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University Students' Statistical Anxiety, Attitude towards Learning Statistics and Academic Achievement

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Abstract

This study investigates the interplay among statistical anxiety, attitudes toward learning statistics, and academic achievement in university students, with a focus on the Pakistani higher education context. Using a correlational research design, data were collected from a sample of 350 university students across multiple disciplines. Instruments employed include the Statistics Anxiety Rating Scale (STARS) and the Survey of Attitudes towards Statistics (SATS-36©), validated tools for assessing statistical anxiety and attitudes. Descriptive statistics, independent samples t-tests and Pearson correlation analyses were conducted to examine relationships between variables and to explore the influence of demographic factors. Findings emphasize the importance of fostering positive attitudes to mitigate anxiety and enhance academic success in statistics courses. This research contributes to the development of targeted educational strategies for improving student outcomes in data-driven academic disciplines.

Keywords: Statistical anxiety, attitudes toward statistics, academic achievement, STARS, SATS-36©, higher education, Pakistan, data literacy.

1. Introduction

Statistics is one of the section in mathematics that is involved with means of in collecting, grouping, categorizing, analyzing figures and as well as drawing conclusions depending on the analysis conducted to the figures collected (Gani & Amalia, 2015). It is defined as problems, stress and fear that a person experiences when undertaking, trying to evaluate, processing or attempting to make an evaluation of any kind of statistical information (Macher et al., 2012). Rosli et al. (2017) observed moderate negative relationship between attitudes toward statistics and statistical anxiety; he noted that favorable attitude reduces anxiety. Khavenson et al. (2012) obtained similar findings using the adapted SATS-36 scale, demonstrating the moderate negative relationship between students' attitude toward statistics, statistics self-efficacy, and statistical anxiety.

Chiesi and Primi (2010) proved that an increase in statistical anxiety results in negative attitudes toward the subject and, a decrease in student competencies and academic achievements. On the other hand, minimal anxiety enhances the student's Statistical Comprehension and more positive statistical attitudes, hence better results. Understanding the complex relationship between statistical anxiety, attitude towards

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learning statistics, and academic achievement is crucial for enhancing teaching methods and improving student outcomes in statistics education (Macher et al., 2012). This study aims to fill the existing gaps by examining the relationship between university students' statistical anxiety, their attitudes towards learning statistics, and their academic achievement in statistics courses. The findings of this research are expected to contribute both practical solutions for enhancing student outcomes and theoretical insights that can inform future research in diverse educational settings. Literature by addressing the overlooked role of attitudes toward statistics, which is often neglected in broader studies on mathematics anxiety.

2. Literature Review

The concept of statistics anxiety can be used to explain the range of mental, emotional, and physiological processes that students go through when they encounter anxiety that is directly related to statistics. According to Bandura and Adams (1977), personal experiences with performing and attempting to master a task have a great influence on a person's sense of self-efficacy regarding that task. Prior positive learning experiences can lead to increased self-efficacy. The physiological or affective state of a person can affect his or her performance when attempting to complete a task. Physiological responses to a situation are related to the emotions experienced when attempting to complete a task, and can manifest in ways such as fatigue, feelings of stress, or altered mood (Hodges, 2008; Zimmerman, 2000).

2.1 Students' Attitudes toward Statistics

According to Schau (2003b), attitudes towards statistics comprise the following six attitudes: positive affect, cognitive competency, difficulty, perceived importance, client interest, and perceived amount of effort. The results of statistics course, students' willingness to use statistics throughout their degree, and students' desire to use statistics in the workplace are all examples of statistics outcomes. According to Steen (2000), mathematics must be used in real-world contexts that captivate and involve pupils in order for it to have meaning for those learning it. According to Moore (1998), "working with data provides a rich setting for problem-solving and group work and gives a context to mathematics exercises that would otherwise be abstract" (p. 1255). For middle and high school pupils, Richard Schaeffer developed "Data analysis and Probability" exercises in the 1990s (Garfield & Ben-Zvi, 2008).

a. Statistical Thinking

Statistical thinking focusses on developing mental habits to solve statistical problems. This involves considering non-data factors that may assist explain data variability and trends (Garfield & Ben-Zvi, 2005). This approach uses statistics and data context to find meaning. Knowledge of data context can explain changes (Watson, 2006). Understanding data variability helps model variance, choose appropriate statistical tests and analyses, validate statistical measure validity assumptions, and draw conclusions. Statistical thinking also helps data-challenged people identify statistical flaws, study design, and data collection issues. Statistical thinking a statistician's data-handling behavior can be improved by learning more about statistics.

b. Context Approach to Teaching Statistics

Students can explore a range of data that they are familiar with thanks to the context-based approach to statistics education, which also enables them to identify and comprehend broader social concerns related to their field of study. According to Dewey (1910), "the available data can only suggest the solution; they cannot provide it" (p. 12). Students must therefore investigate statistical concepts in a specific setting.

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According to Gal (2002), the development of statistical literacy in adults depends on the context-awareness of data. The importance of context in understanding data was recognized by Shaughnessy (2007) who dubbed this process "reading behind the data." Those who struggle with data will be able to explain specific results and patterns that arise from data if they are aware of the context of the situation (Gal, 2002). People who are aware of the data's context will be able to fully evaluate the findings, relate the evidence to the claims, and move beyond the facts to critically examine and debate statistical information (Gal, 2002; Makar & Rubin, 2009; Watson, 2006).

c. Assessment of Statistics Anxiety

Cruise et al. (1985) developed a six-dimensional framework to assess statistics anxiety. These dimensions include: students' emotional responses to statistics about their academic field; the apprehension experienced when interpreting statistical data and making decisions; anxiety triggered during classroom activities or examinations; and a self-perception tied to understanding and engaging with statistics. Onwuegbuzie et al. (1997) built upon the work of Cruise et al. (1985) and identified four primary components that help to understand the nature of the various dimensions of statistics anxiety. Another area to surface was student interpersonal anxiety that might be help-seeking anxiety or anxiety regarding the teacher of statistics. Last, there was the concern of failure anxiety that seems to plague many students with concern for the grades in efforts to learn and understand the information designed (Onwuegbuzie et al., 1997).

3. Research Methodology

The research paradigm of this study is positivism. Statistical Anxiety, Attitude towards Learning Statistics and Academic Achievement are all examined in this study by utilizing a cross-sectional research design. The population of the study comprises all students enrolled in the Faculty of Social Science program at public and private sector universities in Lahore. According to data from the Higher Education Commission (HEC) website, Lahore is home to 36 universities, consisting of 15 public and 21 private institutions. Of these, 5 public universities and 7 private universities offer social science programs. This study encompasses all undergraduate and graduate students enrolled in these social science programs. A multi-stage sampling process was employed to select participants from the social science programs at universities in Lahore. Out of 12 universities offering social science programs, 5 were public and 7 were private institutions. In the first stage, 2 public and 2 private universities were selected using a non-proportionate stratified random sampling technique. In the second stage, schools of social science programs from these selected universities were chosen using convenient sampling. Subsequently, 87 students from each university were conveniently selected. 350 students were selected, with 175 from public universities and 175 from private universities, ensuring balanced representation from public and private institutions.

The instruments used in this study were the Statistics Anxiety Rating Scale (STARS) and the Survey of Attitudes towards Statistics 36 (SATS 36). Academic achievement data is collected through the demographic questionnaire section, gathering information on educational background, course enrollment, age, grades, and CGPA earned. The study's demographic characteristics and main variables, including statistical anxiety, attitude toward statistics, and academic achievement, were

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computed on their means, standard deviation, frequencies, t-test, and Pearson correlations. Data analysis was performed using SPSS 17th edition.

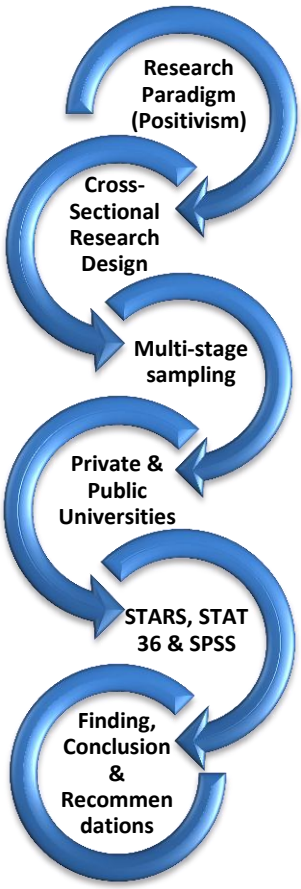

Fig 1: Graphical Representation of Research Design and Methodology of the Study

4. Results

This study aims about the Relationship among University Students' Statistical Anxiety, Attitude towards Statistics, and Academic Achievement.

a. Demographic Characteristics

The demographic profile of the participants illustrates a diverse sample based on age, institution type, gender, qualification, and academic performance as depicted in Table 1. Regarding age, most participants fell into the youngest group, 20 years (n=200, 57.14%), followed by 20–29 (*N*=100, 28.57%). The sample was evenly distributed in terms of the type of institution, with 50.0% (*n*=175) of participants from public institutions and 50.0% (*n*=250) from private institutions.

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Table 1: Demographic Table for Students (N=350)

Variable	Category	n	%
Type of Institution	Public	175	50%
	Private	175	50%
Gender	Male	200	57.14%
	Female	150	42.85%
Age	20	200	57.14%
	20-29	100	28.57%
	30-39	50	14.28%
Qualification	Bachelors	305	61.0%
	M.Phil	35	7.0%
	PhD	10	2.0%
CGPA	Above 3.0	75	21.42%
	Below 3.0	150	42.85%
	Above 3.4	75	21.42%
	Above 3.7	50	14.28%

The gender distribution indicated a slightly higher representation of males (n=200, 57.14%) than females (n=150, 42.85%). For qualification, the majority of participants were pursuing a bachelor's degree (*n*=305, 61.0%), as compared to the MPhil and PhD programs. Academic performance showed that 42.85% (n=150,) of participants had a CGPA above 3.0, with 21.42% (*n*=75) achieving a CGPA above 3.4 and 14.28% (*n*=50) exceeding 3.7.

Table 2: Descriptive Statistics for Students about STARS

Factor	*M*	*SD*
Test and Class Anxiety	3.51	0.96
Interpretation Anxiety	3.31	1.08
Ask for Help	3.21	1.09
Worth of Statistics	3.27	1.08
Fear of Statistics Teacher	3.03	1.12
Computation of Self-Concept	3.21	1.09

Table 2 outlines participants' levels of anxiety in various aspects. The highest level of anxiety was observed in the Statistical Test and Class Anxiety factor among students, with a mean of (M=3.51, SD 0.96) reflecting the pervasive nature of this anxiety among participants. While other factors had an average score indicating moderate

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anxiety levels when seeking assistance or assessing their abilities in computations, with noticeable differences among individual responses.

Table 3: Descriptive Statistics for SATS

Factor	*M*	*SD*
Affect	3.11	1.15
Cognitive Competence	3.31	1.13
Value	3.20	1.10
Difficulty	3.47	1.11
Interest	3.37	1.09

Students' attitudes towards statistics are reflected in the Affect-students' feelings as presented in statistics table 3. With variability showing a range of positive and negative emotions, the average score of 3.11 points to a moderate emotional response. Cognitive Competence: Students' attitude towards their knowledge and abilities in statistics (M = 3.31, SD = 1.13), Students' assessments of their statistical intelligence show a modest level of confidence. Students' interest in statistics is relatively high, as seen by their readiness to interact with statistical concepts (M = 3.37, SD = 1.09).

b. T-Test

This table 4 compares male and female students' scores on various statistics-related variables. For test anxiety, males scored slightly higher (M = 28.46, SD = 3.42) than females (M = 28.06, SD = 3.57), but the difference was not significant, t (348) = 0.71, p = .47 t (348) = 0.71, p = .47, CI [-0.70, 1.50]. The variable asks for help showed no significant gender difference. For worth of statistics, males scored higher (M = 50.83, SD = 9.64) than females (M = 47.40, SD = 11.90), though the difference was not significant, t (348) = 1.86, p = .06, CI [-0.19, 7.05]. However, for computation anxiety, males scored significantly higher (M = 20.37, SD = 3.25) than females (M = 19.02, SD = 4.41), t (348) = 1.99, p = .04, CI [0.02, 2.69].

Table 4: Independent Samples t-Test for Gender with STARS

Variable	Gender	M	SD	T	df	P	95 CI
Test Anxiety	Male	28.46	3.42	0.71	348	.47	[-0.70, 1.50]
	Female	28.06	3.57				
Interpretation	Male	30.13	4.93	0.34	348	.73	[-1.30, 1.85]
	Female	29.86	5.09				
Ask for Help	Male	13.15	2.40	0.78	348	.43	[-0.51, 1.19]
	Female	12.81	2.79				
Worth Statistics	Male	50.83	9.64	1.86	348	.06	[-0.19, 7.05]
	Female	47.40	11.90				
Fear of Statistics Teacher	Male	28.39	3.77	1.51	348	.17	[0.17, 1.32]
	Female	27.82	3.30				
Computation	Male	20.37	3.25	1.99	348	.04*	[0.02, 2.69]
	Female	19.02	4.41				

Note: *p < .05.

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For Affect-student's feelings concerning statistics, males scored slightly higher (M = 16.43, SD = 3.55) than females (M = 15.45, SD = 3.75), but the difference was not significant, t (348) = 1.67, p = .09, CI [-0.17, 2.15] as shown in table 5. Males also scored slightly higher on Value-students attitude about the usefulness, relevance, and worth of statistics in personal and professional life. Finally, for Interest-students level of individual interest in statistics, males scored higher (M = 10.65, SD = 2.07) compared to females (M = 10.00, SD = 2.51), though the difference was not significant, t (348) = 1.66, p =.09, CI [-0.12, 1.41].

Table 5: Independent Samples t-Test for Gender with SAT

Variable	Gender	M	SD	t	df	p	95 CI
Affect	Male	16.43	3.55	1.67	348	.09	[-0.17, 2.15]
	Female	15.45	3.75				
Cognitive Competence	Male	14.46	3.46	2.40	348	.01*	[0.25, 2.52]
	Female	13.07	3.68				
Value	Male	20.22	4.27	1.82	348	.06	[-0.09, 2.47]
	Female	19.03	4.08				
Difficulty	Male	25.26	3.84	2.50	348	.01*	[0.36, 2.99]
	Female	23.58	4.30				
Interest	Male	10.65	2.07	1.66	348	.09	[-0.12, 1.41]
	Female	10.00	2.51				

Table 6 presents t-test results comparing students' scores across public and private universities for several anxiety-related and statistics-related variables. For test anxiety, public university students reported a slightly higher mean (M = 28.39, SD = 3.77) than private university students (M = 27.82, SD = 3.30), but this difference was not statistically significant. In contrast, there was a significant difference in asking for help, where public university students scored higher (M = 13.20, SD = 2.49) than their private university counterparts (M = 12.51, SD = 2.95), t (348) =2.35, p=.01, CI [0.11, 1.26]. Regarding the worth of statistics, public university students again had slightly higher scores (M = 48.62, SD = 10.11) compared to private students (M = 47.07, SD = 13.03), though this difference was not significant, t (348) =1.24, p=.21, CI [-0.90, 4.00].

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Table 6: Independent Samples t-Test for University Sectors with STARS

Variable	University	M	SD	t	df	p	95 CI
Test Anxiety	Public	28.39	3.77	1.51	348	.13	[-0.17, 1.32]
	Private	27.82	3.30				
Interpretation	Public	29.67	4.70	-0.80	348	.42	[-1.50, 0.63]
	Private	30.11	5.40				
Ask for Help	Public	13.20	2.49	2.35	348	.01*	[0.11, 1.26]
	Private	12.51	2.95				
Worth Statistics	Public	48.62	10.11	1.24	348	.21	[-0.90, 4.00]
	Private	47.07	13.03				
Fear of Statistics Teacher	Public	28.39	3.77	1.51	348	.17	[0.17, 1.32]
	Private	27.82	3.30				
Computation	Public	18.99	4.53	-0.87	348	.38	[-1.30, 0.50]
	Private	19.39	4.06				

Note. *p < .05

Public university students and private university students do not significantly differ in the variable Affect-student's feelings concerning statistics and attitude towards their intellectual knowledge and skills as shown in table 7. However, there were notable distinctions between students' attitudes about the value, relevance, and usefulness of statistics in both their personal and professional lives (Value) and their level of personal interest in statistics (Interest) which were significantly higher among private university students (M = 20.30, SD = 3.87) than among public university students (M = 18.07, SD = 4.07), t (348) = −5.23, p<.001, CI [-3.06, -1.39]. The ratings for Difficulty the students' perception of how hard statistics is as a subject were about the same (M = 23.81 for public; M = 23.80 for private), and there was no discernible difference (t (348) = 0.01, p = .99 t, CI [-0.89, 0.91]).

Table 7: Independent Samples t-Test for University Sectors with SATS

Variable	University	M	SD	t	df	p	95 CI
Affect	Public	15.38	3.82	-0.97	348	.33	[-1.17, 0.40]
	Private	15.77	3.66				
Cognitive Competence	Public	12.95	3.73	-1.55	348	.12	[-1.38, 0.17]
	Private	13.55	3.60				
Value	Public	18.07	4.07	-5.23	348	.00*	[-3.06, -1.39]
	Private	20.30	3.87				
Difficulty	Public	23.81	4.10	0.01	348	.99	[-0.89, 0.91]
	Private	23.80	4.46				
Interest	Public	9.59	2.55	-3.87	348	.00*	[-1.51, -0.49]

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	Private	10.59	2.28

The independent samples t-test results revealed significant differences between public and private university sectors in two variables related to SATS (Scholastic Aptitude Tests). Specifically, the private university sector scored significantly higher than the public sector on the Value variable ($t(348) = -5.23$, $p < 0.001$), with a mean difference of -2.23 and a 95% confidence interval of [-3.06, -1.39]. Additionally, the private sector scored significantly higher on the Interest variable ($t(348) = -3.87$, $p < 0.001$), with a mean difference of -0.49 and a 95% confidence interval of [-1.51, -0.49]. However, no significant differences were found between the two sectors on the Affect, Cognitive Competence, and Difficulty variables.

Table 8: Pearson Correlation among STARS and Academic Achievement

Variables	Test Anxiety	Interpretation	Ask for Help	Worth Statistics	Computation	Academic Achievement
Test Anxiety	-					
Interpretation	-0.45**	-				
Ask for Help	0.30*	0.25*	-			
Worth Statistics	-0.28**	0.40**	0.20*	-		
Computation	-0.34**	0.35**	0.15	0.50**	-	
Academic Achievement	-0.50**	0.48**	0.10	0.35**	0.45**	-

Note: *p < 0.05, **p < 0.01

A Pearson correlation analysis was conducted to examine the relationships between Test Anxiety, Interpretation, and Ask for Help, Worth Statistics, Computation, and Academic Achievement. The results revealed several statistically significant correlations as shown in table 8. This finding indicates that seeking help is marginally related to perceiving statistical tasks as worthwhile. In conclusion, the findings highlight the complex interplay between psychological and cognitive variables and their impact on academic achievement. High test anxiety negatively Affect-student's feelings concerning statistics performance, while interpretative skills, perceived worth, and computational competence positively contribute to educational outcomes.

The Pearson correlation analysis showed a number of interesting trends. Emotional engagement is associated with a higher sense of cognitive ability or students' attitude towards their intellectual knowledge and skills when applied to statistics ($r = 0.45$, $p<.01$). The Effect was also positively correlated with students' attitudes towards the value, relevance, and usefulness of statistics in both personal and professional life ($r = 0.37$, $p<.01$) and their level of personal interest in statistics ($r = 0.40$, $p<.01$). There is a negative correlation between students' attitudes about the difficulty of statistics as a subject ($r = -0.30$, $p<.01$) and cognitively competent attitudes about their intellectual knowledge and skills when applied to statistics. This suggests that competent people view tasks as less difficult. All of these findings highlight the importance of emotional

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engagement, competence, value the belief that statistics are valuable, relevant, and valuable in both personal and professional life and interest in promoting academic success. On the other hand, perceptions of difficulty the belief that statistics is a difficult subject seem to impair performance.

Table 9: Pearson Correlation among SAT and Academic Achievement

Variable	Affect	Cognitive Competence	Value	Difficulty	Interest	Academic Achievement
Affect	-					
Cognitive Competence	0.45**	-				
Value	0.37**	0.50**	-			
Difficulty	-0.28**	-0.30**	-0.25*			
Interest	0.40**	0.48**	0.42**	-0.20	-	
Academic Achievement	0.35**	0.52**	0.40**	-0.22*	0.47**	-

The Pearson correlation analysis revealed significant relationships between SAT-related variables and academic achievement. Students with more positive emotions towards the SAT (Affect) tended to have higher cognitive competence ($r = 0.45$, $p < 0.01$) and academic achievement ($r = 0.35$, $p < 0.01$). Additionally, students who valued the SAT (Value) had higher cognitive competence ($r = 0.50$, $p < 0.01$) and academic achievement ($r = 0.40$, $p < 0.01$). Interest in the SAT was also positively correlated with academic achievement ($r = 0.47$, $p < 0.01$). In contrast, students who perceived the SAT as more difficult tended to have lower cognitive competence ($r = -0.30$, $p < 0.01$) and academic achievement ($r = -0.22$, $p < 0.05$).

5. Discussion

The findings of this study underscore the complex interplay between statistical anxiety, attitudes toward learning statistics, and academic achievement among university students, highlighting critical areas for intervention and reform. Statistical anxiety, particularly in test and classroom scenarios, was a prominent factor negatively influencing academic performance. Students reported moderate to high levels of anxiety, with mean scores ranging from 3.41 to 3.70 on the Statistical Anxiety Rating Scale (STARS). These results corroborate existing literature indicating that test anxiety disrupts cognitive functioning, undermining students' ability to process information effectively during assessments (Onwuegbuzie & Wilson, 2003).

Age-related trends in the study provided additional insights into statistical anxiety. Older students (30–39 years) reported significantly lower test anxiety levels compared to younger participants, reflecting greater emotional regulation and maturity as suggested by Pintrich and Zusho (2002). These findings underscore the need for

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tailored support programs for older learners, including workshops focused on digital competence and flexible learning models that accommodate diverse educational backgrounds.

Public university students showed higher scores in the "Ask for Help" subscale ($p = .01$), indicating a more collaborative approach to learning. This could be attributed to resource constraints in public institutions, which may necessitate peer-assisted learning and collective problem-solving. The study also highlights the role of emotional and cognitive factors in shaping students' academic trajectories. Strong correlations between affect, cognitive competence, and academic achievement (e.g., $r = .80$ for affect and competence) reinforce the importance of fostering positive emotions in statistical learning. These findings align with Pekrun's (2006) control-value theory, which posits that students who perceive statistics as valuable and feel confident in their abilities are more likely to engage actively and succeed academically. However, in Pakistan, where academic pressure is pervasive and emotional well-being often neglected, fostering a supportive and encouraging environment is critical. Educators must adopt teaching strategies that prioritize student well-being, reduce intimidation, and emphasize the practical relevance of statistics to real-world contexts.

Finally, the moderate-to-high agreement levels observed in subscales such as Worth of Statistics and Interest suggest that students generally value statistics and recognize its importance. However, systemic barriers, including outdated curricula, limited practical applications, and a focus on theoretical understanding, hinder deeper engagement. To address these challenges, educators and policymakers should integrate applied learning opportunities, such as case studies, projects, and real-world data analysis, to enhance students' appreciation for the subject. By creating a learning environment that values both emotional and cognitive development, educators can help students overcome anxiety and build a more positive and resilient relationship with statistics.

6. Conclusion

This study examined the relationships among university students' statistical anxiety, attitudes toward learning statistics, and academic achievement. The research utilized data from various subscales measuring dimensions such as Test and class Anxiety**,** Fear of Statistics Teacher**,** Cognitive Competence**,** and Worth of Statistics**.** Descriptive statistics revealed moderate levels of statistical anxiety and variability in students' attitudes and perceptions. Inferential statistical tests, including Pearson correlations, and independent t-tests were conducted to explore the effects of demographic variables such as university and gender. The findings highlighted significant relationships among emotional, cognitive, and behavioral factors influencing students' learning experiences. Notable differences in anxiety, competence, and engagement were observed based on gender, university sector, and age groups, while educational qualifications showed no significant impact on any variable. These results underscore the need for targeted interventions to alleviate statistical anxiety, enhance competence, and improve attitudes toward statistics learning.

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