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## Addressing anxiety in the teaching room: Innovative techniques to enhance mathematics and statistics education.



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*Mathematics and statistics anxiety is one of the major challenges involved in communicating complex mathematical concepts to non-specialists. **Meena Kotecha** reports back from a recent conference where educators and researchers presented on how they have addressed the issue of anxiety in the classroom.*

*Individual learning requirements need to be carefully considered in order to promote a climate that is both student-led and student-focused.*

A few months ago, the University of Glasgow hosted the first international conference of the Institute of Mathematics and its Applications (IMA) which explored approaches to teaching and learning mathematics. The idea was to develop a global community of educators willing to align their teaching approaches with the wide ranging learning needs sensitive to academic as well as cultural diversity. I shared a conference proposal which focused on the theme of enhancing teaching and learning mathematics with the vision of increasing educators' awareness about barriers to student engagement with mathematics and statistics. This kind of enhanced learning would make mathematics and statistics more accessible, widen student participation through the promotion of inclusive education, and enhance engagement with mathematical concepts. It was a pleasure co-chairing the conference organising committee and

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this post outlines some of the main discussions that took place during the event.

The conference was structured around ten parallel sessions that delegates could choose from. These included three special thematic sessions: "Student Engagement" organised by Dr. Jeff Waldock from Sheffield Hallam University, "Addressing mathematics & statistics anxiety" and "Enhancing engagement with mathematics & statistics" organised by myself. To encourage a wide-ranging field of perspectives, we invited contributions from academics, educators, teachers and researchers on their work in mathematics and statistics education as well as related areas in general, not limited to any specific theme or education sector. The keynote addresses, paper presentations and working sessions focused on current issues in mathematics as well as statistics education. Solutions were proposed to change negative attitudes towards using mathematics in post-16 students in England and Scotland. These included innovative curriculum for mathematics in education and industry, new pedagogy, blended learning, flipped classroom and innovative methodological tools to assess complex mathematical problems.

Mathematics and statistics anxiety is one of the major challenges involved in communicating mathematical concepts and subjects to non-specialists. Students enrolled on degree programmes in areas other than mathematics or statistics are required to study mandatory courses in mathematics and/or statistics as core elements of their degree programmes. Academics, educators and researchers presented papers on how they have addressed this issue of anxiety using history, enhancing students' self-belief, individual support, demonstrating the relevance of the subjects to their respective degree work and making the learning process enjoyable.



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My reflection and outcome analysis of this session as well as the discussion that followed are as follows:

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The **general** consensus was that

- Students with low confidence experience high levels of mathematics anxiety, which has an adverse impact on their academic performance;
- University students are far from resilient to experiencing mathematics anxiety ;
- It is most common in non-specialist university students;
- It is not always related to students' academic abilities but their prior learning experience of the subjects, self-efficacy and self-beliefs;
- The increasing diversity of the university student population as a result of the high proportion of international students, widening participation and access to higher education, add new dimensions to this challenge;
- This range of cultural, socio-economic and academic backgrounds of students manifests itself through diverse expectations and individual learning requirements that need to be carefully considered;

Delegates agreed on the following way forward:

If educators involved in designing and delivering mathematics, as well statistics courses for non-specialist university students, are aware of the implications of this diversity in student backgrounds they should be able to appreciate the indispensable role that having a variety in teaching and learning approaches plays.

My personal view is that thinking like social scientists would make higher education practitioners empathetic towards students. I think making course delivery student focused as well as student led would encourage students to share responsibility for their education. Focusing on connecting with students and being perceptive as well as receptive to students' feedback and willing to revise teaching delivery can enhance the learning climate in teaching rooms. This would promote student interaction and encourage active learning.

Undergraduates face several issues during their transition to university education such as key gaps in their mathematical skills despite the fact that they have A-level Mathematics or equivalent. Effective practices were shared to include a blended learning project using online formative assessment followed by feedback, encouraging students to work within their **Zone of Proximal Development** (Vygotsky, 1978) and two innovative Mathematics Support Centres (MSCs) that facilitate distant learning. MSCs have become important features of universities in the UK as well as overseas. Training teachers and developing teaching resources was yet another area widely covered.

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Educators shared their projects on scenario based training of statistics support teachers, instruction methods developed by mathematics teachers and using census data as well as other publicly available large data sets to support statistics literacy. Social media was explored as a tool to facilitate deep learning, enhance student engagement in science as well as engineering and improve students' learning experience. I have used Facebook for teaching statistics and operational research since 2012 and would highly recommend it. The National Football Museum's presentation on their project, on using football to deliver real life mathematics, in partnership with teachers intrigued delegates. There were presentations on the effective use of a virtual learning environment, audio feedback and an online collaboration model to encourage students' participation.




Image credit: A mathematics lecture at [Aalto University School of Science and Technology](#) (Tungsten, Public Domain)

Delegates found online formative assessment practice worth exploring to incorporate within their teaching practices. The innovative Mathematics Support Centres (MSCs) that facilitate distant learning sounded appealing to several others. Delegates who had not experimented with Facebook were convinced after a paper presentation that Facebook is an area worth exploring to enhance student engagement.

I use Facebook for setting up study groups for my non-specialist students. My rationale is to address anxiety by connecting with students without intruding into their personal territory i.e. becoming their Facebook friends. Facebook allows academics to use an online system for posting topics for discussions, addressing students' queries, uploading course material and monitoring their progress. These study groups are easy to set up and promote inclusive education. It is a platform students are used to and view positively.

We encouraged all authors to submit extended versions of their papers to Oxford Journal of Teaching Mathematics and its

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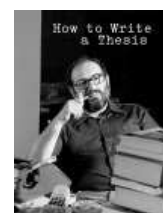
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Applications. Four authors who presented papers at this conference also gave talks at the MSOR 2015 held in September 2015 at the University of Greenwich, London.

Barriers to learning such as neurodiversity were also explored focusing on learning difficulties faced by visually-impaired and hearing-impaired learners. Other areas covered included language difficulty as a barrier to reading mathematics, dyslexia/dyscalculia and teachers' negative bias against students from certain backgrounds. Claire Trott presented the afternoon keynote address on "Dyslexia and Dyscalculia: exploring issues through case studies". Claire has been a Mathematics Support Tutor at the Mathematics Education Centre, Loughborough University since 1999. Her area of specialism is providing support to students who have low mathematical confidence. Gender imbalance was also discussed as a significant barrier with the general consensus being that more women should be encouraged, as well as supported, to pursue careers in mathematics.

In light of the existing literature and research relating to the difficulties blind learners face, it was agreed that this is an area that calls for further research to make mathematics more accessible to the blind. It was proposed that research on combining lexical rules, speech prosody and non-speech sounds would be desirable. Furthermore, providing tools for carrying out mathematical analysis may improve the situation for blind learners.

A critique on the fallacy of assuming a homogeneous student body, and homogeneous teaching in a 'what works' approach introduced an interesting point of controversy in the midst of excitement and optimism about these initiatives. These exchanges of information on research, initiatives and projects should promote multi-disciplinary research collaboration in mathematics and statistics education.

The conference was attended by 75 delegates from the UK as well as overseas and might impact research in a variety of themes related to statistics and mathematics education to include mathematics anxiety, inclusive practice and statistics anxiety. I invite everyone interested in the conference to [join the Facebook group here](#) and also follow updates on Twitter #imabarriers2015 until the next one is scheduled! All conference papers are available to [download here](#).

*Acknowledgement: I should like to express my indebtedness to the University of Glasgow for their warm reception and assisting us diligently with various conference related matters. The credit for delegates' compliments on the conference arrangements in my opinion goes to Pam Bye, Lizzi Lake and the Administration Assistant Lucy Dunford.*

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## About the Author

**Meena Kotecha** has been teaching mathematics, statistics and operational research methods at the London School of Economics (LSE) since 2006. She is an LSE Teaching Prize Winner. Previously, she was a course leader at the University of Hertfordshire. In 2003, she was awarded Chartered Mathematician's designation by the Institute of Mathematics and its Applications (IMA). She was recently listed on Jisc's list of [50 higher education social media influencers](#).



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