

4TH INTERNATIONAL CONFERENCE ON OPPORTUNITIES AND CHALLENGES OF BUILDING MATHEMATICAL RESILIENCE



At The University of Warwick
and simultaneously online

6th JULY 2024
9:00 – 16:00 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. The conference will offer an innovative and friendly environment for participants to showcase and discuss their research or emerging practice.

The day will include the launch of the forthcoming Mathematical Resilience Book. The doors will open at 9am and the conference will run 9.30-16.00.

Register here: [4th Mathematical Resilience Conference](#)

6th July 2024

9:30 Opening Remarks
Sue Johnston-Wilder & Clare Lee

9:45 Book Review
Dave Bowman

10:15 Book Author Talk
Telma Para

10:45 Break

Room 1

11:00 Morning Session
5 presentations – 20 mins each

12:40 Lunch + Networking

13:20 Afternoon Session 1
3 presentations – 20 mins each

14:20 Break

14:30 Afternoon Session 2
3 presentations - 20 min each

Room 2

11:00 Morning Session
5 presentations – 20 mins each

12:40 Lunch + Networking

13:20 Afternoon Session 1
3 presentations – 20 mins each

14:20 Break

14:30 Afternoon Session 2
3 presentations - 20 min each

15:30 Final Session
Meet the book authors and final Q&A



KEYNOTE SPEAKERS

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.

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.

Dr Clare Lee
The Open University, UK





KEYNOTE SPEAKERS

Dave Bowman, a former software industry executive with a background in Mathematics and Theoretical Physics, transitioned to teaching mathematics. His passion for encouraging students to study maths led to the creation of the “YesUCan” message. This culture emphasizes belief, hard work, and brain plasticity as key components of success. Jo Boaler recognized his contributions to improving maths education in England. Dave’s retirement hasn’t stopped him from inspiring teachers and promoting the idea that everyone can improve their understanding of mathematics. The conference aims to reinforce this message alongside the Mathematical Resilience community.

Dave Bowman

YesUCan, UK



Dr Pará holds a Ph.D. in Systems Engineering and Computer Science from the Federal University of Rio de Janeiro (with a period at Institut Joseph Fourier, France). She is currently a researcher and IT teacher at FAETEC-RJ (Support Foundation for Technical Schools in Rio de Janeiro, Brazil) where she has worked on many aspects of mathematics education, with a focus on the teaching and learning of mathematics within the reality of the inclusion of students, the popularisation of mathematics and the management of learning difficulties in mathematics. Her main research areas are Mathematics Education, Teaching Methods, STEM/STEAM Education, Teaching and Learning of Discrete Mathematics, Mathematics Anxiety (MA) and Mathematical Resilience (MR).

Dr. Telma Pará

Support Foundation for Technical Schools in Rio de Janeiro, Brazil





KEYNOTE SPEAKERS

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. Deputy coordinator of the Psychology of Mathematics Education working group of the National Association for Research and Postgraduate Studies in Psychology.

Conference Organising Committee

Masha Apostolidu
Janet Baker
Farhana Gokhool
Aïcha Hadji-Sonni
Holly Heshmati
Sue Johnston-Wilder

Clare Lee
Karina Lumena
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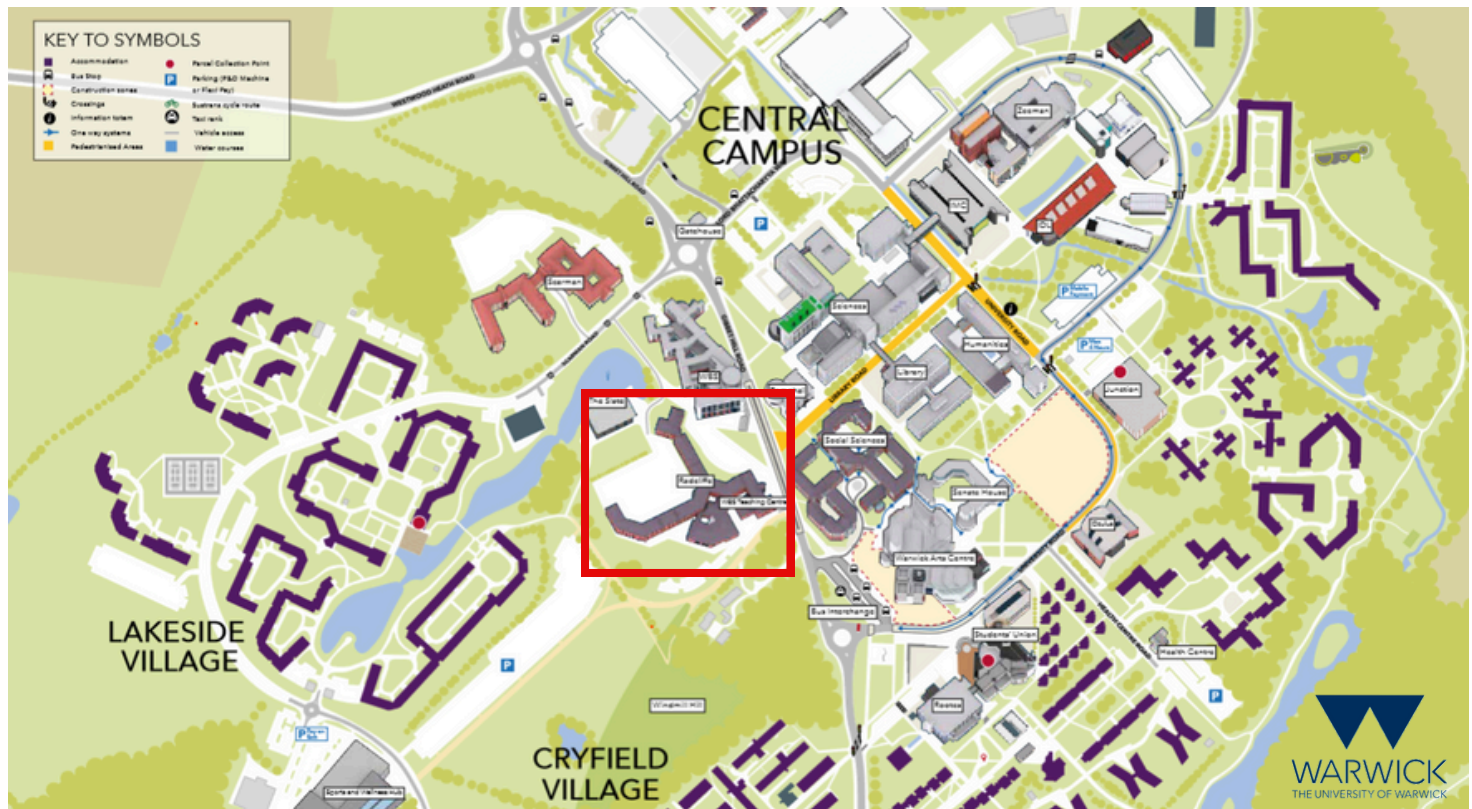
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Saturday 6th JULY

9:30-9.15	ROOM 1: Opening word Associate Professor Sue Johnston-Wilder & Dr Clare Lee 
9:45-10.15	ROOM 1: Book review from teacher-reader perspective Dave Bowman, YesUCan 
10.15 – 10.45	ROOM 1: Book review from the co-authors' perspective Dr. Telma Para 

	ROOM 1	ROOM 2
Morning Session	Opportunities and challenges when addressing mathematics anxiety in school age learners	Opportunities and challenges when addressing mathematics anxiety in school age learners
11:00	The impact of an intervention program on reducing maths anxiety among elementary school students in Brazil João dos Santos Carmo et al.	Exploring Teacher-Learner Partnerships to Enhance Maths Resilience in Learners with Math Anxiety: A Teacher's Perspective Mariam Siddiqa Rashid
11:20	Measuring Mathematics anxiety and mathematical resilience Aicha Hadji-Sonni	How can the learning relationships that work to develop Mathematical Resilience in mathematics classroom be characterised? Clare Lee
11:40	Exploring Mathematics Anxiety and Mindset in Secondary School Pupils Josie Foster, Ellen Marshall, Alexandra Shukie	From Mathematics Anxiety to Mastery: A Tenth Grader's Journey with the Growth Zone Model in Mathematics and Physical Sciences Sakiwaa Boetang
12:00	The Effects of MR Based Math Anxiety Intervention Program on Turkish Secondary Students' Mathematics Anxiety and Mathematical Resilience Levels Abdulvahap Yorgun et al.	Developing resilience – a case study on the challenges involved in leading meaningful change in a highly academic secondary school John Thomas
12:20	Numbers without borders: A comparative study of mathematics anxiety and its predictive factors Thomas E. Hunt et al.	The Relevance of a Healthy Environment in building Mathematical Resilience  Camila Nagem et al.
	12:40 - 13:20	LUNCH BREAK

Afternoon Session 1	Focus on opportunities and challenges in FE	Opportunities and challenges when focusing on adults
13:20	Exploring Project Based Learning to develop mathematical resilience of ESOL learners Sheraz Ahmad	Performing 1-1 interventions to address Mathematics Anxiety – an intervention case study of 3 Brazilian women who believed they were stupid in mathematics Karina Lumena Alves et al.
13:40	Maths Resilience in Further Education: The Role of Self-Efficacy and Teacher Perceptions Masha Apostolidu	Reducing anxiety and increasing confidence through statistics support Ellen Marshall et al.
14.20	Empowering our maths' resit students in the Exam Hall – a case study Valeria Panyko & Masha Apostolidu	Building Mathematical Resilience Through Parents Mercy Kerubo Nyakundi

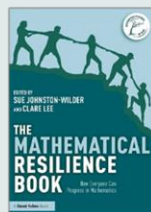
14:20- 14:30 BREAK

Afternoon Session 2	Opportunities and challenges when building resilience in student teachers	Opportunities and challenges when building Mathematical Resilience
14:30	Mathematics anxiety: foundation phase student teachers' experience Folake Modupe Adelabu	A review of research and teaching strategies on Mathematical Resilience Rachel Kangethe
14:50	Anxiety and Resilience Among Undergraduate Chemistry Education Students Royda Kampamba	Exploring Mathematical Resilience as a Coping Mechanism for Anxiety in Statistics among Kenyan Postgraduate Students Monica A. Agunda
15.10	Reflective Writing: Transforming Mathematics Teaching through Insights into Student Difficulties Maria Ryan	Building Mathematical Resilience using emotional self-control strategies and STEAM approach Telma Silveira Pará et al.

ROOM 1:

15:30 – 16.00

Final session: Meet the Book Authors & Final Q&A



ONLINE



BOOK OF ABSTRACTS

4th International Conference

Opportunities and Challenges of
Building Mathematical Resilience



At the University of Warwick
Synchronously Online

6th July 2024
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*Saturday 6th July 2024 – 14:30 – Room 1
Building resilience in student teachers*

Mathematics anxiety: foundation phase student teachers' experience

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This study aims to ascertain the level of mathematics anxiety among student teachers in the foundation phase. *Quantitative* research methodology was applied in this study. A closed-ended questionnaire is used to gather data for the study. In the study, 45 student mathematics teachers participated in the foundation phase. The sample for the investigation was chosen using purposeful sampling. Self-determination theory posits three universal needs which must be met for people to function effectively: Autonomy, Relatedness, and Competence. These three concepts are the theoretical basis for this study as they are particularly relevant in understanding and addressing mathematics anxiety and in helping students to develop mathematical resilience. According to the study's findings, many students worry about making mistakes when practising mathematics, and half of the respondents constantly worry that they do not know enough mathematics to succeed in subsequent mathematics classes. Furthermore, half of the respondents become tense and anxious when preparing for and writing a mathematics exam. However, many people still think they can excel in mathematics.

These findings demonstrated that student teachers have various degrees of mathematics anxiety, which affects their performance in, and poses obstacles to, studying mathematics. As a result, the study recommends introducing a maths intervention, such as GEOGEBRA or MATLAB software, which can assist and inspire the students to learn mathematics. This software is designed to be a precursor to developing resilience, thereby addressing the specific challenges of mathematics anxiety among student teachers.

Keywords: Mathematics anxiety, Mathematics performance, Foundation phase Student teachers

Saturday 6th July 2024 – 14:50 – Room 2
Building resilience in student teachers

Exploring Mathematical Resilience as a Coping Mechanism for Anxiety in Statistics among Kenyan Postgraduate Students

Monica A. Agunda (online)
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This study investigates the role of mathematical resilience in mitigating anxiety associated with statistics among Kenyan postgraduate students. The research addresses the pressing need to understand how students cope with the challenges of statistical learning in the context of higher education. A mixed-methods approach is employed to gather both quantitative and qualitative data. The sample consists of Kenyan postgraduate students enrolled in various academic programs across different universities. The study begins by assessing the level of anxiety experienced by Kenyan postgraduate students when dealing with statistics. Quantitative surveys and standardised anxiety measurement scales are utilised for this purpose. The relationship between mathematical resilience and the ability to cope with anxiety in statistics is examined. Qualitative interviews and focus group discussions provide insights into the strategies employed by students to overcome statistical anxiety. The research identifies factors contributing to mathematical resilience among Kenyan postgraduate students. These factors include academic support systems, self-efficacy beliefs, and previous mathematical experiences. Strategies and interventions that promote mathematical resilience and reduce anxiety in statistics are explored. Practical recommendations are provided for educational institutions and policymakers to enhance support mechanisms for students grappling with statistical anxiety. The findings of this study contribute to the existing literature on student well-being and academic performance in higher education. By understanding the role of mathematical resilience in coping with statistical anxiety, educators and policymakers can design more effective interventions to support the mental health and academic success of Kenyan postgraduate students.

Keywords: Mathematical Resilience, Statistical learning, Higher education, Postgraduate students

*Saturday 6th July 2024 – 13.20 – Room 1
Building resilience in FE*

Exploring Project Based Learning to develop mathematical resilience of ESOL learners

Sheraz Ahmad
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Every maths teacher intends to make a conscious effort to ensure that their learners develop key mathematical skills as well as use these skills to solve real life problems. An efficient and competent mathematics teacher would aim to deliver learner centred lessons using authentic tasks. Project Based Learning (PBL) can provide teachers with opportunities to deliver lessons which will enhance learners' self efficacy and hence develop their mathematical resilience. The objective of this paper is to explore the benefits of PBL in the context of ESOL. It will enquire into how PBL can enhance learners' wider skills, in particular their mathematical skills. The paper will attempt to investigate whether developing mathematical and wider skills of ESOL learners in a further education college can help them become more mathematically resilient by strengthening their self-efficacy and self-confidence. A detailed description of the project with stages and learning outcomes is discussed so that other practitioners can also benefit from it. An ample amount of qualitative as well as quantitative data – pre and post diagnostic assessments; peer and self-evaluation; feedback from the audience; group and individual semi-structured interviews and video recordings of the presentations – is analysed to determine whether PBL contributes to growth of mathematical and wider skills of ESOL learners leading to an increased level of self-efficacy which, as a result, supports learners to develop mathematical resilience.

Keywords: Project Based Learning (PBL); ESOL; Further Education; Mathematical resilience; Wider skills

Maths Resilience in Further Education: The Role of Self-Efficacy and Teacher Perceptions

Masha Apostolidu
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This study delves into the pivotal role of mathematics self-efficacy in fostering mathematical resilience among Further Education (FE) students in the UK. It examines the interplay between individual characteristics, such as mathematical self-concept and self-regulation, and the students' perceptions of past and present mathematics teachers' support.

Recent policy mandates that FE students who have not previously attained a Level 2 qualification must now pursue a GCSE or Functional Skills Level 2 in maths. This study investigates the impact of mathematics related attitudes, particularly self-efficacy and anxiety, on FE students' mathematical achievement. It evidences the need to explore the combined effects of students' perceptions of their past and present maths teachers, alongside individual characteristics, on their mathematics related self-efficacy and anxiety. This research is informed by previous studies that emphasise the complex interplay of individual and social variables in mathematical learning contexts.

Data for an exploratory correlational study is being collected via an online survey on the Qualtrics platform, with subsequent analysis through hierarchical multiple regression using SPSS. The study is designed to shed light on how students' perceptions of their mathematics teachers correlate with their self-assessment of their mathematics ability and their level of anxiety. Furthermore, the outcomes of this study will enhance knowledge of how self-efficacy relates to mathematical resilience. Understanding the dynamics between the perceptions of present and past mathematics teachers will be instrumental in developing targeted interventions to build mathematical resilience. Such interventions could potentially transform the educational landscape by empowering students to overcome challenges and achieve success in mathematics.

Keywords: Mathematical Resilience, Mathematics self-efficacy, Mathematical self-concept, Further Education

Performing 1-1 interventions to address Mathematics Anxiety – an intervention case study of 3 Brazilian women who believed they were stupid in mathematics

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Education Studie³, University of Warwick³, Coventry, United Kingdom
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Mathematics Anxiety is well-researched, but solutions are few. This study introduces an intervention based on the Mathematical Resilience Toolkit (MRT) developed by Baker (2021). This intervention involves 1:1 sessions where participants share their mathematics learning experiences, learn about the MRT, and reframe past negative experiences as unrelated to intrinsic ability. The toolkit includes three tools: the hand model of the brain, the growth zone model, and the relaxation response. The study sought to answer the following research questions: In what ways did the Mathematical Resilience Toolkit affect the participants? The interventions involved Brazilian volunteers living in England from local and virtual communities. Levels of mathematics anxiety were measured before the intervention using the Betz (1978) scale, and narrative records were made. Participants with moderate and high mathematics anxiety were recruited. The qualitative data were analysed using deductive thematic analysis and the Mathematical Resilience Framework. The data indicated a positive impact of the intervention. At the end of the intervention, all the participants reported new perspectives about themselves in relation to mathematics. The study adds the evidence that all mathematics learners and adults with mathematics anxiety would benefit from learning about the Mathematical Resilience toolkit. The study reveals the potential that this intervention has to re-engage learners with mathematics difficulties or anxiety.

Keywords: Mathematics anxiety, Mathematical resilience, Growth zone model, Mathematics education

From Maths Anxiety to Mastery: A Tenth Grader's Journey with the Growth Zone Model in Mathematics and Physical Sciences

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In the South African education system, the transition from ninth to tenth grade is a pivotal moment where learners make choices that significantly influence their academic trajectories. However, many ninth graders are apprehensive and anxious about continuing with mathematics and physical science subjects in the tenth grade. This study delves into the anxieties of a tenth-grade learner regarding mathematics and physical science, investigating her journey from anxious maths/science learner to building resilience. The study is part of a longitudinal action research project in which two maths and science teachers in one school underwent training to use the growth zone model (GZM) for one academic term. The study included semi-structured interviews and classroom observations to gather data. It reveals several complex factors, such as a fear of academic failure and lack of interest, that contribute to learners' lack of resilience by analysing the narrative accounts of one learner. The account reveals the learner's initial difficulty in understanding basic concepts in maths and science, which progressively worsened over time; by the time she entered tenth grade, maths and physical science had become a source of fear and uncertainty for her. However, once her teachers used the GZM intervention, she adopted it and began managing her anxiety. The GZM equipped her to remain calm and build confidence in these subjects. Hence, the study suggests that teachers and policymakers address the root causes of learners' fears and implement comprehensive coping strategies to help learners build resilience in maths and physical sciences.

Keywords: Anxiety, mathematics, Ninth graders, Physical sciences, Resilience, Tenth graders

The impact of an intervention program on reducing mathematics anxiety among elementary school students in Brazil

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Mathematics anxiety is a phenomenon that involves negative emotional reactions in situations that require the use of mathematics. This study investigated the reduction of mathematics anxiety (MA) after an intervention program applied to students in Elementary School. A total of 44 6th-grade students completed a Mathematical Anxiety Scale (MathAS). Of those students, thirteen were identified with high MA and four with extreme MA. Two students agreed to participate in the program (P1 with high and P2 with extreme MA). The intervention program consisted of 10 weekly sessions, with an average duration of 45 minutes each. Sessions were conducted in the school setting and included techniques for emotional self-regulation, shaping of study habits and social skills. To assess some of the program effects, participants responded questionnaires about study habits, before and after intervention. In order to evaluate maintenance of results, a follow-up was conducted two months after the intervention ended. Participants responded to MathAS and study habits questionnaires. Post-test results showed an important reduction in MA among participants (P1 from high to low MA; P2 from extreme to moderate MA). Furthermore, on follow-up both students showed low MA. There was a notable improvement in attitudes toward mathematics among participants, as measured by the questionnaires and interviews with the participants' teacher and parents. These findings suggest that educational interventions combining emotional regulation and shaping of study habits can be effective both to reduce mathematics anxiety, and to changing attitudes toward mathematics, and building resilience patterns.

Keywords: Mathematical Resilience, Mathematics Anxiety, Aid Program, Building Resilience, Elementary Schoolers.

¹ The first author was supported by the Coordination for Higher Education Staff Development (CAPES), Brazil, through a master's scholarship in Psychology.

Saturday 6th July 2024 – 11:40 – Room 1
Addressing Maths Anxiety in School Age Learners

Exploring Maths Anxiety and Mindset in Secondary School Pupils

Josie Foster, Ellen Marshall, Alexandra Shukie
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A growth mindset is the belief that abilities and intelligence can be developed through dedication and hard work, while a fixed mindset is the belief that abilities and intelligence are static traits that cannot be changed. A fixed mindset in mathematics is relatively common and likely associated with mathematics anxiety. Previous research has suggested that both mathematics anxiety and a fixed mindset can have a detrimental impact on academic performance although this is likely to be through their impact on learning behaviour and attitudes.

This study aims to identify levels of mathematics anxiety and growth/fixed mindset in a UK secondary school, focusing on identifying particular groups and examining relationships with academic measures. A carefully designed questionnaire yielded over 800 responses from one school in the UK. We investigated the relationships between mindset levels, students' attitudes towards mathematics, their predicted grades, and the likelihood of pursuing A-level mathematics. By identifying students more affected by mathematics anxiety and lower levels of growth mindset, we suggest possible targeted interventions to help develop a growth mindset. There is evidence that such activities create a sense of belief in ability, help control emotions, decrease maths anxiety and improve mathematical resilience.

Keywords: Mathematics anxiety, Growth mindset, Mathematical resilience

Measuring Mathematics anxiety and mathematical resilience A comparative study amongst 10 to 15 year-old-learners in disadvantaged areas in France

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This study focuses on developing mathematical resilience (MR) while addressing mathematics anxiety (MA). As a mathematics teacher working in disadvantaged areas of France, I observed a lack of MR and the symptoms of MA. International studies also pointed to high levels of MA and poor mathematics performance in French schools. I report on a large-scale survey to measure both MA and MR amongst 10 to 15 year-old learners. I used a 20-item questionnaire, including the Mathematics Anxiety Scale (MAS) by Betz (1978) to measure mathematics anxiety and a Short Mathematical Resilience Scale (SMRS) of 10 items to measure mathematical resilience. The SMRS explored mathematical resilience, including attitudes towards using mistakes as feedback, as well as coping skills, and self-efficacy. The survey involved 1,902 learners aged 10-15.

The findings suggest mathematics anxiety and mathematical resilience seem to relate to both gender and age. Approximately one-quarter of the participants reported high levels of mathematics anxiety, and half of the final-year girls reported having self-inefficacy thoughts when facing mathematical difficulties. Mathematics anxiety and mathematical resilience were found to be negatively correlated. Emotion-focused coping skills were found to be a good predictor of mathematical resilience. This study confirms the rationale for using the three tools for developing mathematical resilience while addressing mathematics anxiety.

The findings of this research have significant implications for understanding MR, it highlights the pivotal role of the affective domain which should be included in teacher training for a more inclusive and effective education system, especially in France.

Keywords: Mathematics anxiety, Mathematical resilience, Mathematical resilience scale, Inclusive education

Numbers without borders:

A comparative study of mathematics anxiety and its predictive factors

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School of Psychology, University of Derby, Derby, U.K.¹; Federal University of Sergipe, Brazil²; Faculty of Medicine and Health Sciences, University of Nottingham, U.K.³; Center for Infectious Disease Education and Research, Osaka University, Suita City, Osaka 565-0871, Japan⁴; Faculty of Education, Nevşehir Hacı Bektaş Veli University, Nevşehir, Türkiye⁵; Department of Counseling, Faculty of Education and Psychology, University of Isfahan, Iran⁶; Department of Psychology, COMSATS University, Islamabad, Lahore Campus, Pakistan⁷; Mbarara University of Science and Technology, Mbarara, Uganda⁸; Department of Computing, Mathematics and Electronics, "1 Decembrie 1918" University of Alba Iulia, 510009-Alba Iulia, Romania⁹; Faculty of Mathematics and Computer Science, Transilvania University of Brasov, 500091-Brasov, Romania¹⁰; School of Computing and Engineering, University of Derby, U.K.¹¹; Centre for Change and Complexity in Learning, Education Futures, University of South Australia, Australia¹²; Department of Psychology, Chukyo University, Japan¹³; Centre for Research in Applied Measurement and Evaluation, Faculty of Education, University of Alberta, Canada¹⁴; University of South Australia Online, Australia¹⁵
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Mathematics anxiety research has taken a more inclusive approach in recent years, targeting populations beyond Western Educated Industrialised Rich Democratic (WEIRD) countries. This has also highlighted a wider range of psychological variables associated with mathematics anxiety. We conducted a large, survey-based study of 1,827 secondary school students (mean age = 15.71 years) in Iran, Japan, Pakistan, Romania, Türkiye, Uganda, and the U.K. We tested the extent to which a range of psychological variables could predict students' self-reported mathematics anxiety. Results showed that mathematics enjoyment and mathematics shame consistently predicted mathematics anxiety across all countries. Other variables, including perceived value of mathematics, perceived importance of struggle in mathematics, mathematical mindset, motivation, parent/peer influence, and collectivism were less consistent predictors, but were highlighted as important predictors of mathematics anxiety in specific countries. Findings emphasise mathematics enjoyment and shame as universal predictors of mathematics anxiety and suggest the need to focus on these within targeted interventions. Findings also revealed the need to consider country-specific predictors of mathematics anxiety, particularly in relation to psychological constructs thought to underpin mathematical resilience, especially the extent to which students perceive the importance of struggle in maths.

Keywords: Mathematics anxiety, Mathematical mindset, Psychological constructs, Struggle

Anxiety and Resilience Among Undergraduate Chemistry Education Students

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This study investigated the depth of anxiety levels in pre-service chemistry teachers, the impact of anxiety in chemistry learning, tests and teaching strategies that could be employed to develop resilience in STEM subjects. Quantitative and qualitative data were collected to evaluate the effects of the approaches trialled. Data collection instruments used in this study were questionnaires and focus-group interviews. A questionnaire comprised of ten (10) items was used to measure pre-levels of anxiety using a Likert scale, followed by focus-group interviews to gain insight into students' anxiety levels. Descriptive statistics were used to analyse quantitative data meanwhile thematic analysis were used to analyse qualitative data. Participants consisted of twenty-six (26) female and twenty-seven (27) male students. Mindset Theory (MT), or Implicit Theory of Intelligence was employed as theoretical framework to explain the findings. According to this theory, people have one of two attitudes concerning intelligence: a fixed or entity mindset, or a growth or incremental mindset. The findings revealed that female chemistry education students had high chemistry-learning anxiety level which they felt were due to teaching strategies. Female interviewees revealed that the mode of teaching chemistry they were experiencing generated no anxiety in some students whereas in some of them anxiety levels were increased, to the extent that they could not learn despite consulting friends hence, it affected their performance. Similarly, male interviewees revealed the same challenges in that their chemistry-learning had created anxiety. Their anxiety levels were slightly lower than the female students. To develop resilience in students' and decrease anxiety levels, field-trips and hands-on, mind-on teaching approaches were proposed because they connect chemistry ideas to real life situations.

Keywords: Chemistry anxiety, Resilience, Chemistry education, Pre-service teachers

Saturday 6th July 2024 – 11:20 – Room 2
Addressing Maths Anxiety in School Age Learners

How can the learning relationships that work to develop Mathematical Resilience in mathematics classroom be characterised?

Clare Lee
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In this presentation I want to explore a question that feels paramount to me in work to develop mathematical resilience. My aim in pursuing work on mathematical resilience is to convince teachers of learners of any age that it is possible to offer learning about the complexities of mathematics without generating mathematics anxiety. Thus, my interest is in how teaching and learning is approached, day in, day out, for the majority of learners. I have, so far, begun to understand the importance of the growth zone model in promoting mathematical resilience because it helps learners understand their own emotions and gives them the vocabulary to express their feelings and dilemmas. But use of the growth zone model by a teacher who is not listening will not help the learners. So, mathematical resilience is developed in environments where the learners are able to express their ideas and where the teacher is prepared to listen, but I think there is more to it than that. I want to establish the crucial characteristics of a classroom that offers care in learning mathematics (Noddings, 1992, Watson, 2021), that is one which prioritises the well-being of students within it so that they are set free to learn effectively and develop the resilience to cope in more difficult environs. The presentation is designed to set out parameters to explore in wider research projects.

Keywords: Mathematical resilience, Growth Zone Model, Mathematical learning, students well-being

A review of research and teaching strategies on Mathematical Resilience

Rachel Kangethe (online)
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The ability to persevere and strive in the face of mathematical difficulties, mathematical resilience, is increasingly recognized as a critical component of both academic achievement and lifelong learning. This conference paper explores the prospects and difficulties of developing mathematical resilience, highlighting new developments, ongoing studies, and potential avenues in this evolving topic. It was motivated by the widespread problem of mathematics anxiety, which has a negative impact on students' performance and interest in the subject. This work investigates interventions and teaching strategies intended to improve mathematical resilience through a comprehensive review of the current literature as well as new empirical research.

Innovative strategies including the use of adaptive technology, collaborative learning spaces, and mindset interventions are critically evaluated. The findings show that when children engage in resilience-building activities, their attitudes and performance in mathematics improve significantly. This is particularly true when programmes prioritise individualised technology solutions, growth mindset, and emotional support. However, there are still many obstacles to overcome before these tactics can be made available to all students and tailored to their specific needs. The findings highlight the significant potential that developing mathematical resilience has to improve learning outcomes. Further research is needed to improve these strategies and remove barriers to their effective application. To help children cope with mathematical problems and succeed academically, future research should concentrate on developing comprehensive, scalable resilience-building programmes and on using technology to provide tailored learning experiences.

Keywords: Mathematical resilience, Mindset interventions, Collaborative learning, Lifelong learning

Building Mathematical Resilience Through Parents

Mercy Kerubo Nyakundi,
Sue Johnston-Wilder, Holly Heshmati
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Parental involvement may refer to parents being active supporters of their biological children, as well as adopted children's learning within the home environment. Parents may help in building mathematical resilience because evidence shows that parental involvement yields strong positive impacts on the academic performance of students. For more than 60 years, mathematics anxiety has proved to be a global challenge. For instance, mathematics anxiety in children and parental mathematics anxiety hinder effective learning of mathematics. Parents may have mathematics anxiety which can negatively impact their involvement in their children's mathematics learning. With this in mind, where parents show signs or express anxiety characteristics, this study will first address the anxiety before allowing the parent to work with his or her child in mathematics. For this reason, it is imperative to address the parents' anxiety before they can help their children at home. Therefore, the construct of mathematical resilience is imperative for learners to persist in learning mathematics. My personal experience in Kenya shows how parents play passive roles regarding their children's mathematics learning. For example, the Early Grade Mathematics Assessment reveals that 61.9% of the children never complete mathematics homework, and 70.2% have low parental involvement in mathematics learning. Essentially, in my M. Ed research study, I often heard children and parents make negative statements about mathematics such as "I fear mathematics", "I will not go to school because I've not done mathematics homework", and parents acknowledging that "My child never performs well in mathematics," "After all, I failed in mathematics too" among others. These avoidances and parental assertions indicate the prevalence of mathematics anxiety in society. Drawing from the three psychological safety models: the Growth Zone Model, the SDT theory, and the Expectancy-Value Theory. The study will employ mixed methods utilising a quasi-experimental, non-equivalent control group design with two groups. The study sample size will be 20 primary schools, 20 teachers, 400 children, and their parents (one parent for each child) purposively selected from 10 urban primary schools and 10 rural primary schools in Kenya. Descriptive and inferential statistics will be used to summarise and analyse data obtained from responses respectively.

This is a positioning paper as part of my PhD study at the University of Warwick.

Keywords: Growth Zone Model, SDT theory, Expectancy-Value theory, Parent's anxiety

*Saturday 6th July 2024 – 13:40 – Room 2
Focusing on Adults*

Reducing anxiety and building statistical resilience through statistics support

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Statistics anxiety, like maths anxiety, is a situation specific anxiety often having a debilitating impact on a student's ability to learn. Many students also have negative attitudes about their own capability and lack statistical resilience, particularly when it comes to undertaking their own research. Anxious students are less likely to have a growth mindset, seek help or persist when struggling. Many universities provide support for statistics in addition to their degree curriculum through maths and statistics support centres but there is very little quantitative research evaluating the impact of using such services. With the right staff, these centres can provide an emotionally secure environment, with the opportunity to receive regular positive feedback and encouragement, increasing self-efficacy and statistical resilience.

Key results from student questionnaires prior to a first statistics support session, immediately after, and at the end of the year will be presented in this talk including validated measures of statistics anxiety, confidence in undertaking aspects of quantitative research, students perceptions of change and qualitative responses. Reductions in anxiety were apparent after just one session whereas significant increases in self-confidence were observed only at the end of the academic year.

The presenters will elaborate on how and why statistics support is effective using existing literature, student feedback and explanations of methods used by the authors to gradually build statistical resilience over several sessions.

Keywords: Statistical anxiety, Statistical resilience, Statistical learning, Higher education

Empowering our maths resit students in the Exam Hall – a case study

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Exam anxiety is a common experience among students, particularly during high-stakes assessments. Their fear of failure and the pressure to perform well can lead to stress, affecting cognitive functioning and overall well-being. Many students in GCSE maths resit classes face significant obstacles, including low self-confidence, cognitive challenges, or serious family issues (such as being young carers or experiencing financial difficulties). Despite their high attendance in maths lessons and consistent completion of weekly online homework, many students encounter a further unique struggle when they enter the exam room. Faced with the exam environment—even in small rooms aligned with their exam access arrangements—they often report experiencing “brain freeze”, preventing them from demonstrating their true knowledge and understanding of the curriculum.

In response to this challenge, our mathematics department is actively exploring approaches to increase students’ self-beliefs and reduce their fear of the exam hall. One promising avenue is the integration of mathematical resilience as a supportive tool. Mathematical resilience encompasses not only mathematical skills but also psychological factors such as growth mindset, self-efficacy, and effective study habits. By fostering resilience, we aim to empower students to overcome maths exam anxiety, adapt to exam conditions, and perform at their best. In this presentation, we will investigate specific strategies that promote mathematical resilience and share insights from our case study. By addressing both the cognitive and emotional aspects of maths exam preparation, we hope to create a more supportive and empowering environment for our students during their GCSE maths exams.

Keywords: Exam anxiety, Fostering Mathematical resilience, Positive experiences in mathematics learning

Building Mathematical Resilience using emotional self-control strategies and STEAM approach²

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In this work we investigate the use of tools for emotional self-control and activities defined in the STEAM approach as a strategy for dealing with Mathematics Anxiety (MA) in secondary school students. MA refers to a feeling of tension and anxiety in situations involving mathematics. We selected second-year technical high school students from a public high school in Rio de Janeiro (FAETEC/RJ) who have high or extreme anxiety according to a scale already validated in scientific papers. We used three tools to tackle this MA: workshops on emotional self-control; study habits, and STEAM. The STEAM activity we use at FAETEC-RJ is influenced by superhero therapy or geek therapy, which seeks to develop resilience incorporating creative activities. Ongoing research into 'geek therapy' has demonstrated its ability to build rapport, create understanding and insight, and provide therapeutic interventions very similar to traditional therapy models. In the first phase, the hero (character), who is an ordinary person, answers a call to adventure and moves into a magical world, beyond the normal world. In the second phase, the hero faces challenges with the help of new powers and other auxiliary characters; he resists and overcomes these challenges and, as a result, is rewarded with new powers or the discovery of inner strength. In the third phase, the hero returns to the normal world and is able to use his new abilities to contribute to the environment and community. From the field notes collected, we verified that the students found a meaningful space to talk, a space where they could share their bad experiences (previous and current) in mathematics, and this supports the idea that the collective adds value to building mathematical resilience. We also saw the benefits of emotional self-control and relaxation techniques to control anxiety.

Keywords: Mathematical Resilience, Mathematics Anxiety, Emotional self-control, Study habits, STEAM, Superhero therapy

² This work is part of the project entitled 'Coping with Maths Anxiety in Secondary Schools with a STEAM Approach', FAPERJ (SEI-260003/013048/2021).

The Relevance of a Healthy Environment in building Mathematical Resilience³

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This work is part of a larger project developed in three public schools in Rio de Janeiro (Brazil) during 2022 and 2023. The project, funded by FAPERJ, "Coping Mathematics Anxiety in High School with a STEAM Approach," aimed to contribute to the construction of mathematical resilience through workshops using STEAM methodology. During the research, several obstacles were encountered setting up the STEAM workshops. One of the research sites (Colégio Pedro II – Campus Realengo II) was peculiar in its students' perception of their mathematics anxiety and the influence of the environment in this process. In their reports, students reported experiencing mathematical difficulties, failures in the subject, and mathematics anxiety as a symptom but did not want to stay in the programme and avoided the workshops. We therefore sought to understand the internal and external motivations that influenced these students' withdrawal and to act to provide other support. As a result, we add to the principles of developing Mathematical Resilience (MR), the concept of a welcoming or healthy environment as fundamental. Mathematics anxiety (MA) is likely to stem from an unhealthy environment, arising as a reaction, the individual's defence against obstacles perceived as insurmountable, hindering bonding formation and complicating the learning process. To cope with MA, the student must first accept its existence, and then develop strategies to overcome obstacles. In these shared spaces, in addition to sharing relaxation and breathing techniques and defining study strategies, students, starting from a healthy environment, feel ready to discuss their obstacles, paving the way for the structuring of MR.

Keywords: Mathematics Anxiety, Mathematical Resilience, STEAM, Self-perception, Healthy environment.

³ This work is part of the project entitled 'Coping with Maths Anxiety in Secondary Schools with a STEAM Approach', FAPERJ (SEI-260003/013048/2021).

Saturday 6th July 2024 – 11:00 – Room 2
Addressing Maths Anxiety in School Age Learners

Exploring Teacher-Learner Partnerships to Enhance Mathematical Resilience in Learners with Mathematics Anxiety: A Teacher's Perspective

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In the UK, Mathematics education for lower-attaining learners often presents significant challenges and lacks the learning opportunities provided for top-set learners. This research explores the impact of secondary school mathematics experiences on learners' apprehensions regarding resit GCSE Mathematics courses at Further Education (FE) Colleges. Focusing on the teacher-learner partnership from the teachers' perspectives, this study examines how these relationships can enhance mathematics resilience in learners with mathematics anxiety. Seven teachers participated in the study, including four from different secondary schools and three from an FE College. Data were collected through semi-structured interviews, revealing diverse mindsets and approaches among teachers when addressing the needs of low-attaining learners. The findings reveal diverse approaches to addressing the needs of low-attaining learners and highlight the neglect of resit mathematics learners' psychological well-being, particularly those with significantly low previous attainment. Past negative experiences often lead to ongoing anxiety and disengagement, which seemed to have been seldom addressed, exacerbating these issues during educational transitions. This study underscores the importance of recognising and addressing these emotional and cognitive challenges to improve engagement and academic progress in Mathematics. By exploring the challenges and emphasising the role of teacher-learner partnerships in enhancing Mathematics resilience, the research advocates for interventions that cater to the emotional and cognitive needs of these learners, fostering growth mindsets for both teachers and learners.

Keywords: Mathematical resilience, Growth mindset, GCSE Mathematics courses

Reflective Writing: Transforming Mathematics Teaching through Insights into Student Difficulties

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The beliefs and practices of the mathematics teacher have a significant impact on the teaching of mathematics, and play a central role in shaping their students' mathematics abilities, attitudes to mathematics, and overall success in mathematics. For pre-service teachers, understanding the challenges of the second-level mathematics classroom is underpinned by their level of preparedness, and awareness of their students' approaches and attitudes to learning mathematics. In this regard, the practice of reflective writing, and reflection in general, lends itself to self-efficacy in mathematics for the teacher and ultimately their students, thereby contributing to the advancement of mathematical resilience within the second-level educational context.

Rolfe, Freshwater and Jasper's (2001) reflective model poses three questions to frame the practice of reflective writing: what?, so what?, now what? This framework is useful particularly where a student teacher recognises a problem to reflect on (what?), documents their observations about this problem (so what?), and affirms what they would do differently next time in a similar situation (now what?), and gauging subsequently if this was effective. Pre-service mathematics teachers were invited to complete an online questionnaire after completion of school placement. Guided by Rolfe et al.'s framework, respondents were asked to recall a mathematics lesson they perceived as challenging for their students, sharing their reflection on it and how effective the proposed outcome was subsequently. The findings present the benefits and challenges of reflective practice to pre-service teachers' understanding of their approach to facilitating secondary school students' ability to learn mathematics

Keywords: Mathematics self-efficacy, Reflective model, Pre-service teachers

*Saturday 6th July 2024 – 12:00 – Room 2
Focusing on Adults*

Developing mathematical resilience – a case study on the challenges involved in leading meaningful change in a highly academic secondary school

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All teachers have a role to play in equipping students with the skills needed to become lifelong, resilient, independent learners and middle leaders have a clear influence on driving the change needed to make this happen. However, in a busy work environment the competing pressures of enabling learners to make progress academically, the day-to-day leadership of a team of teachers, and ensuring accountability to the headteacher and governors, makes embedding change challenging. Beginning with the hypothesis that Maths Anxiety affects academically able students, I describe the progress of a doctoral research project within a highly selective boys' school in Kent aimed at enabling all students to develop a highly resilient approach to their study of mathematics. I discuss the process followed from the initial pilot through to a large-scale intervention and follow-up survey and the indicative results from this, before addressing the issues that arise when competing pressures begin to interfere with the research process. This leads to a consideration of the next steps needed to reach a successful conclusion of the research project and lessons learned about the need to ensure agency for practitioner researchers as well as the learners we have a responsibility to.

Keywords: Agency, Practitioner research, Mathematical resilience

The Effects of MR Based Math Anxiety Intervention Program on Turkish Secondary Students' Maths Anxiety and Mathematical Resilience Levels

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The effects of Mathematics Anxiety Intervention Program on maths anxiety level and mathematical resilience of secondary students will be investigated in this research. Although mathematics anxiety seems to be one of the main barriers blocking students to learn mathematics, limited scientific efforts has been spent on addressing it. The PISA 2003 (Program for International Student Assessment Project) used a five-item instrument to measure the mathematics anxiety level of eighth grade Turkish students and the findings released that that the mean mathematics anxiety score of Turkish students was higher than the means of other OECD students (EARGED, 2005).

Therefore, there is an urgent need to design intervention programs and tools to help students overcome their mathematics anxiety. In this research, a mathematical resilience based intervention program was developed and the effect of it among secondary students was investigated. The session titles of the Mathematics Anxiety Intervention Programme, which was designed as ten sessions, were planned. Each session lasted for 90 minutes and they were conducted by three counsellors in an IT classroom. This research follows an experimental procedure including one experiment and one control group. The Mathematics Anxiety Scale and Mathematical Resilience Scale were administered to 5th, 6th and 7th grade students of Mustafa Çukur Secondary School located in Bayraklı district of İzmir. Those who have high mathematics anxiety and low mathematical resilience level were detected and called to participate in group work. The students who accepted were randomly assigned to experiment and control groups. In order to investigate the effects of the program on maths anxiety of the experiment group, the pre and post-test measurements will be collected and data will be analysed through SPSS.

Keywords: Mathematical Resilience, Mathematics Anxiety Intervention Program, Secondary education