WORKSHOP REPORT

Teaching students who feel apprehensive towards statistics - what works?

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1. Workshop rationale

Specialist conferences such as the Sigma Network's CETL-MSOR conferences in the UK and The Australian Statistical Conference (ASC) Statistical Education Symposium (SES), bring together experts in statistics education. These forums provide a rich intellectual environment for the exchange of contemporary research, pedagogical innovation, and evidence-based strategies for addressing statistics anxiety (mental distress when encountering statistics, Zeidner, 1991) and students' reluctance to engage with statistics. Workshops held during these two conferences in 2025 aimed to provide a dedicated space for experts to talk and, importantly, document their professional experiences and perspectives so that these ideas could be disseminated to the wider community of Higher Education statistics educators internationally. While research on measuring statistics anxiety is well established (Trassi et al., 2022), less attention has been given to practical approaches that address it (but see Wilson, 1999). Furthermore, much effective practice by educators remains underreported. In this report we fill that gap by distilling practitioner perspectives on addressing statistics anxiety in Higher Education.

2. Workshop design, delivery and analysis

Accepted workshop abstracts, submitted by us as workshop co-organisers, were disseminated through the conference programmes and explicitly invited delegates to participate in these interactive and collaborative sessions. The abstracts outlined that co-organisers would present their work to date on mitigating statistics anxiety to prompt structured discussion and collective exploration of strategies for fostering positive attitudes to statistics. The workshops were 1 hour long. After short presentations highlighting key findings and themes drawn from our research (Marshall et al., 2024; Riach et al., 2025; Shaker et al., 2021; Shaker et al., 2025; Binkowski et. al., 2024) there were two facilitated discussions. The first discussion was prompted by the question: "What have you found that works or what do you think works when teaching students who may feel apprehensive towards statistics?". This aimed to draw out participants' descriptions or ideas of best pedagogic practice. The second discussion, "How can you share and foster best practices of teaching students who may feel apprehensive towards statistics among colleagues or your teaching teams?" concerned how to disseminate this practice and encourage its uptake by others.

Following discussions, participants were invited to type up their thoughts in an online shared document either individually or collaboratively as groups. Access to the shared documents did not work for all participants in the first workshop. Therefore, we advise anyone repeating this method to thoroughly test permission settings are correct. From our experience at similar conferences, we

anticipated people would be eager to share their thoughts; however we were conscious of also wanting to provide for someone to simply engage in discussions without having to record their contributions. We therefore emphasised to participants that the time they were given to record their thoughts could alternatively be used to continue discussions or review contributions from others if they preferred. In addition to participant information on the shared document, the workshop facilitators verbally explained that any written contributions to the shared document could potentially be used in a Workshop Report and that in contributing to the document participants were providing consent. Participants were asked to contribute anonymously and not name institutions to mitigate reputational risks. The project was approved by the Research Ethics Committee for Biological Sciences, University of Leeds (reference number FBS FREC 3263).

The comments contributed by the workshop participants were independently coded by two authors using inductive thematic analysis (Braun and Clarke, 2006), with related or conceptually similar comments identified using a consistent colour-coding system. Three authors then met to discuss the comments and reach consensus on themes. Themes mentioned in at least two participant comments were quantified, serving to consolidate and distil the key themes emerging from the workshops. Comments could be assigned multiple themes where relevant.

To facilitate the dissemination of these discussions among educators, an infographic summarising the comments participants contributed during the workshops was produced with the aid of artificial intelligence AI Infographic Generator (1bit.AI, https://www.1bit.ai/services/ai-infographic-generator) to summarise comments into text and Gemini 1.5 Pro (https://gemini.google.com/) to produce the infographic.

3. Key themes from workshop contributions

A total of 12 and 50 participants attended the UK and Australian conference workshops, respectively. Participants were observed to represent multiple institutions, span the full range of career stages, and comprise a mix of statistics support tutors, statistics lecturers and other educators teaching statistics-related classes, as well as consultants who taught clients. For anonymity, demographic data were not explicitly recorded.

Collectively, participants contributed a total of 3288 words of comments as a mixture of single-line notes and short paragraphs. Examples of participants' comments are presented below under their respective discussion prompt. Where possible, quotes are used to preserve the original meaning of participants' contributions. Citations are provided where further information on a specific practice is available.

3.1 Discussion 1: "What have you found that works or what do you think works when teaching students who may feel apprehensive towards statistics?"

When considering only themes mentioned by at least two participants during Discussion 1, thirteen themes emerged with varying frequency (Figure 1).

There were 20 contributions (Figure 1) that emphasised the importance of using data which was "*tangible real-world examples*", "*tailored for the client's specific domain"* or "*relevant contexts e.g., clinical health".* Some participants explained why this was important.

> *"show them how statistics can make them a better [X] (biologist, ecologist, economist, etc.)"*
>
> *"they are there because they love something else that requires them to study statistics… give them the mathematical tools to do what they love"*

"The examples akin to "pulling coloured tokens from a bag" are not going to get a student inspired and are likely the reason students think statistics is boring and halts any desire for expanding their statistical skills."

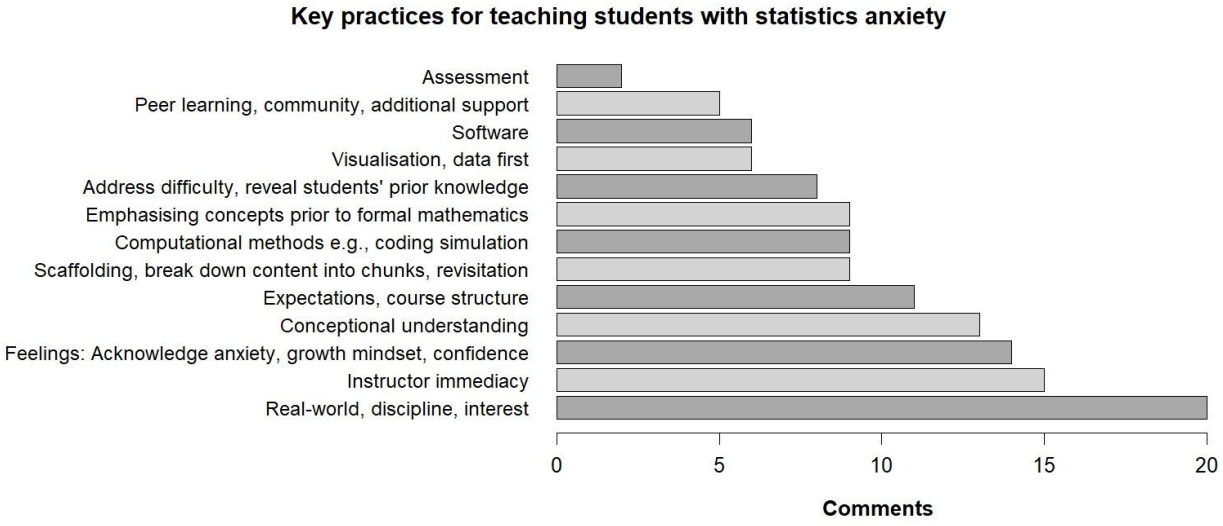


Figure 1. Frequency of themes identified from participants' comments from Discussion 1.

Several contributions highlighted mathematics, particularly the links students make between mathematics and statistics, the focus on fundamental statistical concepts, and the impact of delaying or removing mathematical content, consistent with guidelines for teaching statistics (e.g., Carver et al., 2016).

"Performing simple class activities that demonstrate theoretical statistical concepts and help them see why the math/theory, 'works,'."

"Theoretical mathematics without significant links to outside the classroom creates a significant hurdle for a lot of students who do statistics as part of their degree"

"Take a good, hard look at your course, and ask yourself what students actually need to be able to ,"do stats,", and what remains as artifacts from a world before computers."

Some comments highlighted the power of visualising data for conceptual understanding (Sofroniou, 2025), for demonstrating the application of statistics or for mitigating anxiety by helping students develop intuition that supports their understanding of the underlying mathematics, before engaging with more intimidating, formal mathematical representations.

"I have students start with ggplot to create great graphs and then the stat analysis becomes more understandable."

"Show them the utility of visualising data. Not doing any inferential analysis, just simply showing and understanding the data. Then start adding little elements, building it up little by little."

"Helping students to first see what they <u>can</u> do then build on it. (e.g., if they say 'I can't do stats', show them they <u>can</u> do some e.g., A really bad graph – what is wrong with it"

Participants also described a range of pedagogical approaches using visual or dynamic elements, including using *"simulations to show how statistical tests behave",* creatively displaying information

or using colours to identify key concepts and in one case using, "*live coding*" (Nederbragt et al., 2020).

> "*Visual representation of data and information is important. Not just plots of data, but display of various forms of information"*
>
> *"Overwhelmed by statistical output; remedy for this student was to print out the output and highlight the bits that are relevant"*

There were also comments relating to breaking down or scaffolding learning and recapping on prior content to reinforce learning. Some people gave "*A recap at the start of each lecture*" or "*space for students to ask about topics already covered*" such as "*an anonymous online forum so students can ask questions without being judged*". This technique of breaking down learning into "small steps" was used for "*Getting confidence up early*" or to "*boost your confidence*".

Assessment was discussed less frequently than expected given its importance in teaching statistics (Garfield et al., 2008) with only two comments about "*accessible design*" and *"large numbers/amounts of low-stakes assessments"*. Other comments concerning course structure or design included the choice of software where one participant advocated for the use of "*jamovi/jasp as can be simpler*". One R user emphasised "*that you don't have to be an expert coder*".

In terms of peer learning and community, it was thought that students could *"learn from their peers, assuming class discussions are encouraged*" and people made students aware that peers also have concerns or "*feel anxious*", that "*they're not alone"* and that it should not be a competition.

> *"Students get anxious when they see others ahead of them. It is interesting to contrast this with informing them that others feel the same way. And in fact other students can be very supportive, they might be ahead but still feeling the same way!"*

In terms of supporting students, people were "*offering multiple avenues to help*" and thinking how to make students use the help available.

> *"radical levels of course support with strong built-in mechanisms to force students to use the support as a prerequisite for completing work"*

Beyond considerations of how content was taught or course design, participants also emphasised the importance of *"setting realistic expectations about how fast they will be able to learn"* and stating "*that you are not meant to become experts in stats"* from the start, whilst acknowledging the inherent difficulty of the subject.

> *"The tunnel of statistics can seem long and dark to those that are anxious. I find giving people an early glimpse of how far down the tunnel we're going (this can include saying "were not going beyond X") helps set expectations early and can reduce the anxiety that they might just keep falling and falling into the abyss."*

People also talked about acknowledging students' feelings (Schleutker, 2022) including anxieties, championing a "*growth mindset",* and recognising students' previous experiences.

> *"shaking off prior trauma can be hard, may need one on one, also reassurance that their prior experiences with stats education may have been genuinely terrible - not their skill, the courses they took may have been awful!"*
>
> *Ensure they know stats is not maths. I suspect some of stats anxiety is due to maths anxiety; students thinking that stats = maths."*

One person described their specific method for dealing with fear.

> *"Asking students to reflect seems useful. My first assessment of each term has them write a sentence or two about what they are most fearful about for the course. My final assessment of the term has them write a sentence or two about how it went, and what they think. And a lot of them, given the chance, seem to converge on "this wasn't as bad as I thought it would be!""*

Instructor immediacy is a set of positive verbal and non-verbal behaviours exhibited by an instructor which conveys approachability or availability. These include asking opinions, using names, sharing experiences, making eye contact, engaging in conversation and being available outside class. These are thought to reduce anxiety (Wilson, 1999; Williams, 2010; Riach et al, 2025) and improve student outcomes (McCluskey et al., 2017). Many participants (Figure 1) described aspects of their approach to teaching that reflected immediacy behaviours.

> *"Being approachable and making sure students know we care and want to help"*
>
> *"Introducing myself (family, interests, etc) so I appear more ,'human,'!."*
>
> *"be as not-like-a-mathematician as possible,- welcoming, excited to be there, excited to be teaching the students"*
>
> *"A friendly demeanor is important, as is demonstrating that you will not treat "stupid questions" with contempt. Apprehension of statistics can often be the apprehension of statisticians!"*

3.2 Discussion 2: "How can you share and foster best practices of teaching students who may feel apprehensive towards statistics among colleagues or your teaching teams?"

There were fewer comments in response to the second discussion but these reported colleagues "*shadowing or mentoring*" new staff, "*observing staff from other subjects teaching mathematics and statistics*" and that new tutors "*watch the lecture recordings*" or "*tutorial videos created during covid*". People used "*initial*" or "*weekly meetings*", "*group email*" or a "*message board or chat system*" to communicate and described that this was "*where content is discussed and teaching approaches*" explained.

> *"Mentoring is more based on regular discussions, informal as they are agendaless but formal enough to be regular and booked in. This allows for some organic direction in the conversation and (hopefully - seems to be the case for us) allows the junior person to bring both small and large queries/issues to the table for discussion."*

There was also "*Sharing of resources*", "*provision of materials*" and "*suggested activities each week*".

Two comments acknowledged challenges.

> *"Fear factor - teaching teachers you have to persuade them it's something they can do"*
>
> *"without university not doing a proper training it is difficult to properly train new tutors."*

While many participants discussed developing and mentoring staff, the importance of recruiting the right people was also mentioned.

> *"Some level of progression, so hiring qualified tutors to do the "easiest jobs" first (grading), then moving them on to the tutoring role, and eventually up to the role of lab demonstrator, with experience and proven ability."*
>
> *"recruitment process to assess a person's approach/style to teaching statistics."*

To aid the dissemination of these findings, comments from both discussions 1 and 2 were distilled into an infographic (Figure 2). A high-resolution version of Figure 2 is available to print at https://doi.org/10.5281/zenodo.19946805

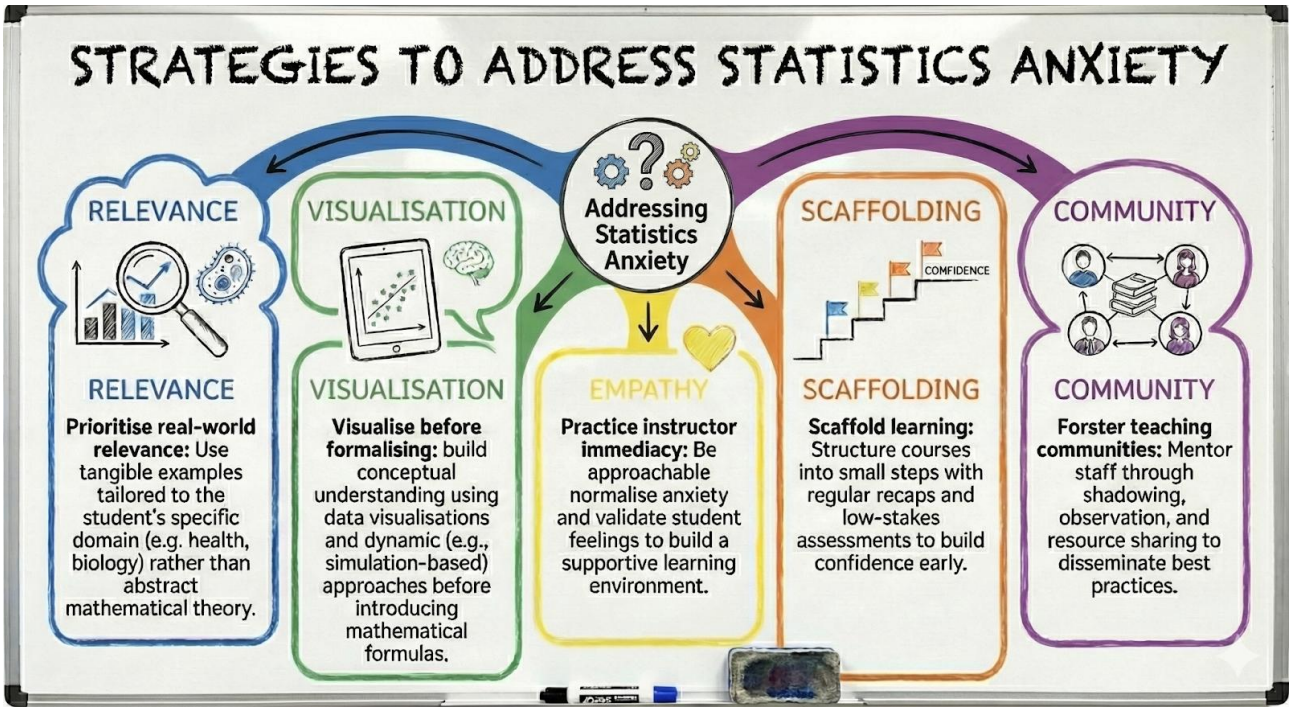


Figure 2. Summary infographic of key themes identified from the workshop's contributions.

4. Final reflection

Previous work has indicated that multiple strategies are needed to address anxiety rather than isolated adjustments (Pan and Tang, 2005; McGrath et al., 2015; Riach et al., 2025). The general themes that emerged from the workshop discussions (Figure 2) align both with this body of prior work and with the GAISE (Guidelines for Assessment and Instruction in Statistics Education) recommendations for assessment and instruction in statistics education (Carver et al., 2016). Specifically, that the focus should be on developing conceptual understanding; using technology, software, and visualisations to understand concepts; scaffolding learning; and analysing authentic data within relevant contexts. The need for breadth in pedagogical strategies is further reflected in the range of methods reported in this work. Practitioner perspectives highlighted that the process of overcoming statistics anxiety starts with explicitly acknowledging and addressing concerns about statistics, and establishing rapport. Foregrounding mathematics and conceptual understanding through visualisation, and the use of authentic, relevant data were among the most widely reported strategies. Instructor immediacy behaviours including attentiveness, approachability and offering additional support were also consistently featured. Together, these results reaffirm and extend individual-cohort studies by consolidating and distilling contributions from a wide range of experiences and Higher Education contexts across the UK and Australia. The contributions are weighted towards the Australian workshop which had more participants, and in choosing to attend such workshops the participants were self-selecting. Since this was a non-random sample, the external validity may be impacted, and the results may not be fully generalisable to the wider statistics education community. Nevertheless, the findings provide a trans-national, practitioner-informed perspective that highlights the value of integrating pedagogical, relational, and structural strategies to address statistics anxiety.

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