3RD INTERNATIONAL CONFERENCE ON DEVELOPING MATHEMATICAL RESILIENCE

At The Open University
and simultaneously online

1-2 JULY 2022
10:00 – 15:00 BST

This conference will showcase work on Mathematical Resilience from researchers, teachers and others, from across the world. Mathematical resilience enables people to overcome mathematics anxiety and protect their mathematical well-being. There will be presentations from those researching the affective domain of mathematics education in the broadest sense. The conference will offer an innovative and friendly environment for participants to showcase and discuss their research or emerging practice.

Registration link: tinyurl.com/MRCon22

Friday 1st July	
10:00	Intro
10:10	Keynote 1 Professor Alain Finkel [ONLINE]
10:40	Session 1 2 presentations – 30 mins each
11:40	Break
11:50	Session 2 2 presentations – 30 mins each
12:50	Lunch + Networking
13:20	Session 3 2 presentations – 30 mins each
14:20	Break
14:30	Keynote 2 Professor João Carmo [ONLINE]
15:00	Conclusion

Saturday 2nd July	
10:00	Intro
10:10	Keynote 3 Sue Johnston-Wilder and Clare Lee[F2F]
10:40	Session 4 2 presentations – 30 mins each
11:40	Break
11:50	Session 5 2 presentations – 30 mins each
12:50	Lunch + Networking
13:20	Session 6 2 presentations – 30 mins each
14:20	Break
14:30	Keynote 4 Gaye Williams [ONLINE]
15:00	Conclusion

KEYNOTE SPEAKERS

Professor Alain Finkel

École Normale Supérieure
Paris-Saclay, France

Alain FINKEL is a professor of cognitive science and computer science at the École Normale Supérieure Paris-Saclay.
Due to his dual training in "hard sciences" (computer science and mathematics) and in human sciences, his interests and his position as a professor in an ENS (one of the main missions of which is the training of teachers and researchers), he naturally invested in the field of university pedagogy. Teaching cognitive sciences for pedagogy in 1995 led to structuring a set of courses useful for lecturers (and researchers) following requests from several departments of ENS Paris-Saclay, the Doctoral School of Practical Sciences and several CIES. Finally, he created one of the rare long pedagogical training courses, ACTA, for higher education teachers and launched the handbook about Cognitive Analysis of Emotions in 2022.

Professor João Carmo

Universidade Federal
de São Carlos, Brasil

Dr Carmo has a Ph.D. in Education from the Federal University of São Carlos (2002), and is a professor of the Department of Psychology at the Federal University of São Carlos (UFSCar).

- Advisory Professor at the Graduate Program in Psychology at UFSCar.
- Researcher at the National Institute of Science and Technology on Behavior, Cognition and Teaching (INCT-ECCE).
- Coordinates the Laboratory of Applied Studies to Learning and Cognition (LEAAC) of the Psychology Department at UFSCar.
- Coordinator of the WG Psychology of Mathematics Education.

KEYNOTE SPEAKERS

Dr Clare Lee

The Open University, UK

Clare trained as a secondary mathematics teacher at Reading University and has taught in comprehensive schools in Oxfordshire and the West Midlands before becoming the Research Fellow on the Kings Medway Formative Assessment Project. Since then she has worked as a LA adviser before joining Warwick University and then moving to the Open University. She has worked with Sue on developing the construct “Mathematical Resilience”, working with schools and teachers and in particular with the students themselves to consider how teaching can enable students to use the resilience that they display in many areas of life to learn, use and control mathematics both to pass exams and to empower them in their lives after school.

Sue Johnston-Wilder
Associate Professor

University of Warwick, UK

Sue trained as a secondary mathematics teacher at Cambridge University and taught in London comprehensive schools. Since then she has worked in mathematics education for Kings College London, the Open University and Warwick University. She has published widely including the Sage 'Developing Thinking in Mathematics' series. Sue was Chair of the Association of Teachers of Mathematics 2005-2009. In collaboration with Clare Lee, working with students, teachers, school leaders, and parents, she has developed the construct 'Mathematical Resilience' as a positive framework for working with schools and families on 'the maths problem'. In collaboration with The Progression Trust and ASDAN, she has developed a programme for developing Coaches for Mathematical Resilience, so that mathematically anxious adults can support mathematics learners, from where they are now with their mathematics.

KEYNOTE SPEAKERS

Gaye Williams, Honorary Senior Fellow in the Graduate School of Education at the University of Melbourne, and member of the late David Clarke's International Centre for Classroom Research was a mathematics teacher (year 7-12) for over 20 years. Her doctoral research, awarded the University of Melbourne Chancellor's Prize (2007), explored the intellectual and affective quality of mathematics lessons (personal, social, contextual influences). She found that optimism (resilience) was a crucial personal characteristic of students who creatively developed mathematical insights, and that the relative resilience of group members could influence opportunities for such activity. She has also explored the resilience-building nature of creative student activity, and influences of teacher characteristics on such activity.

Dr Gaye Williams

Melbourne Graduate School of Education. Australia

Conference Organising Committee

Masha Apostolidu
Aïcha Hadji-Sonni
Sue Johnston-Wilder
Clare Lee
Rosemary Russell
Telma Silveira Pará
Ben Sinclair

Reach us at:

@DMR_Network
@MathematicalResilience
mathematicalresiliencenetwork@gmail.com
Mathematicalresilience.org

FRIDAY 1st JULY

10:00-10:40	**ROOM 1:** Welcome, Introduction & Keynote 1	
10:10	**Professor Alain Finkel** [ONLINE] 	
	ROOM 1	**ROOM 2**
Session 1	Life story work; Mathematical resilience in adult and life-long learning	Teaching for mathematical resilience
10:40	The mathematics life story framework – towards understanding the development of mathematics anxiety **Maria D. Ryan**	Developing a Workshop for Statistical Resilience **Ellen Marshall, Anna Riach, Amanda Shaker & Diane Haigney**
11:10	National Numeracy's work with Value, Belief and Persistence **Beth Barnes**	Developing Mathematical Resilience through dealing with errors: analysis of an intervention in Rio de Janeiro. **Ana Luísa Furtado & Telma Pará**
	11:40 - 11:50	BREAK
Session 2	Emotional regulation in mathematics teaching and learning	Teaching for mathematical resilience
11:50	The Mediating Role of Psychological Resilience in The Relationship Between Early Childhood Experiences and Mathematics Anxiety **Abdulvahap Yorğun**	Developing mathematical resilience while addressing mathematics anxiety in disadvantaged areas in France **Aïcha Sonni**
12:20	Mathematics teaching anxiety in Romanian pre-service elementary teachers **Thomas E. Hunt, Agata Napiorkowska, Ioan-Lucian Popa, & Ovidiu Bagdasar**	The use of a mathematical resilience intervention to increase student engagement with mathematics and statistics support **Farhana Gokhool**
	12:50 - 13:20	LUNCH BREAK
Session 3	Working with parents to address mathematics anxiety	Mathematical resilience in adult and life-long learning; Mentoring and coaching for mathematical resilience
13:20	Working with parents to address mathematics anxiety **Sue Skyrme**	Coaching for Mathematical Resilience in Cambridge Regional College **Julie Savage, Georgina Norris & Sarah Stokes**
13:50	New ways of communicating ideas about mathematical resilience to parents **Rosemary Russell & Donna Wright**	Why Bother? Identifying the barriers to motivation in resit mathematics **Rebecca Exley**
	14:20- 14:30	BREAK
14:30-15:00	**ROOM 1:** Keynote 2 & Conclusion	
14:30	**Professor João Carmo** [ONLINE] 	

FACE-TO-FACE
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SATURDAY 2nd JULY

10:00-10:40	**ROOM 1:** Welcome, Introduction & Keynote 3	
10:10	**Dr Clare Lee & Associate Professor Sue Johnston-Wilder** 	
	ROOM 1	**ROOM 2**
Session 4	Emotional regulation in mathematics teaching and learning	IT, media and mathematics resilience
10:40	Recognising and Coping with Mathematics Anxiety in Adult Learners **John Morgan**	Maths ACTive: Mastering Mathematics with Psychological Flexibility **Ben Sinclair**
11:10	Remembered Trauma – The Origins of Mathematics Anxiety **Clare Lee**	Cameras on, Augmented Reality app in hand and let's learn outside the box! **Maria Fakih**
	11:40 - 11:50	BREAK
Session 5	Emotional regulation in mathematics teaching and learning	Mentoring and Coaching for mathematical resilience; Emotional regulation in mathematics teaching and learning
11:50	The role of autonomy and emotional awareness in managing mathematics anxiety. **Janet Baker**	Making mentoring transformational through co-teaching: a case study in the FE sector **Sheraz Ahmad**
12:20	Workshop: Designing an app to track mathematics anxiety **Janet Baker, Katie Baker & Jack Fletcher**	Words helping numbers: Using writing to mediate anxiety in mathematics learners **Ellie Willard**
	12:50 - 13:20	LUNCH BREAK
Session 6	Mathematical resilience in adult and life-long learning	IT, media and mathematics resilience. Educational leadership in embedding mathematical resilience
13:20	People are afraid of looking foolish: how can we stop mathematics anxiety from holding us back? **Masha Apostolidu & Sue Johnston-Wilder**	Teaching Newton's Binomial using ICT environment and STEM approach - a strategy to enhance mathematical resilience **Telma Pará, Amanda Mourad & Simone Dantas**
13:50	A qualitative investigation of the background determinants of apprehensions in FE resit mathematics learners **Mariam Siddiqa Rashid**	Limiting the impact of mathematics anxiety on secondary school learners: practitioner research in a selective boys'school **John Thomas**
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14:30-15:00	**ROOM 1:** Keynote 4 & Conclusion	
14:30	**Dr Gaye Williams** [ONLINE] 	

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Joining and Navigating the Conference

Step 1: Open the program schedule which has all the links needed to take part in the conference

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FACE-TO-FACE
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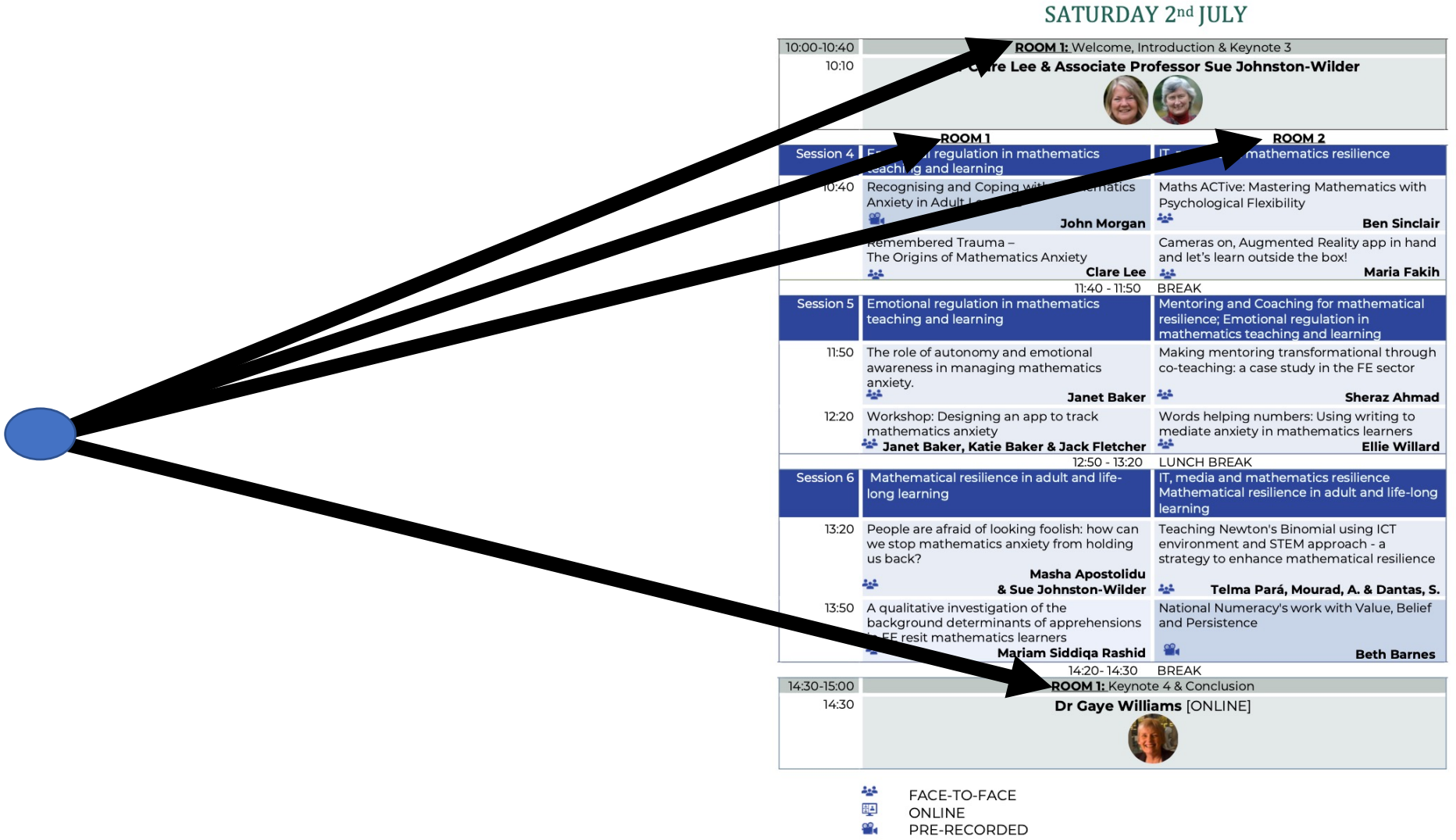
Step 2: Click on the link that you would like to access. Links are underlined and can be found here:



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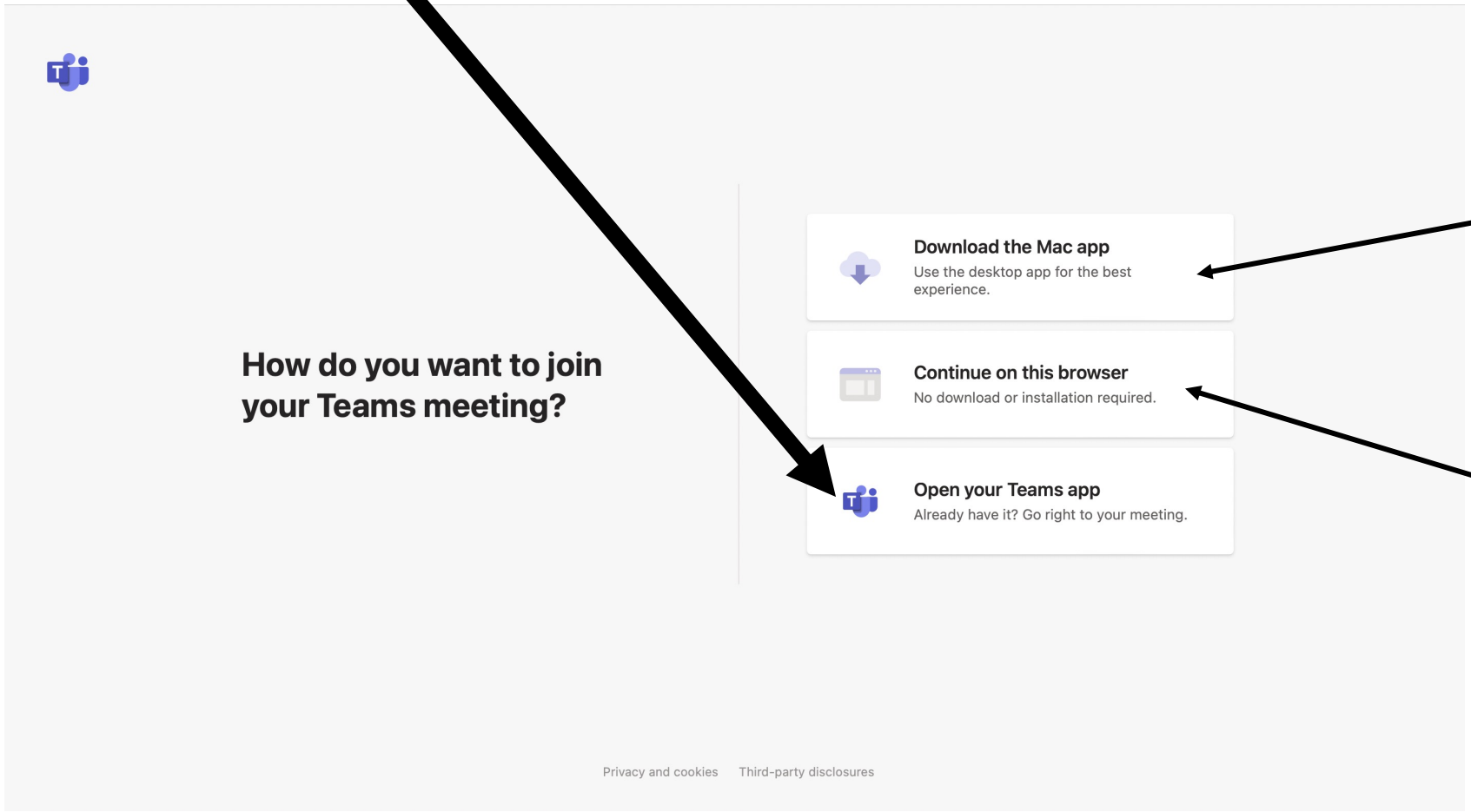
Step 3: If you have a Microsoft Teams account, click on *"Open your Teams app"*



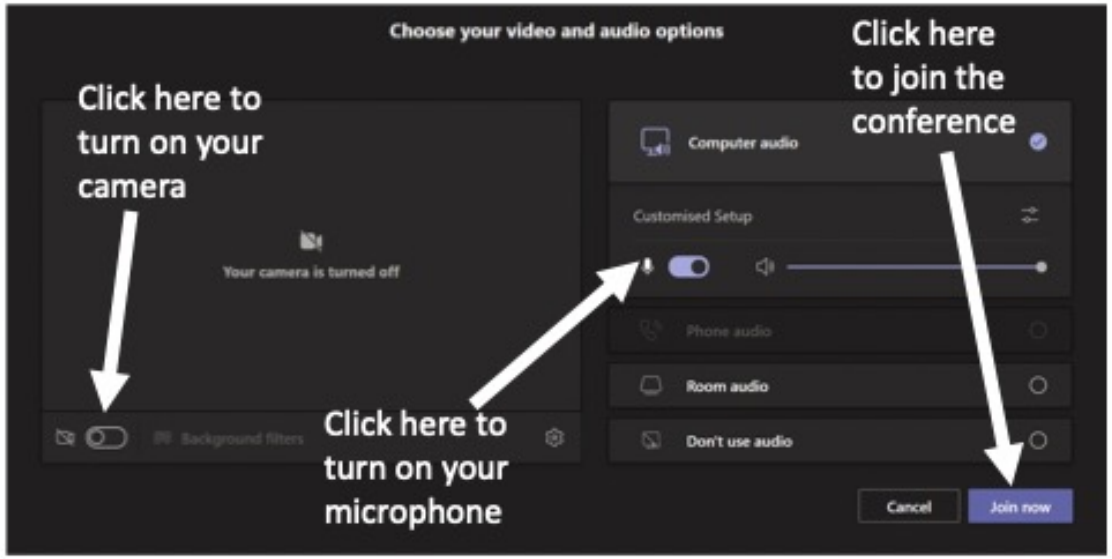
You can also create an account by clicking "Download the Mac App (or the Windows App)

If you do not have an account, click "Continue on this browser"

Step 4: Click *"Join Now"*

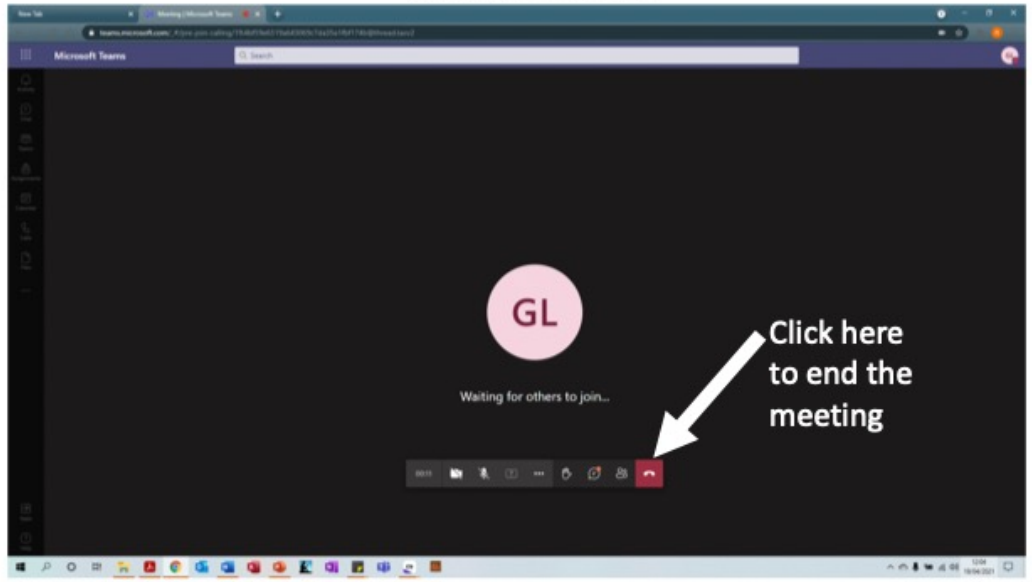
Web browsers

MS Teams Desktop App



Step 5: To switch between rooms, click the red *"Leave"* button and repeat steps 1 to 4

Web browsers



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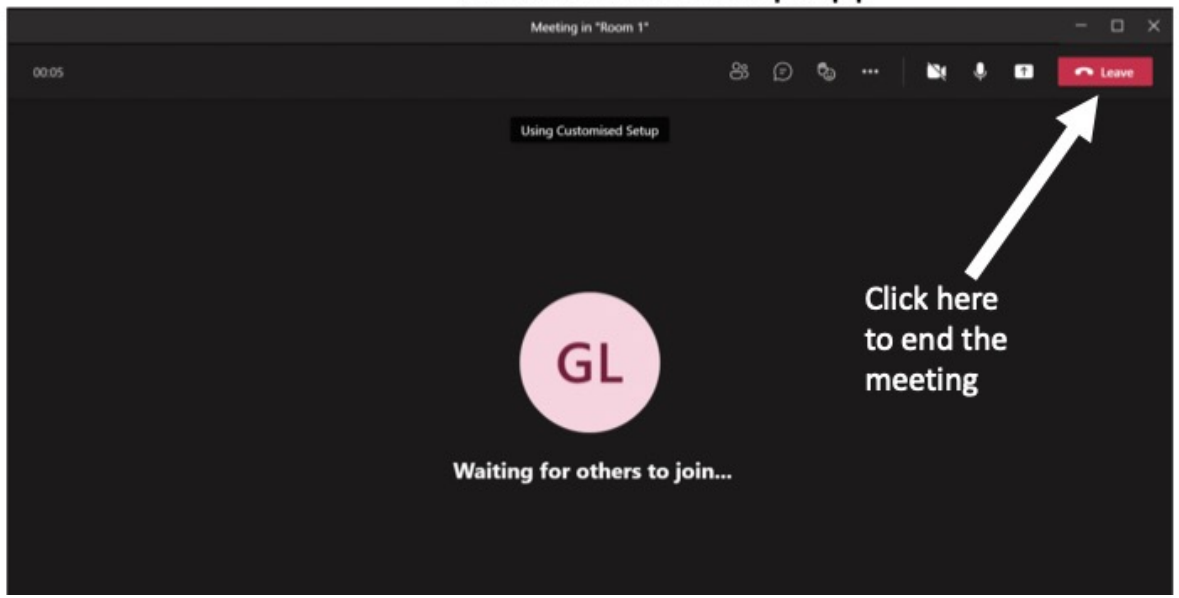

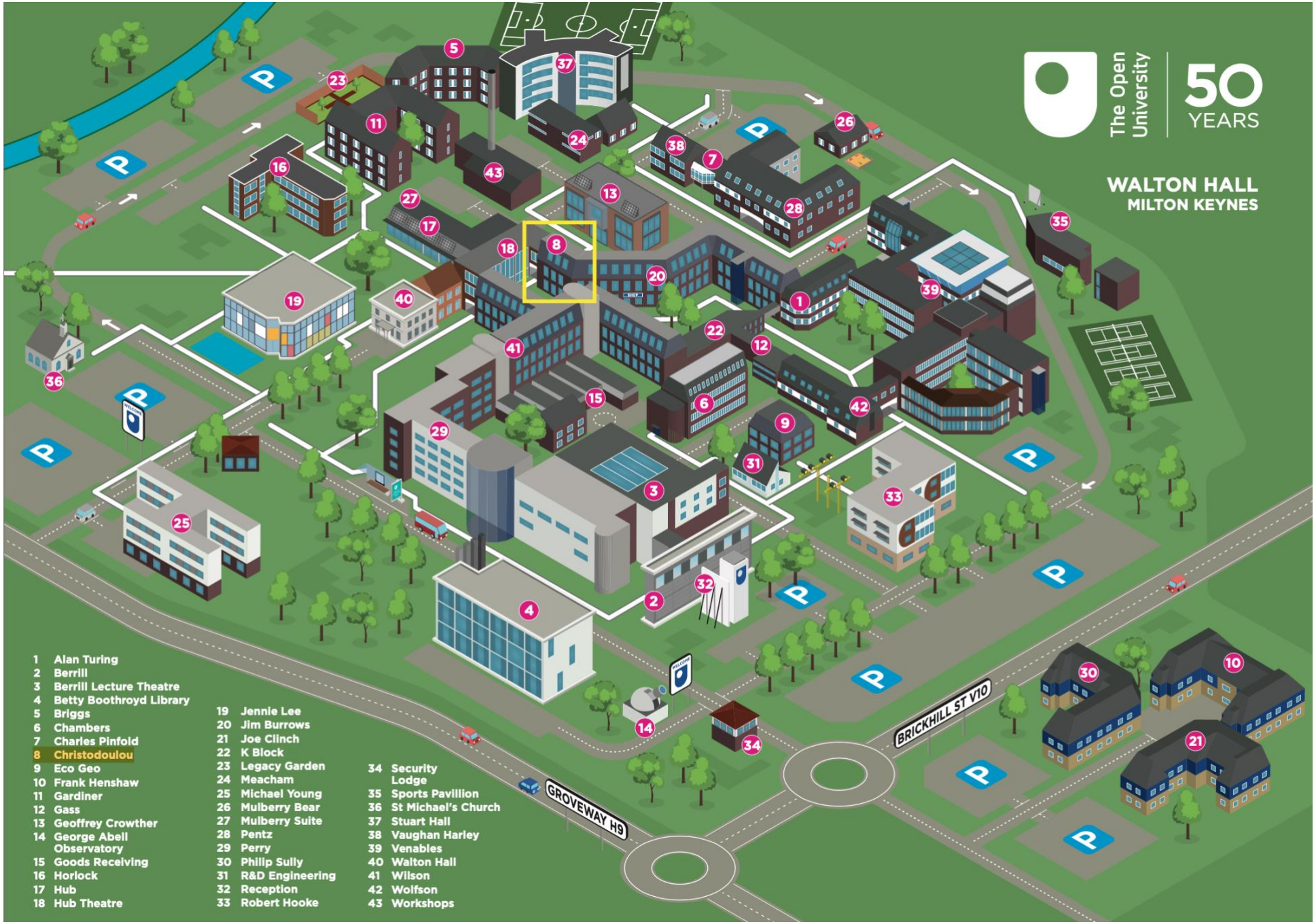

Directions to Walton Hall: https://www.open.ac.uk/about/estates/travel-advice/directions-walton-hall-campus

Friday 1st July 2022 – 10:40 – Room 1
Other: new research method

Understanding the development of mathematics anxiety using the mathematics life story framework

Dr Maria D. Ryan
Mary Immaculate College
(MariaD.Ryan@mic.ul.ie)

In the past six decades, different research methods have facilitated the study of mathematics anxiety (MA) (Dowker, Sarkar & Looi, 2016); for example, since the 1960's (Aiken & Dreger, 1961) measurement scales have been used to gauge the extent of MA; and since the 1990's variations of mathematics stories (Thumpston & Coben, 1994; Tobias, 1993) have provided space for individuals – and especially adult learners – to convey how MA has impacted them. While many measurement scales use Likert-type formats to denote levels of MA in different contexts (Richardson & Suinn, 1972), the outcome is a total score for each respondent. Interpretation of scores can be problematic, as there is no gauge for what score constitutes a high level of MA (Carey, Devine, Hill, Dowker, McLellan & Szűcs, 2019; Dowker et al., 2016). Further, examining individual responses to the measurement scale does not uncover the etiology of the individual's level of MA. In this regard, the scores of MA scales can be elucidated when combined with qualitative methods to allow greater insight into likely sources of MA (LoPresto & Drake, 2004).

This presentation proposes a new research method – the mathematics life story (MLS) framework – to facilitate interpretation of adult learners' MA scores through their mathematics life story. The framework comprises ten questions that tease out the interviewee's experiences with mathematics throughout their lives. As proof of concept, a summary of one adult learner's MLS is presented. The findings show that the MLS framework provides a structured and comprehensive method of exploring the adult learner's life experiences with mathematics, thereby helping to identify what contributed to their denoted level of MA.

Friday 1st July 2022 – 10:40 – Room 2
Teaching for mathematical resilience

Developing a Workshop for Statistical Resilience

Ellen Marshall; Anna Riach; Amanda Shaker; Diane Haigney
Sheffield Hallam University; University of Leeds; La Trobe University; Open University
(ellen.marshall@shu.ac.uk)

Statistics is one of the widely taught subjects in higher education but many students feel anxious and lack confidence in statistics which can impact on their learning, performance and progression. As part of a longer-term collaboration, the presenters of this talk have developed research-based self-help resources including a short video, and an interactive workshop, with the aim of developing statistics resilience and enabling students to learn effectively. The workshop expands on previously developed mathematics anxiety workshops (Marshall et al, 2017) and uses strategies for statistics resilience commonly used in mathematics and statistics support (Johnston-Wilder & Marshall, 2017).

This talk will focus on the development and delivery of the statistics anxiety workshop for multi-institution online delivery to students at UK and Australian institutions including similarities and differences between mathematics and statistics anxiety, strategies to build statistical resilience and adaptions for online delivery.

The video and other self-help resources are available for use by any institution on the Sheffield Hallam Mathematics and Statistics Support Service webpages along with the referenced publications: https://maths.shu.ac.uk/mathshelp/Anxious.html

Friday 1st July 2022 – 11:10 – Room 1 [Recorded Poster Presentation]
Mathematical resilience in adult and life-long learning

National Numeracy's work with Value, Belief and Persistence

Beth Barnes
National Numeracy
(beth@nationalnumeracy.org.uk)

National Numeracy is an independent charity established in 2012 to help raise low levels of numeracy among adults and to promote the importance of everyday mathematics skills. We believe that numeracy is an essential skill - and an entitlement - for everyone. The economic success of the UK and the wellbeing of people individually are dependent on it.

We propose using a poster and recorded presentation to explore National Numeracy's framework of Value, Belief and Persistence and how it is used throughout National Numeracy's work. This approach is aimed at dispelling the myths around mathematics and introducing a more positive approach to improving numeracy skills.

We believe that everyone in the UK can become numerate, but to do this, negative attitudes must be challenged and it is necessary to build mathematical resilience. We all need to understand the value of everyday mathematics, have the belief that our ability is not fixed and recognise the importance of persistence as a part of learning.

Value is our motivation to learn, our understanding of why it is useful to improve our numeracy and what benefits it would bring to our work and life.

Belief is understanding, accepting and recognising that everyone can improve their everyday numeracy skills. Learners must become aware that if everyone can improve, then that means that they can too. Mathematical understanding is not determined at birth.
Persistence is understanding that improving your numeracy may feel hard; learning any new skill is difficult and it is often a struggle.

Friday 1st July 2022 – 11:10 – Room 2
Teaching for mathematical resilience

Developing Mathematical Resilience through dealing with errors: analysis of an intervention in Rio de Janeiro.

Ana LuísaFurtado; Telma Pará
Centro Federal de Educação Tecnológica Celso Suckow da Fonseca
(ana.furtado@cefet-rj.br)

It is essential to understand that errors are not reflections of not knowing, but knowledge that needs revisiting, analysis and reflection. In the context of the Vector Calculus course taught at CEFET-RJ (Federal Centre for Technological Education of Rio de Janeiro), it is very common for students to understand the concepts of the syllabus, but have low performance because they do not know the techniques required. There are several ways to try to turn common mistakes made by students into a teaching tool. We suggest some interventions in the classroom, coordinated by the teacher, based on prior knowledge of common errors: providing reflections, presenting errors and working on ways to resolve the issues; holding debates with students about the solutions they propose, presenting games and challenges that include errors and, from these, outlining strategies for understanding the concepts and procedures for solving the problem. We observed that these activities require the teacher's experience and knowledge of the common mistakes that students make. Thus, part of this study is dedicated to sharing this teaching experience.

Methods: In the period of remote teaching due to the pandemic, there was a need to use ICT in education. CEFET-RJ adopted Microsoft's Teams platform for classes to take place. A case study application of MR was carried out in vector calculus classes in which students had to, in a collaborative way, create questions and solve them. The activity was performed in the Teams channel as if they were conversations and had the following steps: Create a scalar function on R^2; Create any curve in R^2 for a function defined by a colleague previously; Solve the line integral for this curve and this function given by two different colleagues; Comment on a colleague's answer.

Results and Conclusions: This experience has been enriching, as it is an active methodology in which students analyse their own mistakes and collaborate with each other, developing mathematical resilience. The intervention happens naturally, and it is possible to see their growth in understanding the content. Although this activity took place on the Teams platform, it is possible to adapt it to the face-to-face classroom.

Friday 1st July 2022 – 11:50 – Room 1
Emotional regulation in mathematics teaching and learning

The Mediating Role of Psychological Resilience in The Relationship Between Early Childhood Experiences and Mathematics Anxiety

Abdulvahap Yorğun
Bayraklı Guidance and Research Centre (Directorate of National Education Department of İzmir)
(vahapyorgun@gmail.com)

The mediating role of psychological resilience in the relationship between early childhood experiences and mathematics anxiety of Turkish high school students will be investigated in this research.

A significant relationship has been mentioned between psychological disorders such as mood and anxiety disorder and adverse childhood experiences (Gilbert, et al., 2003; Gluckman, Hanson and Beedle, 2007; Rutter et al., 1994). Similarly, positive associations have been found between childhood trauma and anxiety disorder (Evren and Ögel, 2003), negative self-esteem (Güneri-Yʋðnen, 2016), low self-confidence and self ability (Önder and Gülay, 2007) in later periods of their life. An assumption is made that continuous low attainment in mathematical tests is a significant predictor of mathematics anxiety.

However, resilience is a protective factor which can help individuals to cope with adverse experiences. The term 'resilience' is defined as the capacity of the individual to strive against the challenges which threaten that person's stability, viability and development and to recover from adversity (Rutter, 2013). Those who have high level of resiliency may not develop mathematics anxiety. Concluding, resilience can play a mediating role.

In this study, the mediating role of resilience in the relationship between mathematics anxiety and early childhood experiences of Turkish high school students will be investigated. While there is a significant relationship between early childhood experiences and pathologic behaviours displayed in later years, resiliency level may protect the individuals, thereby playing a mediating role. Thus, the results may provide findings about the role of resiliency in coping with mathematics anxiety.
The Regression analysis techniques will be employed in order to investigate the hypothesis of the research. The Mathematics Anxiety Rating Scale-Short Version (Suinn and Winston, 2003; Baloğlu, 2010). Turkish Version of the Early Life Experiences Scale (ELES; Gilbert, et al., 2003; Akın et al., 2013) and Psychological Resiliency Scale Short Version (Doğan, 2015) will be used to collect the data.

The data will be gathered from 10 high schools located in Bayraklı District of Izmir city after an official permission that will be taken from the National Education Directorate of Bayraklı District. Because of the pandemic and other reasons, data collection tasks will be held online. The findings derived from the statistical analysis will be presented and the implications and contributions of the results will be discussed.

Friday 1st July 2022 – 11:50 – Room 2
Teaching for mathematical resilience

Developing mathematical resilience while addressing mathematics anxiety in disadvantaged areas in France

Aïcha Sonni
University of Warwick
(Aicha.Hadji-Sonni@warwick.ac.uk)

Recent international studies are alarming about mathematics anxiety (MA) levels and mathematics performance In French schools. As a mathematics teacher in disadvantaged areas in France, I observed avoidance and passivity, symptoms of MA. As a researcher, I focus on developing mathematical resilience and coping skills.

I surveyed students from disadvantaged areas in France aged 10-15 years about MA and self-inefficacy (N=1902). Using a design-based approach, I designed a whole-class intervention, based on 3 tools: the hand model of the brain, relaxation response and growth zone model (Johnston-Wilder et al., 2020). I measured the impact on MA, using pre-and post-intervention surveys (N=120). Worst and best mathematics experiences were collected from students (N=153).

Learning mathematics can trigger joy, confidence, or happiness, leading to self-efficacy. It can also trigger anger, fear, disgust, or sadness, leading to self-inefficacy. Half of the final-year girls report self-inefficacy thoughts when experiencing mathematical difficulties. Self-inefficacy triggers MA (Bandura, 1978). A quarter of participants declared high MA and this study, based on the affective domain, adds ways of developing mathematical resilience while addressing MA. The intervention proved effective in secondary, especially for younger learners and those declaring high MA. Additional studies are needed in more advantaged areas.

This study can help mathematics education in France become more effective and inclusive; I recommend the affective domain to be added to teachers' training in France.

Friday 1st July 2022 – 12:20 – Room 1
Emotional regulation in mathematics teaching and learning

Mathematics teaching anxiety in Romanian pre-service elementary teachers

Thomas E. Hunt[1], Agata Napiorkowska[1], Ioan-Lucian Popa[2], & Ovidiu Bagdasar[1]
[1]University of Derby; [2]Univeristy of Alba Iulia
(t.hunt@derby.ac.uk)

Whilst there has been exponential growth in maths anxiety research in recent years, this has tended to focus on the general student population. Perhaps counterintuitively, a high proportion of teachers and trainee teachers appear to experience maths anxiety. More recently, research has acknowledged an important distinction between general maths anxiety and a more context-specific maths teaching anxiety, with maths teaching anxiety shown to be related to factors such as length of teaching experience, qualification status, and the level of education being taught. There are several negative implications associated with maths anxiety and maths teaching anxiety among pre- and in-service teachers, including issues with teacher recruitment and retention, transfer of anxiety to students, poor teaching practices, and general negative work experiences. Despite this, there is a limited body of research evidence to draw upon, particularly involving more diverse teaching populations.

In the present study, 238 Romanian pre-service elementary teachers completed an online survey including measures of maths teaching anxiety, maths anxiety, and general anxiety. A further, open-ended question provided participants with an opportunity to describe their personal experiences with maths anxiety. Findings will inform current practices regarding teacher training through greater understanding of the factors that contribute to the development and maintenance of mathematical resilience.

Friday 1st July 2022 – 12:20 – Room 2
Teaching for mathematical resilience

The use of a mathematical resilience intervention to increase student engagement with mathematics and statistics support

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In a world of increasingly quantitative disciplines, mathematics and statistics support (MSS) is offered across numerous universities to facilitate student learning. However, many of those who may benefit from engaging with MSS currently do not, particularly those in health and life science courses.

It is widely accepted that many students display a fear of mathematics to such an extent that it interferes with their ability to learn mathematics effectively, which can be harmful in today's society. Since this "mathematics anxiety" is known to deter students from engaging with mathematics, the research that will be discussed sets out to understand whether this avoidance could also extend to asking for help with mathematics via MSS.

Students from Coventry University have been offered an optional intervention to increase mathematical resilience and thus reduce mathematics anxiety. In the intervention, the terminology is first defined, followed by an equal exchange of ideas between the researcher and students on how mathematics anxiety can be managed. Students are also informed about MSS at Coventry University (we call our support service SIGMA), and how they can be supported through the service.

The content of the intervention and its effect on student engagement with MSS will be discussed in this presentation.

Working with parents to address mathematics anxiety

Sue Skyrme
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'I can't naturally do it. My mum gave me the feeling that mathematics is something to be feared. Panic. Feel sick. Fear of mistakes. I just can't help my son with maths.' (parent)

Research has established that mathematics anxiety is recognisable and measurable, defined as
'A feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in ordinary life and academic situations.' (Richardson and Suinn, 1972)
It is important to consider three interlinked areas

- Parents' own anxiety about mathematics
- Parents' anxiety about helping their children
- Children's anxiety and how parents can support them

This presentation explores how parents, children and teachers can work together to reduce mathematics anxiety. Whilst working with National Numeracy, I have conducted nationwide research through focus parents' groups, family learning sessions and surveys to fully understand the causes of the high levels of anxiety. Many have bad past experiences of mathematics and others feel confused by the 'new' methods used in schools. Most ‘do not want their children to be like them’. Reflecting on the feedback received, parents' numerical confidence and negative attitudes around mathematics affects their everyday functionality, but also inadvertently impacts their child's achievement and life chances. How can we support parents to be able to positively help their children? How can everyday activities encourage a positive attitude and enjoyment of maths?

This presentation suggests simple, evidence-based tips and strategies to address all these aspects, aiming to develop confidence, positive attitudes and an 'I can do' mindset. Mathematics anxiety can be overcome!

Friday 1st July 2022 – 13:20 – Room 2
Mentoring and Coaching for mathematical resilience

Coaching for Mathematical Resilience in Cambridge Regional College

Julie Savage with Georgina Norris & Sarah Stokes
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Students with lower average grades attend FE colleges compared to school sixth forms or sixth form colleges, and as a consequence have seen the largest increase in numbers re-sitting GCSE mathematics. According to Rodeiro (2018), this forced re-sit often leads to disengaged, demotivated and anxious learners who struggle to overcome these barriers to learning. Re-sit success rates are low and 60% of students do not improve their grade when they re-sit the exam (Rodeiro, 2018), often leading to a re-sit cycle over the three consecutive years.

After identifying a high proportion of disengaged and demotivated students enrolled on our re-sit maths courses at Cambridge Regional College, we began to research how best to support them. The students' barriers to learning were found to be complex, for example we found that a large proportion of our learners were also displaying signs of mathematics anxiety; that is, "feelings of concern, tension or nervousness that are experienced in combination with mathematics" (Buckley, 2013).

As a result, over the last two years we have piloted a research project at CRC on the impact of coaching on GCSE maths students' motivation, engagement and resilience. This has involved employing Student Engagement Coaches to work closely alongside maths teachers to support our GCSE re-sit students. The role of the coaches is to focus on the emotional needs of the students, the teacher more on the academic needs, providing a holistic approach to ensure that students are equipped with the skills they need to be in the right mindset for learning to take place.

We have developed approaches that have resulted in stronger staff-student relationships, a safer learning environment and more resilient learners, ultimately increasing motivation and engagement and reducing mathematics anxiety in our re-sit students.

Friday 1st July 2022 – 13:50 – Room 1
Working with parents to address mathematics anxiety

New ways of communicating ideas about mathematical resilience to parents

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Parental engagement can have a large, positive impact in general (Desforges & Abouchaar, 2003). However, many parents have had negative and sometimes traumatic experiences of mathematics. Beilock and colleagues (Maloney et al., 2015) found that for mathematics, in some cases, if parents with mathematics anxiety helped their children at home, this had a negative impact on progress. But Goodall, Johnston-Wilder and Russell (2017) show that parental mathematics anxiety can be overcome, leading to a positive experience for parent and child.

During 2020, the country was in lockdown. Parents were called upon to support their children's mathematical learning at home. Wright received, through her role as a Senior Education Improvement Adviser for Solihull, reports that many parents found supporting mathematics very challenging. She therefore developed ways of offering support to parents.

Since 2018, following an opportunistic invitation from Dorset Library Services to give an author talk, as part of their Libraries Week celebration of local authors, Russell gave author talks to parents in libraries about how to help give your child a 'can-do' attitude to mathematics. With the restrictions due to the Covid-19 pandemic, library talks, as public gatherings, were disallowed. However, this opened up another way to reach parents. Russell's recent author talks, based on her latest book (2020) focusing on communicating mathematical resilience ideas to parents, have been given online.

We shall be reporting on the new ways that we have found of communicating ideas about mathematical resilience, which have been positively received and appreciated by parents.

Friday 1st July 2022 – 13:50 – Room 2 [Recorded Poster Presentation]
Mathematical resilience in adult and life-long learning

Why Bother? Identifying the barriers to motivation in resit mathematics

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Compulsory resits for learners who have not attained a Grade 4 GCSE in Maths or English have been in place since 2015 (Department for Business Innovation and Skills, 2014). Despite the mandatory resit programmes, less than 25% of these students achieve their grade 4 in Maths and English by age 19 (Association of Colleges, 2019). Motivation is low in this group of learners (Higton et al, 2017; ETF/CfEM, 2020).

This student voice project aimed to explore the main reasons why students on resit programmes have low motivation and the potential link between student motivation and attendance and participation in resit lessons. A survey was developed and conducted with students currently enrolled on the resit programme within a large FE institution, looking at their prior attainment and educational experiences, as well as their attitude to resit classes. Students also completed the attitude to mathematics scale developed by Tapia (1996) to gain an overall sense of their motivation levels.

Analysis of the results was done with reference to the basic psychological needs described by Ryan and Deci (2020) in self-determination theory, and showed that students understood the value of mathematics and wanted to develop their skills in maths, but felt they lacked the competence to achieve. This also affected students' enjoyment of maths, and could be linked to being in low sets during school.

This study was small scale and while key findings indicate a need for developing a growth mindset and mathematical resilience both in re-sit classes and in earlier schooling, there is also a need for further research.

Saturday 2nd July 2022 – 10:40 – Room 1
Emotional regulation in mathematics teaching and learning

Recognising and Coping with Mathematics Anxiety in Adult Learners

John Morgan
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Many mature students returning to education feel anxious and find mathematics difficult, this is particularly true of Access to higher Education (HE) students who typically leave school with minimal qualifications and in later life return to college for a new start.

Mathematics anxiety is a phenomenon studied for over 60 years (Dowker, Sarkar, & Looi, 2016). It can be defined as “feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in ordinary life and academic situations" (Richardson & Suinn, 1972, p.551). Historically, the focus for such research has been on younger learners. The research reported here is instead concerned with adult student returners, specifically focussing on cohorts of Access to HE students.

Dweck (2007) asserts that if students realise that mathematics anxiety is ‘normal’ and widely accepted as a debilitating state; then they will be that much more able to challenge and address their negative feelings in pursuit of mathematics proficiency. A broad research programme has been undertaken into potential interventions building on this assertion, with the aim to help mature students more easily engage with the learning of mathematics, as follows:

Firstly, the extent to which mathematical anxiety exists in the Access students was investigated using the Mathematics Anxiety Survey (MAS, Betz, 1978). Secondly, using action research, an intervention was conducted in the form of a short presentation to help students understand why they feel anxious and to introduce strategies to overcome such feelings. The differences in student feelings of mathematics anxiety prior to and following the presentation were encouraging.

The research has found significant numbers of students (>80%), do have mathematics anxiety at course entry. The research has revealed that with appropriate intervention and motivation, it is possible to reduce anxiety levels in mathematics. This research is likely to be of importance as students take their place as confident, competent, problem-solving health professionals.

Saturday 2nd July 2022 – 10:40 – Room 2
Information technology, media and mathematics resilience

Maths ACTive:
Mastering Mathematics with Psychological Flexibility

Ben Sinclair
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A rich understanding of *Mathematics anxiety* (MA) has resulted from the necessarily varied repertoire of approaches by which it has been historically studied. Whilst rarely stated explicitly, much of the research undertaken has taken a pathological view of MA – an assumption that abnormal processes are at its root. 'Causes' and 'symptoms' are sought; 'courses' of development are tracked across time and location; and 'treatments' are devised and tested for efficacy. However, coherence across all three ventures is rare. Conversely, *mathematical resilience* (MR) offers a positive and practical approach to addressing MA through the identification and promotion of the adaptive processes that allow learners to thrive in mathematics.

In order to unify these efforts, a new conceptualisation of MA and MR is proposed that is based upon the assumption that both of these constructs result from the same 'normal' psychological processes. *Psychological flexibility* is a functional and empirically grounded model that delineates six dynamic processes and behaviours and, under the pillars of *openness*, *engagement*, and *action*, is the goal of Acceptance and Commitment Training (ACTr). Adopting this framework opens up a wealth of evidence-based approaches and techniques that support learners in working *with* their anxieties to become more mathematically resilient. An online mathematics mastery course for teenagers, *Maths ACTive*, has been designed to determine if such an approach is indeed as fruitful as previous research suggests. This presentation will first explore the new model before explaining the process and challenges of adapting ACTr for use with the secondary mathematics students in an online medium.

Saturday 2nd July 2022 – 11:10 – Room 1
Emotional regulation in mathematics teaching and learning

Remembered Trauma – The Origins of Mathematics Anxiety

Clare Lee
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This talk is about relationships in education and the life-long detrimental effect that a breakdown in the relationships in the mathematics classroom can have on learners. In this talk, I will present data from the point of view of adult learners looking back at their experiences of mathematics at school. I discuss the many ways that educational relationships can be ruptured. It is not wholly negative; relationships can be repaired and the adult learners whose traumatic experiences in learning mathematics are reported here also show that when that repair is taken seriously, they can and do succeed.

The teachers' actions reported in the study are remembered as having had a negative effect, sometimes even a devastating and traumatic effect, which has limited the participants' lives, careers and the decisions they have made for themselves. Therefore, this data is important, and the intention is to allow the participants' voices to be heard so that those charged with enabling the learning of mathematics can understand the effect certain actions may have on learners. It makes uncomfortable reading, and we hope that it enables those who teach learners of any age, and those who are charged with devising the educational systems within which those teachers work, question how and why the participants in this study could have interpreted and reported their experiences in the way that they do and whether the system currently encourages actions, when teaching, which could also be remembered in this way in the future.

Saturday 2nd July 2022 – 11:10 – Room 2
Information technology, media and mathematics resilience

Cameras on, Augmented Reality app in hand and let's learn outside the box!

Maria Fakih
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The global pandemic has changed the mode of delivering lessons. Adult learners have missed and continue to miss the hands-on learning activity, which is a form of experiential learning (Kolb, 1984). When it comes to teaching three dimensional, geometric shapes (3D), learners often benefit from handling and manipulating concrete shapes (Bruner, 1966) and having learning materials accessible is a key ingredient in building resilience. This study examined the use of an Augmented Reality (AR) mobile application, as a learning tool for geometric shapes in virtual mathematics classrooms.

Data were collected from 30 learners at Functional Skills levels and GCSE in a Further Education college in Birmingham, UK. Learners were divided into Control and Experimental groups. The Control group used traditional learning materials, while in the Experimental group, an AR application was utilised during lessons. Qualitative data was gathered using mixed methods of one-to-one interviews and questionnaires to evaluate the learners' experience. The data was triangulated with observation and note-taking by the teacher. Results showed an increased curiosity, improved activity and interactivity within the session, contributing to more efficient understanding of the 3D shapes topic, when compared to the traditional, passive teaching and learning strategies used. From the results of this study, we can deduce that AR-based tools are a beneficial resource in teaching mathematics and improving learner experience in virtual classrooms. Further studies are required to evaluate quantitative improvements in student performance, as well as to implement AR as a regular teaching strategy.

Keeping learners in the growth zone is supported by creativity and conjuring a sense of curiosity and exploration.

Saturday 2nd July 2022 – 11:50 – Room 1
Emotional regulation in mathematics teaching and learning

The role of autonomy and emotional awareness in managing mathematics anxiety

Janet Baker
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Mathematics anxiety affects a large proportion of the population, limits learning and performance and impacts career development. However it is not a life sentence and can be managed to minimise its effect. The research reported in this presentation aimed to support learners to manage their mathematics anxiety by encouraging them to develop their autonomy and emotional awareness. The Growth Zone Model proposed by Johnston-Wilder and Lee to build mathematical resilience was an integral part of the intervention. A comprehensive school in a Midlands town provided a year 7 cohort, who completed an adapted version of the Betz Mathematics Anxiety Scale. This indicated that levels of mathematics anxiety were high in the group. Learners with the highest levels of mathematics anxiety were offered one-to-one sessions outside the classroom but within the school day, and 13 learners accepted.

Using a Design-Based Research approach to improve this intervention, the sessions aimed to develop autonomy and awareness of emotions before encouraging the learners to proactively manage their emotions. The results from this small group of learners indicated that the introduced strategies were effective in managing mathematics anxiety and building resilience, to the extent that learners made more progress than expected with their mathematical learning. The research supported the contention that autonomy and emotional awareness are of fundamental importance in building mathematical resilience.

Saturday 2nd July 2022 – 11:50 – Room 2
Mentoring and Coaching for mathematical resilience

Making mentoring transformational through co-teaching: a case study in the FE sector

Sheraz Ahmad
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Enhancing students' experience in a maths classroom by improving instructional quality (Hattie, 2011) in the FE sector has been an ongoing challenge for years. Although mentoring has contributed quite considerably to developing teachers' competence in the delivery of innovative and engaging maths lessons, looking at mentoring from a different perspective requires and deserves our immediate attention. Using a case study 'in naturally occurring social situations', this research explores 'in considerable depth' (Domm et al., 2000 cited in Bassey 2003) how mentoring can prove even more constructive, efficacious and transformational through co-teaching and building a higher level of trust with mentees. Brookfield's critical incidents (1995) along with Hobson's ONSIDE mentoring model (2016) provide the theoretical framework for this innovative study which aims to change minds and practices by changing habits.

Furthermore, a novel model of mentoring (mentoring through co-teaching – MTCT) is presented and investigated in order to further explore mentoring in the moment (Thompson and Schademan, 2019). It is hoped that this model will support mentees to actively reflect on their practices (Schon, 1987) and help them become more resilient teachers (Day and Gu, 2013) and skilled practitioners of maths through mentoring in action. As a result of this, they will be able to be better equipped to develop mathematical resilience in their learners, especially in the post-Covid era. Rich and ample qualitative data in the form of a structured interview with the participant, observation reports and students' voice is analysed to determine the impact of this study and future recommendations are made in an attempt to further improve teaching, learning and assessment of maths in the FE sector.

Saturday 2nd July 2022 – 12:20 – Room 1
Emotional regulation in mathematics teaching and learning

Designing an app to track mathematics anxiety

Janet Baker; Katie Baker; Jack Fletcher
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The efficacy of the Growth Zone Model proposed by Johnston-Wilder and Lee in 2010 in supporting learners with mathematics anxiety and building mathematical resilience has been well documented. The presenters developed an app to both enable learners to access the Growth Zone Model and enable teachers to track and respond to the emotional responses of their learners to mathematical activities.

The first version of the app was developed and trialled with 13 year 7 pupils in a comprehensive school in a Midlands town using a Design-Based Research approach. Whilst the app was not suitable for classroom use in this particular school, it proved to be an effective tool for one-to-one support in terms of prompting learner descriptions of experiences and tracking progress in growth zone development.

A second, more robust, version of the app has now been developed and feedback from practitioners is sought. This workshop will include a practical element where participants will have the opportunity to use the app and give feedback to the developers with a view to improving the functionality and affordances of the app. Ongoing access to the beta version of the app will be provided to participants.

Saturday 2nd July 2022 – 12:20 – Room 2
Emotional regulation in mathematics teaching and learning

Words helping numbers: Using writing to mediate anxiety in mathematics learners

Ellie Willard
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Mathematics anxiety is a potential barrier to health service staff being able to deliver treatments safely. Nursing students are required to demonstrate their mathematical competency (and drug calculation capability) by completing a Safe Medicate exam each year. Teaching staff identified that levels of anxiety prior to the exam were problematic and they wished to explore interventions that may help reduce anxiety felt by students.

The presentation will consider the effects of a writing task used immediately prior to the Safe Medicate mock exam to reduce mathematics anxiety. This is following published research demonstrating the reduction of mathematics anxiety using expressive writing in many contexts (Ramirez and Beilock, 2011., Park et al, 2014).

Initially, the researchers established baseline mathematics anxiety using the 14 item Mathematics Anxiety Scale-Revised (Bai et al, 2009) with a student nurse population at a University in the North of England. Secondly, in two randomised groups, we explored the effectiveness of an expressive writing intervention and a control task (neutral writing task) on mathematics anxiety and scores on a mock medication calculation exam. A selection of the expressive writing was also analysed to identify themes regarding feelings prior to the mock exam.

The preliminary findings from the research will be presented at the conference and the implications for further research and mathematics anxiety in health service staff will be discussed.

Saturday 2nd July 2022 – 13:20 – Room 1
Mathematical resilience in adult and life-long learning

People are afraid of looking incompetent: How can we stop fear of mathematics from holding us back?

Building resilient learners in further education– research in andragogy of teaching mathematics

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Mathematics anxiety is a prevalent problem, and the scholarly literature demonstrates that mathematics anxiety has significant consequences in mathematics learning for both individuals and wider society (Maloney and Beilock, 2012). The related literature discusses underlying concepts, such as self-efficacy and emotional regulation. However, to date, there has been less work on simple, comprehensive, practical approaches available to teachers, support staff, carers and learners to address this and overcome emotional barriers to learning mathematics. One exception to this is a mathematical resilience toolkit proposed by Johnston-Wilder et al. (2020).

In this paper, the research underpinning the mathematical resilience toolkit is reviewed, the notion of psychological safety introduced and the results of a small-scale study using the toolkit with eight mature GCSE mathematics learners in a further education college are presented and evaluated. In this exploratory mixed-methods study, data are collected from questionnaires and interviews, and analysed using non-parametric data tests and thematic analysis. Mathematics anxiety and resilience were assessed using a 2-part questionnaire, the Betz (1978) Mathematics Anxiety Scale and the Mathematical Resilience Scale (MRS) (Kooken et al., 2013).

The results demonstrate that 5 of the 8 participants reported significantly reduced levels of stress and increased levels of resilience in learning mathematics. The key themes that emerged highlight the importance of addressing emotional aspects of learning mathematics in the classroom. All participants have rated the Mathematical Resilience Toolkit as ‘extremely useful’ and would advise it as a practical strategy to anyone having anxiety in mathematics learning. This approach warrants further research to properly establish its efficacy in different contexts.

Saturday 2nd July 2022 – 13:20 – Room 2
Information technology, media and mathematics resilience

Teaching Newton's Binomial using ICT environment and STEM approach - a strategy to enhance mathematical resilience

Telma Pará; Mourad, A.; Dantas, S.
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Backgrounds: COVID-19 has drastically transformed the teaching and learning process, forcing the educational system to shift from traditional face-to-face learning to online learning. During this period, technology was crucial to making mathematics education possible as it is an essential tool for social development and global competitiveness. Combinatorial Analysis in Basic and Higher Education has proved to be a great challenge, both from the point of view of teaching and learning. This subject tends to be explored in a mechanized way, with memorization of formulas and calculations that do not contribute to the construction of combinatorial reasoning (Sabo, 2017). This work aims to create a Didactic Sequence (DS) using the ICT environment to enhance Mathematical Resilience, which is defined as "a learner's stance towards mathematics that enables pupils to continue learning despite finding setbacks and challenges in their mathematical learning journey" (Johnston-Wilder, 2018). The activity is interdisciplinary, contextualized. The DS took a STEM approach (Science, Technology, Engineering and Mathematics), to present the content of Newton's Binomial in line with the concepts of Genetics.

Methods: The DS is divided into two moments, which are summarized in two distinct and complementary activities, both produced through Google Forms, called "Expanding Genetics" and "Binomial's fault". The first activity contains questions, GIFs (Graphics Interchange Format) and videos to build the students' knowledge. In this experience, we let the students try many possibilities in a non-supervised environment that allows them to try different solutions – promoting students' autonomy – so that they can develop a mindset for mathematical resilience. By changing the usual teaching methodology, we are fostering creative, investigative thinking and problem solving. We don't want students to memorize formulas but learn to reflect on how they are formed and how they are expanded. The second form intends to verify the students' learning, more formally, through four questions about the content presented. Both activities are designed in a student-centred learning environment, with more active participation, rescuing the idea that mathematics is a valuable subject and is worth studying.

Results: Collected notes from Google Forms were analysed, and this brief study brought greater access to combinatorics concepts, increased engagement, and interest in the learning of mathematics.

Conclusions: It shows the potential that this type of intervention contributes to strengthening mathematical resilience in students.

Saturday 2nd July 2022 – 13:50 – Room 1
Educational leadership in embedding mathematical resilience

Limiting the impact of mathematics anxiety on secondary school learners: practitioner research in a selective boys'school

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Equipping otherwise highly academically able students with the tools needed to limit the impact of mathematics anxiety (MA) on their progress and attainment is not always considered to be as important as developing sound pedagogy needed to deliver a crowded mathematics curriculum. Given that MA is a common experience for a significant proportion of learners in secondary school settings, enabling young people to gain agency over negative emotional experiences in their learning in mathematics should be considered in terms of well-being and safeguarding.

This report describes the progress of a large-scale practitioner research project across all year groups in a selective boys' school, with a mixed sixth form, where all students are expected to study mathematics to age 18 as part of the International Baccalaureate Diploma Programme. All students in the school were invited to complete an online questionnaire based on the Betz MA scale: 750 responses spread over year groups 7-13 indicated that MA was a common experience for many. Following in-school Continuing Professional Development (CPD) which introduced mathematics department staff to mathematical resilience, a simple intervention was introduced by all teachers within the mathematics department and its efficacy investigated with a repeat of the Betz questionnaire in years 10 and 13. I describe the project and how the results of the follow-up survey informed the final stage. I also discuss the challenges I faced as a head of department and part-time doctoral student in developing an already effective department's practice.

Saturday 2nd July 2022 – 13:50 – Room 1
Mathematical resilience in adult and life-long learning

A qualitative investigation of the background determinants of apprehensions in FE resit mathematics learners

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The UK's future progress in advanced fields of research and technology demands good mathematical skills. However, around half of the young generation at school leaving age do not gain a grade of 4 or above in a GCSE examination, and three quarters join Further Education (FE) colleges (Russell, 2014). Policy reforms since 2014 constrained learners without Mathematics qualifications to resit compulsory Mathematics until they achieve or reach the age of 19. At FE colleges, most resit Mathematics learners feel like failures, demotivated, less engaged, and apprehensive (Lupton et al., 2020).

This study has taken Mathematics apprehensions as a psychological state of anxiety, unnecessary fears of failure, misperception, and frustration while dealing with mathematics problems in FE resit lessons. This investigation emphasised background determinants of apprehensions in FE resit mathematics learners in order to gain a better understanding of the situation and highlight key areas that may improve the situation.

I used a qualitative cross-sectional design to gain an intersubjective understanding of learners' behaviours and learning barriers from their perspectives and experiences. I selected 16 participants from FE college resit Mathematics classes and organised three focus group interviews. Additionally, I interviewed 7 Mathematics teachers from FE colleges and different secondary schools to further develop a deeper understanding of the learners' past Mathematics experiences.

Implicit theories in understanding learners' responses identified learners holding more entity beliefs than incremental beliefs. Data analysis revealed the emerging determinants of apprehensions in FE resit mathematics learners are linked with their experience with Mathematics because their psychological needs were not met. Most of the participating learners lost hope, and their behaviour was justified to protect themselves from another failure by avoiding the situation.