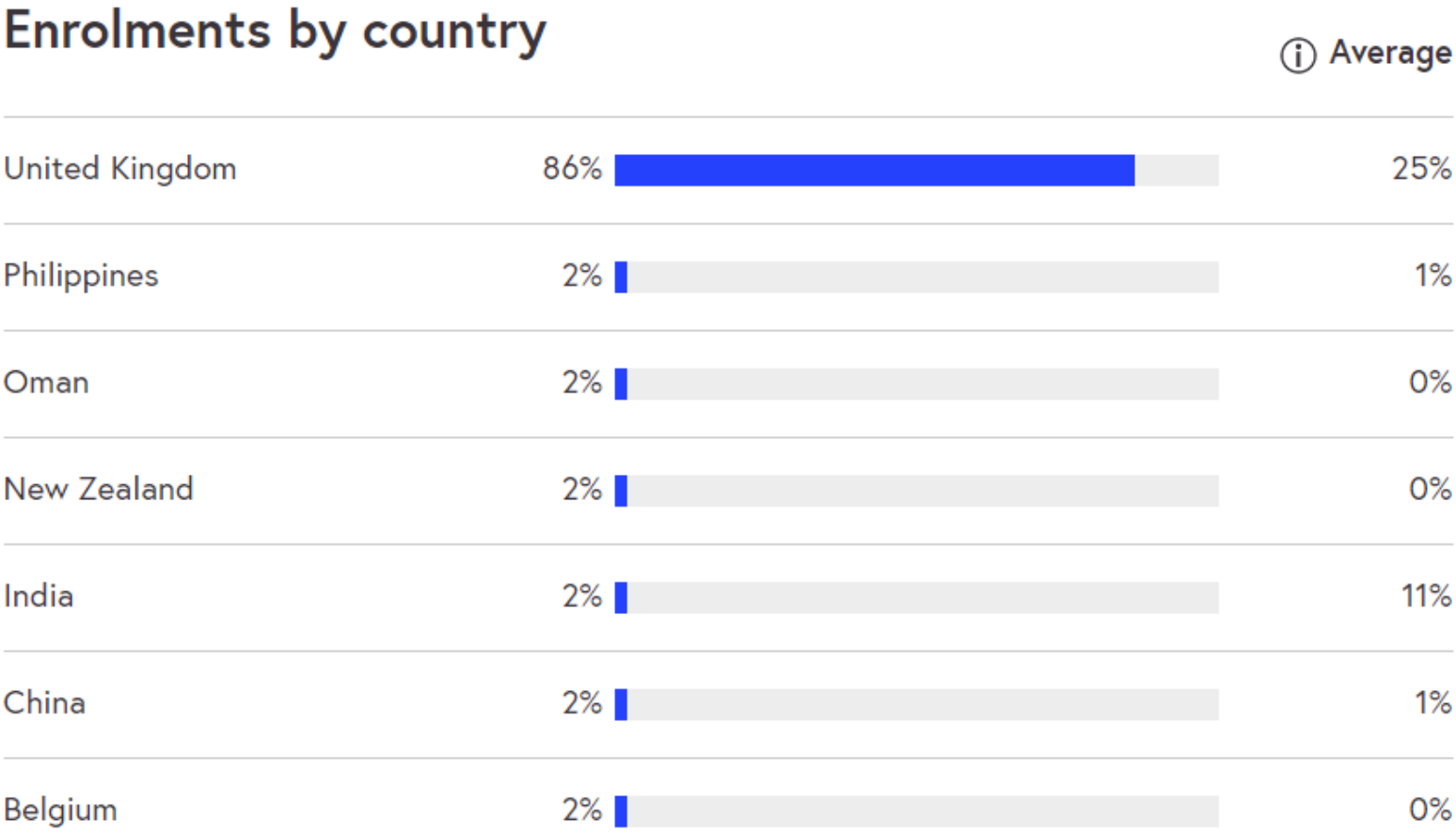
48 participants



OCoMM: The Pedagogical Strand

The Research Strand

OCoMM: Research-Informed Pedagogy

Modelling Research-Informed Pedagogy

Research-Informed Pedagogy in Practice

WEEK 3: FOSTERING GEOMETRIC REASONING

Introduction

The activities below model how engagement with research empowers teachers to recognize the challenges pupils might have in learning geometry, providing thus a stimulus for consideration of how to better support their learning.

3.1 WELCOME TO WEEK 3 VIDEO (04:40)

Working with diagrams

This activity provides the stimulus for consideration of how to support students to talk and reason about geometric figures.
Image: Jimwrenholt CC BY 2.0

3.2 LABELLING AND NOTATIONS DISCUSSION

3.3 WHAT DOES THE RESEARCH SAY? ARTICLE

3.4 A PUPIL'S SOLUTION DISCUSSION

3.5 ANALYSING PUPIL'S WORK ARTICLE

3.6 RESEARCH-INFORMED TEACHER SUPPORT VIDEO (02:49)

Working with negative numbers: language and notation

0 comments

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 4 = 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

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?

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

References

Gallardo, A. (1995). Negative numbers in teaching of arithmetic: Repercussions in elementary algebra.In M. Owens, M. Reeds, & G. Millsaps (Eds.), Proceedings of the 17th Annual Meeting of PME-NA (Vol. 1, pp. 158-163). Columbus, OH: PME-NA.

Sfard, A. (2007). When the rules of discourse change, but nobody tells you: Making sense of mathematics learning from a commognitive standpoint.The Journal of the Learning Sciences 16(4), 565-615.

OCoMM: The Pedagogical Strand

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.*

The Research Strand

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).

Research-Informed Pedagogy in Practice

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.*

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OCoMM: Research-Informed Pedagogy in Practice

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 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)