

Investigating links between student awareness and use of generative AI tools, and student anxiety and confidence when studying statistics

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Statistics anxiety is common amongst Higher Education students, with an estimated 70–90% experiencing anxiety while studying statistics. The emergence of Generative AI (GenAI) allows for new possibilities for how students might support their learning of statistics. In this international, multi-institutional study, we consider links between student awareness, perceptions, and usage of GenAI with student anxiety and confidence while studying statistics. Data were collected from students at universities across the UK and Australia during 2024 and 2025. Findings suggest that while GenAI usage is modest, it is more common among postgraduate students, and using GenAI tools can have a positive impact by reducing student anxiety and improving confidence while studying statistics. This study informs GenAI-driven pedagogy in higher education by highlighting the value of GenAI tools in supporting student learning of statistics and reducing student anxiety while studying statistics.

INTRODUCTION AND LITERATURE REVIEW

Statistics anxiety is “characterised by extensive worry, intrusive thoughts, mental disorganisation, tension and physiological arousal” (Zeidner, 1991, p. 319) when encountering statistical situations, and it is thought to affect 70-90% of students (Zeidner, 1991; Marshall et al, 2021) studying statistics as part of their course (or degree). Statistics anxiety has been shown to be negatively associated with student performance (Macher et al., 2012; Paechter et al., 2017), particularly anxiety about asking for help (Shaker et al., 2021). Chew and Dillon (2014) make various pedagogical recommendations based on the statistics anxiety literature. These include a greater focus on conceptual understanding rather than mathematical calculations, weekly quizzes, use of humour, and instructor immediacy behaviours. Teaching strategies found to be associated with reductions in statistics anxiety and/or improved attitudes towards statistics, include incorporation of game-based learning and fun (Shaker et al., 2021; Smith, 2017; Cohen, 2015), and a combination of collaborative learning, technology-enhanced learning, and project-based learning (Cujba & Pifarre, 2024). Riach et al. (2025) compared teaching strategies typically used to address statistics anxiety, including instructor behaviours and attitudes, use of humour, use of software and collection of own data. They found that instructors’ approachability and attitude towards statistics, as well as incorporation of humour or fun, were the most effective in improving students’ attitudes towards statistics.

The recent emergence of Generative Artificial Intelligence (GenAI) technologies has led to exploration of their capabilities and integration into modern statistics education (e.g. Xing, 2024; Derrick & Weir, 2025; Goodale, 2024). For example, Morales-Vargas and Benitez-Medina (2025) piloted the use of GenAI as a learning tool within a module and found that while some students demonstrated enthusiasm, students also expressed uncertainty and distrust related to using GenAI. Schwarz (2025) explored the use of GenAI for statistics tasks and found that it performed well, yet still requires oversight by a user with adequate statistical knowledge, thus arguing that statistics education should begin to focus more on conceptual understanding rather than software-specific skills. Al-Labadi et al. (2025) compared GenAI as a learning tool with traditional lectures, finding both methods led to comparable student performance results. However, concerns such as academic integrity and accuracy of AI-generated content were also highlighted.

The use of GenAI, whether incorporated into the curriculum or students' own use, could potentially offer assistance to anxious students, particularly those with high levels of anxiety about asking for help. To our knowledge, few studies have examined the interaction between statistics anxiety and the use of GenAI while studying statistics. Wahba et al. (2024) found that students who used ChatGPT-based learning experienced enhanced attitudes towards statistics compared with students who did not use ChatGPT. Shaker et al. (2021) found that the use of technology (Kahoot) within the curriculum was linked to increases in student confidence and decreases in statistics anxiety. Delima et al. (2024) studied the relationship between ChatGPT usage during independent study, and mathematics anxiety, and found no significant association. On the other hand, Etcuban (2025) found that students using ChatGPT for learning algebra reported a perceived decrease in anxiety and increase in confidence. In this study, we consider the interaction between GenAI usage and perceptions, and statistics anxiety and confidence, through the following research questions:

- How does students' experience of statistics anxiety and/or self-perceptions of ability relate to their use and perceptions of GenAI?
- How does use of GenAI impact on anxiety or confidence with learning statistics?

METHOD

Data collection

Data were collected from students at universities in the UK and Australia during 2024 and 2025. The study received ethical approval initially from Coventry University's Ethics Committee, P180041. Partner institutions sought additional approval where this was required by their own internal ethics policies. Participants were invited to take part by course (or subject/module) leads who acted as local gatekeepers at the participating universities. Course leads were either the members of the research team involved in the study or internal colleagues teaching courses that had the need for at least some study of statistics. The survey asked questions relating to participants' demographics, their awareness, perceptions of and use of GenAI within both general learning contexts and learning statistics specifically. Additionally, participants were asked questions about their confidence and anxiety with learning statistics and their help seeking behaviours. The survey was deployed via Jisc Online Surveys with all data being stored securely in the EU. The survey remains ongoing and so an interim data download was taken on 26th March 2025 to allow analysis of the data for this paper.

Statistics anxiety is known to have different dimensions, such as interpretation, asking for help, test, and class anxiety (Cruise, Cash and Bolton, 1985). A short 3-item scale in this study uses the most important item from each of the three dimensions of statistics anxiety identified in Marshall et al, (2024) and has Cronbach's alpha of 0.77. Students were asked to rate their anxiety on a scale of 1 (Not at all anxious) to 7 (Extremely anxious) regarding 'asking a lecturer for help with material they are struggling with', 'interpreting statistics', and 'using software to carry out analysis'. Students were asked how using GenAI had impacted their anxiety and their confidence about statistics on 5-point scales, with an additional option included for 'Not used GenAI'. Students were also asked how they perceived their ability of statistics on a 5-point score from very poor to very good.

As part of the survey, students were asked how often they used GenAI for four specific areas: choosing the right statistical test, analysing a dataset, explanation of output, and writing results. Response options included 'Not aware', 'Aware but not used', 'Rarely', 'Sometimes', 'Often', and 'Regularly' (Appendix A1). These options were scored from 1 to 6 respectively, and a mean score calculated for each participant across the four areas (Cronbach's alpha: 0.92). Users were then split into three usage groups: those who were 'Unaware' GenAI could do any of the four specific activities (mean score = 1), those aware but with 'No to low usage' ($1.25 \leq \text{mean score} \leq 3$), or those with 'Medium to high usage' (mean score > 3). However, participants were later asked about the impact of using GenAI on their anxiety or confidence with learning statistics. In this case, some students classified previously as being 'Unaware' GenAI could do any of the stated activities, reported how GenAI had impacted on their anxiety and/or confidence, rather than selecting the 'Not used GenAI' option. We do not know whether this was accidental or whether they had used GenAI while studying statistics for a purpose different to the four areas specified. Hence those students were grouped separately (referred to as 'Unaware / other non-specified use') from those consistently saying they have not used GenAI in both sets of questions. A summary of the usage groups is provided in Table 2.

Participants

Table 1 summarises participants by country, institution, level of study, age, and gender. The participants of this study were students from various Australian and UK universities. The survey remains ongoing, but as at 26th March 2025, 724 students participated in the study, 611 of whom indicated that they were either studying statistics as part of their course or needed to make use of statistics such as for a dissertation/thesis, and so only these 611 are included in the results of this paper. Participants ranged from having a minor (33%) to major (29%) amount of statistics in their course, meaning the level of statistics studied by students included in the study is diverse, however the majority of students enrolled were in STEAM degrees (Appendix A2).

Table 1. Participants by country, institutional affiliation, level of study, age, and gender.

Country	Institution	N	Level of study		Age (years)		Gender (%)		
			UG (%)	PG (%)	Mean	SD	Man	Woman	Other
Australia	La Trobe	48	100.0	0.0	26.2	11.34	18.8	79.2	2.1
	Macquarie	63	71.4	28.6	22.7	5.65	47.6	50.8	1.6
	Total	111	83.5	16.5	24.2	8.72	35.1	63.1	1.8
UK	Coventry	65	37.5	62.5	26.2	8.72	60.0	40.0	0.0
	Open University	161	98.1	1.9	39.3	13.44	64.6	33.5	1.9
	UCL	89	23.6	76.4	23.0	3.08	44.9	55.1	0.0
	UWE Bristol	185	54.1	45.9	24.8	7.20	57.3	38.9	3.8
	Total	500	60.2	39.8	29.3	11.69	57.8	40.2	2.0
Overall	Total	611	64.5	35.5	28.4	11.38	53.7	44.4	2.0

Data analysis

Given that many of the variables were ordinal, Spearman's correlation was used to test for relationships, and Kruskal-Wallis to test for group differences. ANOVA was used to test for differences in statistics anxiety by usage group and ANCOVA to control for other significant predictors of statistics anxiety identified using backward elimination regression models. Relationships between nominal variables were assessed using Chi-Squared tests. Statistical analyses were conducted using SPSS version 26 and R (R core team, 2023).

RESULTS

Overview of GenAI usage and the impact of using GenAI on anxiety and confidence with statistics

Table 2 provides an overview of GenAI usage, including a breakdown between undergraduate and postgraduate students. Overall, 30.6% of the 611 responding students indicated medium-high usage for statistics learning, however postgraduates were more likely to be frequent users of GenAI ($\chi^2(3) = 62.678, p < 0.001$), with 50% of postgraduates indicating medium-high usage, compared to 20.2% for undergraduates. The majority of undergraduates (63.2%) are aware of the possible use of GenAI but either choose not to use it, or have low usage. While the rate of no-low usage may appear higher than expected, this may be subject to underreporting where, for example, students were concerned about potential academic misconduct (see Table 3). Furthermore, the usage reported relates to statistics specifically, as opposed to general study purposes which saw higher reported usage (55.3% medium-high usage overall). Variation in usage across fields of study was found to be small (Appendix A2).

Table 2. GenAI usage for specific activities relating to the learning and assessment of statistics, by study level.

Stats GenAI user	Unaware		Unaware / other non-specified use		No-low usage		Medium-high usage		Overall	
	N	%	N	%	N	%	N	%	N	%
Undergraduate	35	8.8%	31	7.8%	251	63.2%	80	20.2%	397	100.00%
Postgraduate	4	1.9%	10	4.7%	93	43.5%	107	50.0%	214	100.00%
Total	39	6.4%	41	6.7%	344	56.3%	187	30.6%	611	100.00%

Overall, the mean statistics anxiety level was 3.1, with 19.8% having a mean less than 2 (none-low anxiety) and 11.5% having anxiety above 5 (high). Figure 1 summarises the responses to the impact of using GenAI on statistics anxiety and confidence. The majority felt that using GenAI reduced anxiety (38.7% + 20.6% = 59.3%) and increased confidence (66%), with higher reported changes for frequent users (see Table 4).

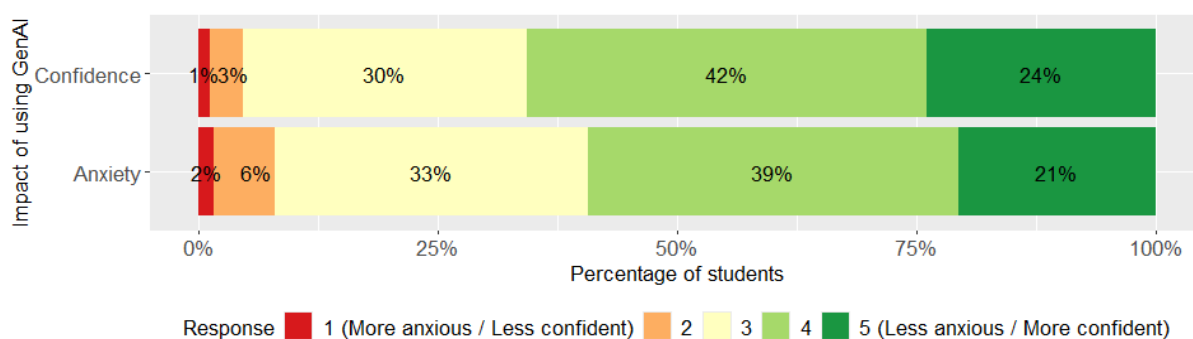


Figure 1. Impact of using GenAI on statistics anxiety and confidence with learning statistics.

Student perceptions of GenAI

Participants were asked to indicate the extent to which they agreed with the statements listed in the first column of Table 3, with responses from strongly disagree to strongly agree in a 5-point Likert scale. The second column of Table 3 indicates the extent to which participants either agreed or strongly agreed. Students generally feel that they have been given guidance on the appropriate use of GenAI (68%), but fewer feel encouraged (36%) or think they should be encouraged to use it (43%). Students generally don't trust the responses GenAI provides (19%), and many feel anxious about potential academic misconduct (65%). Some students also had concerns about GenAI use reducing their ability to learn properly (45%), and feel that it undermines the value of university education (42%). Table 3 also shows the Spearman correlations between the level of agreement with these statements and their perceived ability, statistics anxiety, usage, reduction in anxiety and increase in statistics confidence. These perceptions could be viewed as barriers or enablers of adopting GenAI use, particularly if they are related to GenAI use. Perceived ability in statistics does not appear to be strongly related to perceptions of GenAI (fourth column). Some weak relationships with statistics anxiety are present, but stronger relationships exist with usage (as may be expected), and also stronger relationships with both perceived reduction in anxiety and increase in confidence. Encouragement or potential encouragement, receiving guidance, and being able to use GenAI in assessments are all related to a reduction in statistics anxiety as a result of using GenAI. Beliefs about GenAI reducing their ability to learn and undermining a university education have a negative relationship with anxiety reduction. The results for increase in confidence are similar, with a belief that students should be encouraged to use GenAI in their studies having the strongest association.

Table 3. Perceptions of using GenAI Percentage agreement and Spearman's correlations. (*significant at the 0.05 level; **significant at the 0.01 level.).

Opinion Statements	Overall % agree	Spearman's Correlations				
		Statistics anxiety mean	Perceived ability	GenAI usage for statistics	Reduction in statistics anxiety	Increase in statistics confidence
I am encouraged by my lecturers to use GenAI to help with my studies.	36%	0.02	0.07	0.30**	0.20**	0.24**
I have been given clear guidance on the appropriate use of GenAI in my studies.	68%	-0.04	0.10*	0.13**	0.22**	0.22**
Students should be encouraged more by their lecturers to use GenAI to help them with their studies.	43%	0.12**	-0.03	0.36**	0.29**	0.38**
Students should be allowed to use GenAI when completing assessments.	37%	0.16**	-0.01	0.32**	0.28**	0.27**
Using GenAI for assessments undermines the value of a university education.	42%	-0.03	-0.02	-0.18**	-0.24**	-0.22**
I trust that the answers or responses from GenAI are always truthful and correct.	19%	0.12**	0.02	0.25**	0.12**	0.15**
I am anxious about using GenAI for fear of being accused of academic misconduct.	65%	0.17**	-0.10*	-0.05	0.00	0.05
I am concerned that GenAI might limit my ability to learn my subjects.	45%	0.04	0.03	-0.08*	-0.13**	-0.17**

Relationships between statistics anxiety, perceived ability, usage, and impact on anxiety & confidence

Table 4 shows the correlations between perceived ability, statistics anxiety, usage, reduction in anxiety and increase in statistics confidence. Significant but weak relationships are present between use of GenAI for the statistics tasks specified, and both statistics anxiety and perceived ability in statistics. This suggests that anxious students and those feeling their statistics ability was good are more likely to use GenAI for their learning of statistics. However, further investigation indicated that this relationship may not be generally monotonic (increasing), and so further comparisons are provided in Table 5. The relationships between usage and perceived changes in anxiety and confidence (Table 4) are significant, positive and moderate, meaning that the more students use GenAI, the greater their change in statistics anxiety and confidence. Students with higher levels of statistics anxiety are also more likely to report a decrease in statistics anxiety but not in confidence.

Table 4. Usage, statistics anxiety, ability and changes in anxiety and confidence: Spearman's correlations. (*significance at the 0.05 level; **significant at the 0.01 level.).

Spearman's correlation	Statistics anxiety	Perceived ability	Gen AI statistics usage	Reduction in statistics anxiety	Increase in statistics confidence
Perceived ability	-0.36**				
Gen AI stats usage	0.08*	0.13**			
Reduction in statistics anxiety	0.23**	0.09*	.43**		
Increase in statistics confidence	0.08	.11*	0.50**	0.66**	
Age	-0.11*	-0.01	-0.17*	-0.09	-0.01

Comparisons of statistics anxiety, age, perceived ability, and impact of using GenAI on anxiety and confidence, between usage groups.

Table 5 summarises ANOVA and Kruskal-Wallis results to compare scores for the variables listed in the first column by usage group. Although significant differences were found between usage

groups for each test, effect sizes were small to moderate. The no-low usage group had significantly lower anxiety than frequent users and the ‘unaware / other non-specified use’ group. The not aware group were significantly older than other groups and frequent users significantly younger than non-users. The ‘unaware / other non-specified use’ are less likely to perceive their ability with statistics as good. The most frequent users had significantly higher changes in both reduced anxiety and increased confidence due to using GenAI than both the non and low user groups. Given group differences for a range of demographic and perception questions, usage category differences were also tested after controlling for other predictors of statistics anxiety (Table 5, bottom row). A backward elimination model identified GenAI usage groups, age, institution, study level, perceived ability in statistics, and the perception questions on fear of being accused of academic misconduct and students being allowed to use GenAI in assessments, as significant predictors of statistics anxiety. The no-low usage group had significantly lower anxiety than frequent users ($p = 0.016$) and a borderline significant difference from those who are unaware ($p = 0.071$) after controlling for the other significant predictors.

Table 5. Comparisons of statistics anxiety, age, perceived ability, and impact of using GenAI on anxiety and confidence, between usage groups.

Variable	Hypothesis test result and effect size	Unaware	Unaware / other non-specified use	No-low usage	Medium-high usage	Overall
Statistics anxiety	$F(3,607)=6.78, p<0.001, \eta^2=0.032$	3.5	3.4	2.9	3.3	3.1
Age	$F(3,607)=15.02, p<0.001, \eta^2=0.069$	36	29	30	25	28
% good ability	$K-W=15.08, p=0.002, \eta^2=0.020$	28%	20%	41%	47%	40%
% reduced anxiety	$K-W=61.9, p<0.001, \eta^2=0.099$	NA	29%	49%	79%	59%
% increased confidence	$K-W=86.9, p<0.001, \eta^2=0.140$	NA	25%	56%	87%	66%
% PG	$\chi^2(3)=62.678, p<0.001, V=0.320$	10%	24%	27%	57%	35%
Statistics anxiety (after controlling for other factors)	$F(3, 559)=4.76, p=0.003, \eta_p^2=0.025$	3.5	3.1	2.9	3.3	NA

DISCUSSION, CONCLUSIONS AND FUTURE WORK

While the reported amount of GenAI usage for studying statistics is modest overall, our findings indicate that GenAI usage is associated with reductions in statistics anxiety and increases in confidence while studying statistics. Overall, mean statistics anxiety is positively associated with GenAI usage. However, students who were unaware of GenAI usage for statistics tasks were more anxious on average, compared with students who were aware but chose not to use GenAI or had no-low usage. This suggests that in terms of anxiety reduction, possible benefits may accrue in students being made aware of GenAI use for statistics learning. This benefit may also apply to perceived ability with statistics, since students who were aware of GenAI usage, regardless of whether or not they chose to use GenAI, had higher perceived ability compared with students who were not aware. Other factors significantly associated with statistics anxiety were age, institution, perceived ability in statistics, and perceptions related to anxiety about using GenAI for fear of being accused of academic misconduct and students being allowed to use GenAI in assessments. Different institutions may have different approaches in terms of how much students are encouraged to use GenAI, and what is considered to be appropriate versus inappropriate use of GenAI, meaning that further research to understand these differences would be useful. The limitations of this study include reliance on self-reported data, as well as the variability of GenAI use over time in the rapidly evolving GenAI landscape, both of which may have resulted in lower stated GenAI usage than may be expected. Given the latter limitation, further research is recommended so that the findings of this study can be reassessed. In conclusion, our findings indicate that both awareness and usage of GenAI are related to lower statistics anxiety and increased confidence. While students tend to have some healthy skepticism around GenAI outputs, the results also highlight the potential of GenAI as a useful learning assistant, particularly for students who experience statistics anxiety. Further work is

therefore recommended on educating students on how to use GenAI appropriately while learning statistics, and the impacts of this on anxiety, confidence and learning, as well as analysis of qualitative data to provide further insights.

APPENDIX

Table A1. GenAI usage categories.

Usage of Gen AI for learning statistics	I wasn't aware GenAI tools could do this	I am aware GenAI tools can do this but Never used	Rarely used (e.g. several times per year)	Sometimes used (e.g. several times per month)	Often used (e.g. several times per week)	Regularly used (e.g. several times per day)	% aware
	1	2	3	4	5	6	
Getting help with choosing the right method of statistical analysis	132	186	108	114	52	19	78%
Uploading a dataset and asking GenAI to analyse the data for you	157	231	88	80	44	11	74%
Uploading results of a statistical analysis (e.g. from statistics software) and asking GenAI to explain what those results mean.	126	225	80	94	58	28	79%
Getting help with formulating conclusions and writing up results based on any statistical analysis performed.	105	251	77	97	58	23	83%
New categories	Unaware	Aware but no-low usage	Medium-high usage				
mean usage	1	1.25 - <=3	>3				
N group	80	344	187				

Table A2. Field of study and mean usage.

Subject	Frequency	Percentage	Mean usage
Data Sciences	187	21.6%	3.1
Business management	142	16.4%	3.1
Mathematics	121	14.0%	2.4
Building, engineering and physical sciences	108	12.5%	2.7
Computing and IT	87	10.0%	2.9
Social sciences (including economics)	86	9.9%	2.1
Biological, sports, life and health sciences	73	8.4%	2.2
Statistics	62	7.2%	2.6
Total	866*	100%	2.7

*Students could identify more than one field of study included in their qualification, meaning that the 611 responding students identified 866 fields of study in total.

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