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Exploring Pre-Service Biology Teachers' Anxiety Levels In the University of Education, Winneba

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ABSTRACT

This study explored the levels and sources of anxiety among Level 100 pre-service biology teachers at the University of Education, Winneba, Ghana, with a focus on how gender influences anxiety experiences during lessons and assessments. Employing a mixed-methods research design, the study integrated a descriptive survey and a qualitative descriptive design to collect both quantitative and qualitative data. The study involved the entire cohort of 81 level 100 pre-service biology teachers (51 males and 30 females). Data were gathered via a structured questionnaire (adapted from the Betz MAR-S scale, 1978) to measure biology-specific anxiety and semi structured interviews. The quantitative findings revealed that while many students reported low to moderate levels of anxiety, significant anxiety was triggered by conceptual difficulty and cognitive overload rather than test-related stress. Inferential statistical testing revealed that male students reported significantly higher levels of anxiety specifically related to conceptual confusion and cognitive overload, though general test anxiety did not differ by gender. Qualitative data further illuminate the impact of anxiety on academic performance, highlighting themes such as cognitive interference, self-doubt, study avoidance, and reduced classroom engagement. These findings underscore the need for targeted pedagogical interventions, including scaffolding of complex concepts, breaking down cognitive overload, alongside stress management workshops and peer support systems, to enhance academic performance and emotional well-being among biology teachers.

1. Introduction

In Ghana, as in many other countries, various educational levels are designed to meet the needs of individuals and society at large. University education, especially for preservice teachers, plays a critical role in shaping future educators, and this includes preparing them for the demands of secondary education and beyond. The University of Education, Winneba (UEW), stands as an institution central to developing competent educators, particularly in the field of biology education. Scholars argue that higher education aims to produce teachers who are well prepared not only for professional success but also for the betterment of society (Nketsia, 2011).

Thus, pre service teacher education should focus on nurturing individuals who are not only knowledgeable but also skilled in imparting knowledge in ways that benefit both the learner and society. Students are expected to master various professional competencies, including agricultural, industrial, commercial, and economic principles, which are pivotal for advancing the national development agenda (Nketsia, 2011). In turn, these future educators are expected to contribute significantly to sectors such as technology, sciences, and commerce, effectively preparing the next generation of specialists (Mokaya, 2013).

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One of the critical subjects within the teacher education curriculum is biology. Biology is an essential scientific discipline that fosters an understanding of the natural world and equips students with the knowledge necessary for solving contemporary global challenges.

It not only enhances students' awareness of living organisms, including plants and animals but also promotes environmental education and broader scientific literacy (Kim, 2016). Biology education thus serves as a key avenue for developing competent citizens who can actively participate in societal development through scientific and technological engagement (Bandelow, Michaelis, & Wedekind, 2017).

However, while science education, particularly in biology, plays an important role in pre service teacher training, challenges related to the teaching and learning process often arise. One such challenge is the issue of academic anxiety, which has been identified as a significant barrier to effective learning in various academic fields, including biology. Anxiety, particularly academic anxiety, is a psychological state that negatively affects cognitive, behavioural, and emotional well-being. While some level of anxiety can motivate students to excel, excessive anxiety can severely hinder academic performance (Cassady & Johnson, 2002). This phenomenon is not limited to students in secondary education but extends to pre service teachers as well.

In the context of biology education, anxiety can manifest in various forms, including test anxiety, performance anxiety, and subject-specific anxiety. A study in Kenya revealed that test-related anxiety negatively affects students' achievements in the sciences, including biology (Mokaya, 2013).

Similarly, research conducted in India has indicated that mathematics anxiety has a detrimental effect on students' creativity in the subject (Sharma, 2014). In Ghana, a study by Orakwue and Okigbo (2023) highlighted cognitive test anxiety in biology as a key factor influencing academic success. However, there remains a gap in research specifically focusing on anxiety levels among pre service biology teachers. Understanding anxiety at the pre service level is crucial; research shows that pre service teacher anxiety often leads to "anxiety taint," where anxious teachers unconsciously transmit negative attitudes and anxiety toward the subject to their future students. Currently, there is a lack of contextualized data on what specifically triggers anxiety in pre service biology teachers at UEW and how gender influences these experiences.

Thus, this study aims to explore the levels of anxiety among pre service biology teachers at the University of Education, Winneba. By examining the sources of anxiety and their effects on academic performance, this research seeks to contribute to improving biology teacher training programs. To achieve this aim, the study was guided by two research questions:

(1) What are the levels and sources of anxiety and their effects on academic performance?
(2) How does gender affect the anxiety levels of pre service biology teachers during lessons and tests?

2. Methodology

2.1 Research design

The study employed a mixed-methods research design, integrating both quantitative and qualitative approaches, specifically, a descriptive survey design and a qualitative descriptive design. This design is appropriate for systematically investigating the levels of anxiety among pre service biology teachers by combining the use of structured questionnaires to gather numerical data with open-ended questionnaires to explore personal experiences and underlying factors. The descriptive survey design enables the collection of data from a representative sample, allowing for statistical analysis to identify trends and measure the prevalence and intensity of anxiety in the target population. This methodological combination enhances the validity and depth of the findings by capturing both the breadth of statistical trends and the nuanced depth of individual experiences (Creswell & Creswell, 2017).

2.2 Population and Sample

The target population comprised Level 100 pre service biology teachers at the University of Education, Winneba with a population of 81 students at the time of the study. A census approach was adopted where the entire population was involved in the quantitative phase of the study since the population was relatively small and manageable (n=81). This group was chosen because, as newcomers to the university environment, first-year students are highly susceptible to transitional and academic anxiety. This sampling approach ensured that the selected group was relevant to the study's focus on the challenges faced by first-year students. For the qualitative phase, 8 purposively selected groups, each consisting of 5-6 participants, were selected from the survey respondents to participate in focus group discussions, ensuring that a diverse range of anxiety experiences were captured.

2.3 Instrumentation

Data were collected via two instruments. A closed-ended questionnaire consisting of 10 items with a 5-point Likert scale adapted from the Math Anxiety Rating Scale (Betz, 1978, as cited in Kim, 2016, was modified to measure biology-specific anxiety. A semistructured interview guide was used for data collection from the respondents. The questionnaire was designed to elicit feelings, ideas, and relations from the participants, particularly in large and heterogeneous populations, making it suitable for this study since the subjects are literate and can read and write according to the questionnaire's instructions. The questionnaire includes subsections: Section A measures the demographic information of the respondents, while Section B focuses on sources of anxiety and students' feelings related to anxiety. The second instrument was a semi structured interview guide consisting of three open-ended items aimed at eliciting deep, narrative data regarding the effects of anxiety on students' academic performance

2.4 Validity and reliability of the instrument

To ensure the validity of the instruments used in this study, the questionnaire and interview guide were reviewed by experts in science education to ascertain that the items effectively measured the intended constructs related to academic anxiety. Additionally, a pilot test was conducted with 20 groups of students who were not part of the main sample to refine the items' clarity, relevance, and structure. To establish the construct validity of the adapted Biology Anxiety Rating Scale (BARS), an Exploratory Factor Analysis (EFA) was conducted on the pilot study data. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .82, and Bartlett's test of sphericity was statistically significant ($\chi 2 = 112.4$, $p < .001$), confirming the factorability of the correlation matrix. A Principal Axis Factoring extraction with Promax rotation yielded a clean, unidimensional factor structure (as expected for a domain-specific anxiety scale). All 10 items loaded saliently onto a single factor, with factor loadings ranging from .62 to .84, and no cross-loadings above .30. This empirical evidence confirms that the adapted instrument validly measures a single underlying construct: biology-specific anxiety, rather than general test anxiety or mathematics anxiety. For the quantitative instrument, internal consistency was assessed via Cronbach's alpha, which yielded a reliability coefficient of 0.78, indicating an acceptable level of reliability. To ensure the trustworthiness of the qualitative data, the researcher employed member checking by summarizing the interview responses and verifying them with a subset of the participants.

2.5 Method of data collection

The data collection for this study was conducted in two phases. First, the structured questionnaire was administered to all 81 Level 100 preservice biology teachers during a regular lecture period. One week later, the qualitative phase was conducted. Semi structured interviews were conducted via a predeveloped interview guide with 8 purposively selected focus groups, each consisting of 5-6 participants. The focus groups were audio-recorded with the participants' consent. This two-step approach combined quantitative insights from the questionnaires with qualitative narratives from the interviews, providing a comprehensive understanding of the participants' anxiety experiences.

2.6 Data analysis

The quantitative data from the structured Likert scale questionnaires were analysed via the Statistical Package for the Social Sciences (SPSS) version 24, which employs descriptive statistics, specifically means and standard deviations, to identify trends in anxiety levels and gender-based differences. Qualitative data from audio recordings were transcribed verbatim and analyzed using a rigorous, six-phase thematic analysis approach based on Braun and Clarke's (2006) framework. This involved: (1) familiarization with the transcripts through repeated reading, (2) generating initial codes inductively (e.g., 'memory freeze', 'avoidance'), (3) searching for themes by collating related codes, (4) reviewing and refining themes to ensure internal homogeneity and external heterogeneity, (5) defining and naming the final themes (e.g., 'cognitive interference', 'academic disengagement'), and (6) producing the final report with representative verbatim quotes. To ensure methodological rigor and trustworthiness, triangulation was employed; the qualitative themes were cross-referenced with the quantitative survey results to ensure convergence. For instance, only students who scored above the mean on cognitive anxiety items in the survey were prioritized to validate the 'cognitive interference' theme during member checking.

3. Results

3.1 Research Question 1: What are the levels and sources of anxiety and their effects on academic performance?

To address the research question, a questionnaire was administered and the results obtained were analysed and are presented in Table 1

STATEMENT	MEAN	STD.
Biology makes me feel uncomfortable and nervous	3.35	1.10
I have usually been at ease during biology lessons	4.04	0.76
It wouldn't bother me at all to do biology next academic year	3.99	0.95
It wouldn't bother me at all to do biology at the postgraduate level	3.88	1.01
Biology concepts make me feel uneasy and confused	3.44	1.16
I rarely get uptight while taking my biology test	4.14	0.73
I have usually been at ease during a biology test	4.16	0.71
My mind goes blank, and I'm unable to think clearly when doing biology	3.25	1.08
I usually get uptight during a biology test	2.91	0.96
I get a sinking feeling when I think of trying hard biology problems	1.78	0.80

Table 1. Levels and Sources of Anxiety
Source: Field Survey (2024)

The analysis of the data in Table 1 reveals that students experience varying levels of anxiety related to learning biology, with most responses falling within the low to moderate range. According to Boone and Boone (2012), on a five-point Likert scale, mean scores between 1.00–2.49 are interpreted as low, 2.50–3.49 as moderate, and 3.50–5.00 as high. On the basis of this interpretation, the mean scores indicate that students generally reported being at ease during biology lessons (M = 4.04) and tests (M = 4.16), reflecting low anxiety in those areas.

Moderate levels of anxiety were observed in response to items such as "Biology makes me feel uncomfortable and nervous" (M = 3.35), "Biology concepts make me feel uneasy and confused" (M = 3.44), and "My mind goes blank and I'm unable to think clearly when doing biology" (M = 3.25). These scores suggest that a substantial number of students experience anxiety when engaging with the mental demands and complexity of biological concepts.

In contrast, scores related to anticipatory and performance anxiety were generally low. For example, the statements "It wouldn't bother me at all to do biology the next academic year" (M = 3.99) and "It wouldn't bother me at all to do biology at the postgraduate level" (M = 3.88) show that most students feel comfortable continuing their studies in biology. Similarly, performance-related items such as "I have usually been at ease during a biology test" (M = 4.16) and "I rarely get uptight while taking my biology test" (M = 4.14) reflect low levels of test anxiety. The lowest level of anxiety was associated with the statement "I get a sinking feeling when I think of trying hard biology problems" (M = 1.78), further indicating that fear of academic challenges is not a primary concern.

During the interviews, several Level 100 pre-service biology students shared how anxiety negatively impacts their academic performance, particularly during lessons, revision, and examinations. Their accounts revealed not only emotional distress but also clear academic consequences. The data from the interviews revealed several interrelated themes regarding how anxiety influences the academic performance of Level 100 pre-service biology students. These include cognitive interference and memory lapses, self-doubt and second-guessing, study avoidance and procrastination, physical manifestations of anxiety, reduced concentration during instruction, and academic disengagement.

3.1.1 Cognitive Interference and Memory Lapses During Assessment

Many students reported that anxiety significantly interferes with their ability to recall information during examinations. Despite extensive preparation, they often find themselves unable to access knowledge under pressure. This phenomenon reflects what

is commonly known as cognitive interference, where heightened anxiety disrupts the brain's working memory, making it difficult to retrieve previously learned information (Sarason, 1984). The participants shared experiences of going blank during tests, only to recall the correct answers after the assessment had ended. These memory lapses were not due to a lack of understanding but rather to the overwhelming mental pressure triggered by test conditions.

A student said,

"Honestly, I always prepare before my biology exams, and I even revise with friends. However, once I enter the exam hall and see the question paper, my heart starts beating fast, and everything I studied just disappears. My mind goes blank. It's like I never even opened a book. Sometimes, I sit there staring at the questions, trying to remember what I know, but the anxiety just blocks everything. Later, when I come out, I suddenly start remembering the answers, and it makes me feel worse."

3.1.2 Self-Doubt and Second-Guessing

Students also expressed how anxiety leads them to question their knowledge and instincts, which often results in poorer academic performance despite their initial knowledge of the correct answers. This pattern of self-doubt is a common cognitive manifestation of anxiety, where students experience a lack of confidence in their abilities and tend to second-guess even well-prepared responses. One student said,

"I always feel I'm not good enough in regard to biology. Even when I know the answer to a question, the fear of getting it wrong makes me change it. I start second-guessing myself a lot. There was this test I took recently. I had most of the answers right at first, but after reviewing them out of anxiety, I changed nearly half. Later, I found that my first answers were correct. It's frustrating. I'm not failing because I don't know the material, but because of the fear that I might be wrong."

3.1.3 Study Avoidance and Procrastination

Many students express that anxiety significantly hinders their academic engagement. As one student remarked, *"Every time I sit down to study, I feel overwhelmed, and it often leads me to just avoid my books altogether."* This sentiment reflects a broader trend where stress related to coursework can trigger avoidance behaviours, ultimately resulting in underperformance.

Furthermore, some students reported that perfectionism exacerbates their avoidance behaviours. As one student shared, *"I feel like if I cannot do it perfectly, I'd rather not do it at all."* This perfectionistic mindset can lead to increased anxiety and further procrastination, creating a vicious cycle that hampers academic success. Another student shared:

"To be honest, there are times I avoid studying biology because I get overwhelmed just thinking about the topics. It feels like there's too much to understand, and I get stressed before I even start reading. Therefore, I procrastinate and then end cramming at the last minute, which doesn't work well for me. I know this habit is affecting my grades, but the anxiety makes it hard to concentrate or even open the book sometimes."

3.1.4 Reduced Concentrations during Lectures

Students frequently report that anxiety significantly impacts their concentration during lectures. As one student expressed, "I find my mind wandering, and I struggle to focus on what the lecturer is saying. It is like I'm there physically, but mentally, I'm miles away." This observation highlights how a heightened cognitive load from anxiety can inhibit the ability to absorb and retain information, complicating future study efforts.

Research supports these experiences, indicating that anxiety diverts cognitive resources away from learning tasks. According to a study by Eysenck (2012), anxiety can lead to attentional control deficits, causing students to become easily distracted. This aligns with another finding by Mokaya (2013), who noted that students who experience test anxiety often struggle to concentrate during initial learning experiences, further impairing their academic performance.

Additionally, some students mentioned the impact of external distractions, exacerbated by their internal anxiety. One student noted, "Even small noises in the classroom can throw me off completely. I end up missing key points." This reflects a broader concern identified in research that external stimuli can become more intrusive when a student is already preoccupied with anxious thoughts (Sarason, 1984).

3.1.5 Academic disengagement

Students frequently articulate that anxiety drives them to withdraw from academic participation. As one student shared,

"When I start feeling overwhelmed, I just stop going to classes. It feels easier to hide than to face the stress."

This withdrawal, while initially perceived as a coping mechanism, often exacerbates their academic challenges, creating a cycle of disengagement.

3.2 Research Question 2: How does gender affect the anxiety levels of pre-service biology teachers during lessons and tests?
This research question sought to investigate how gender affects the anxiety levels of pre-service biology teachers. To address this question, a questionnaire was administered, and the results were analysed and are presented in Table 2

STATEMENT	MALE (N=51)		FEMALE (N=30)					
	M	SD	M	SD	T	DF	P	COHEN'S D
Biology makes me feel uncomfortable and nervous.	3.64	0.91	3.06	1.25	2.41	79	.018*	0.55 (Medium)
Biology concepts make me feel uneasy and confused.	3.80	1.05	3.07	1.25	2.79	79	.007**	0.65 (Medium)
My mind goes blank when doing biology.	3.50	1.12	3.00	1.03	2.00	79	.049*	0.46 (Small-Med)
I get a sinking feeling trying hard biology problems.	2.00	0.93	1.56	0.66	2.20	79	.031*	0.53 (Medium)
I usually get uptight during a biology test.	3.10	1.03	2.71	0.88	1.70	79	.093	0.40 (Small)
It wouldn't bother me to do biology next academic year.	4.20	0.88	3.78	1.02	1.91	79	.060	0.44 (Small)
It wouldn't bother me to do biology at postgraduate level.	4.00	0.95	3.75	1.07	1.09	79	.279	0.25 (Small)
I have usually been at ease during biology lessons.	4.05	0.78	4.03	0.74	0.11	79	.910	0.03(Negligible)
I rarely get uptight while taking my biology test.	4.15	0.70	4.13	0.76	0.12	79	.903	0.03(Negligible)
I have usually been at ease during biology tests.	4.25	0.66	4.06	0.76	1.15	79	.254	0.27 (Small)

Table 2. Independent Samples t-test Comparing Male and Female Pre-Service Biology Teachers' Anxiety Levels

Source: Field Data (2024). *$p < .01$, *$p < .05$. Cohen's *d* benchmarks: 0.2 = Small, 0.5 = Medium, 0.8 = Large

Table 2 presents the results of the independent samples *t*-tests comparing anxiety levels between male and female pre-service biology teachers. Contrary to the common narrative that females experience higher science anxiety, the data reveal a nuanced pattern. There were no statistically significant gender differences in general test ease or lesson comfort ($p > .05$). However, male students reported statistically significantly higher anxiety specifically related to conceptual difficulty. Males scored significantly higher on feeling 'uneasy and confused by biology concepts' ($M = 3.80$ vs. 3.07, $p = .007$, $d = 0.65$) and feeling 'uncomfortable and nervous' ($M = 3.64$ vs. 3.06, $p = .018$, $d = 0.55$).

Male students also experienced significantly higher cognitive interference, reporting higher levels of their mind 'going blank' during tasks ($p = .049$, $d = 0.46$) and a 'sinking feeling' when facing hard problems ($p = .031$, $d = 0.53$). While males expressed greater long-term confidence in continuing biology (e.g., next academic year: $M = 4.20$ vs. 3.78), this difference did not reach statistical significance ($p = .060$). Therefore, the claim that males are 'more anxious' must be strictly delimited to conceptual and cognitive anxiety, not general test anxiety.

4. Discussions

These findings in Table 1 suggest that students' anxiety stems more from conceptual difficulties and cognitive overload than

from assessment-related stress or fear of further academic engagement. This aligns with earlier research by Mallow (2006), who reported that science anxiety often originates from the perceived difficulty of the content, leading to cognitive interference and lowered confidence in classroom settings. Similarly, Bong et al. (2012) argued that students with low anticipatory anxiety often exhibit a stronger academic self-concept, which supports the current findings that students are interested in continuing with biology despite experiencing some conceptual anxiety.
Furthermore, Cassady and Johnson (2002) emphasized the negative effects of test anxiety on academic performance. However, in this study, the minimal levels of test anxiety may reflect the presence of effective pedagogical strategies and a supportive academic environment that promotes exam readiness. Overall, the major challenge facing students is the cognitive demand for biology content rather than the anxiety triggered by evaluation.

This finding under the theme "cognitive interference and memory lapses during assessment" is consistent with previous research indicating that anxiety impairs the retrieval process by occupying the cognitive resources needed for recall (Kim, 2016). In high-stakes academic settings, this cognitive load can undermine performance, even among well-prepared students. The data from this study suggest that pre-service biology teachers are particularly vulnerable to such interference owing to the conceptual complexity of biology and the pressure to perform, underscoring the need for targeted interventions that support both emotional regulation and retrieval strategies during assessments. The findings under "student doubt and second-guessing" resonate with those noted by Cassady and Johnson (2002) who observed that anxious students often engage in over monitoring during assessments, which disrupts cognitive processing and leads to unnecessary changes in answers. Similarly, Mkaya (2013) reported that students with high levels of test anxiety frequently modify correct responses out of fear of being wrong, thereby lowering their actual performance outcomes. In this study, the students revealed that they often knew the correct answers initially but changed them due to anxiety-induced uncertainty. This finding reinforces the idea that anxiety can erode academic self-concepts and create a cycle of hesitation and poor decision-making, even in well-prepared learners.

Research supports findings obtained under the theme "school disengagement", revealing that avoidance behaviour can lead to increased feelings of isolation and academic failure. A study by Heyne (2022) revealed that students who disengage from school due to anxiety are more likely to experience lower academic achievement and higher dropout rates. This mirrors the experiences of the students who noted,

> *"The longer I stay away, the harder it is to catch up, and eventually, I feel like giving up entirely."*
> *Moreover, some students mentioned feeling a sense of shame associated with disengagement. One student remarked,*
> *"I know I should be in class, but the thought of facing my peers and the material makes me anxious. I feel like a failure."*

This aligns with findings from a study by Winograd and Rust (2014) which highlighted that perceived stigma related to mental health issues can further discourage students from seeking help or re-engaging with their studies. Study avoidance and procrastination are identified as themes, and research corroborates these observations, indicating that anxiety can create a cycle of procrastination. A study by Nash (2018) revealed that individuals who experience high levels of anxiety are more likely to procrastinate, as they often fear failure or feel incapable of meeting academic demands. This aligns with another finding by Sharma (2014), which suggested that procrastination is often a coping mechanism for managing negative emotions associated with study tasks.

The findings presented in Table 2 partly contrast with previous research, which often identifies higher anxiety levels in female students, particularly in science-related subjects (Wolter & Hannover, 2019). However, in this context, male students appear more anxious, particularly in terms of their cognitive and emotional responses, although they remain confident about continuing in the discipline. This duality of greater anxiety, yet stronger long-term engagement, may indicate greater internal pressure among male students to succeed, possibly influenced by societal norms that associate male identity with competence in science (Wolter & Hannover, 2019)

These insights raise important considerations for how anxiety and academic persistence manifest differently across genders. While both male and female students reported a general sense of comfort during instruction and testing, male students exhibited more indicators of internalized anxiety, even as they expressed greater academic ambition. Educational institutions may benefit from developing gender-sensitive interventions that help all students manage anxiety while nurturing their academic confidence. Initiatives such as peer mentoring, stress management workshops, and targeted academic support could be effective in addressing these nuanced emotional and cognitive needs.

5. Conclusions

This study explored the levels and sources of anxiety among Level 100 pre-service biology teachers at the University of Education, Winneba. The findings indicate that while most students feel comfortable during biology lessons and assessments, a significant proportion experience moderate anxiety linked to cognitive overload, conceptual confusion, and academic pressure.

Inferential statistical analysis revealed a nuanced gender dynamic: while general test anxiety did not differ significantly between genders, male students exhibited significantly higher anxiety specifically tied to conceptual confusion and cognitive overload, despite expressing equal or slightly higher confidence in continuing the discipline. The impact of anxiety on academic performance was also clearly expressed through student narratives, showing how it contributes to memory lapses, avoidance behaviour, reduced concentration, and disengagement. Addressing these anxiety-related challenges is essential for improving academic performance and preparing resilient, confident future biology educators.

5.1 Study Limitations and Suggestions for Future Research

Several limitations of this study should be acknowledged when interpreting the findings. First, the study was conducted at a single institution and involved only Level 100 pre-service biology teachers (n = 81), so the results may not be generalised to other universities, year groups or science programmes. Second, the cohort was unevenly distributed by gender (51 males and 30 females), and the relatively small number of female participants may have reduced the power of the gender comparisons; the gender differences reported should therefore be interpreted with caution. Third, the quantitative data were based on self-reported responses to an adapted 10-item scale, which may be affected by social desirability and recall bias, so students may have under-reported or over-reported their anxiety. In addition, the validity evidence for the adapted instrument came from a pilot sample, and the scale measures biology-specific anxiety only. Fourth, the cross-sectional design captured anxiety at one point in time. It cannot show how anxiety changes as students progress through the programme or establish a causal link between anxiety and academic performance, and the effect of anxiety on performance was explored through students' own narratives rather than objective measures such as examination scores. Finally, the focus group discussions may have been influenced by group dynamics, with more outspoken students shaping the views expressed. These limitations do not invalidate the findings, but they define the boundaries of the study and suggest that the conclusions are best read as indicative of the experiences of this cohort.

Future research could build on this study in several ways. Studies involving larger and more gender-balanced samples drawn from several teacher education institutions and from different levels would test whether the patterns found here hold more widely. Longitudinal designs that follow students from Level 100 to the final year would show how anxiety develops and whether it eases as students adjust to university life. Researchers could also combine anxiety scores with objective measures of academic performance, such as examination results, to examine the relationship between the two directly. Experimental or action research studies are needed to test the effectiveness of the interventions suggested in this study, including the scaffolding of complex concepts, stress management workshops and peer support systems. Finally, further qualitative work could explore why male students reported higher conceptual anxiety while expressing strong confidence in continuing with biology, and how female students experience anxiety in the same context, as these questions remain unanswered.

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References

Bandelow, B., Michaelis, S., & Wedekind, D. (2017). Treatment of anxiety disorders. *Dialogues in clinical neuroscience*, *19*(2), 93-107.

Bong, M., Cho, C., Ahn, H. S., & Kim, H. J. (2012). Comparison of self-beliefs for predicting student motivation and achievement. *The Journal of Educational Research*, *105*(5), 336-352.

Boone, H. N., Jr., & Boone, D. A. (2012). Analysing Likert data. *The Journal of Extension*, *50*(2), 48.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.

Cassady, J. C., & Johnson, R. E. (2002). Cognitive test anxiety and academic performance. *Contemporary educational psychology*, *27*(2), 270-295.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications.

Eysenck, M. W. (2012). Anxiety and cognitive performance. *HANDBOOK OF PSYCHOLOGY OF EMOTIONS*, 87.

Heyne, D. (2022). Developmental issues associated with adolescent school refusal and cognitive-behavioural therapy manuals. *Zeitschrift für Kinder- und Jugendpsychiatrie und Psychotherapie*.

Kim, K. J. (2016). Factors associated with medical student test anxiety in objective structured clinical examinations: a preliminary study. *International journal of medical education*, *7*, 424.

Mallow, J. V. (2006). Science anxiety: research and action. *Handbook of college science teaching*, 3-14.

Mokaya, Z. M. (2013). *Influence of school infrastructure on students' performance in public secondary schools in Kajiado County, Kenya* (Doctoral dissertation, University of Nairobi).

Nash, M. (2018). *Mental Health Research Productivity of Nasp-Approved School Psychology Programs: 2010-2015* (Doctoral dissertation, University of Nevada, Las Vegas).

Nketsia, W. (2011). *Teacher education and inclusion in Ghana*: pre-service teachers' preparedness for creating an inclusive classroom.

Orakwue, J. N., & Okigbo, E. C. (2023). Cognitive test anxiety as predictor of secondary school students' achievement in biology in Ogidi EducationZone. *International Journal of Innovative Research and Advanced Studies (IJIRAS)*, *10*(1), 11-16.

Sarason, I. G. (1984). Stress, anxiety, and cognitive interference: reactions to tests. *Journal of personality and social psychology*, *46*(4), 929.

Sharma, Y. (2014). The effects of strategy and mathematics anxiety on the mathematical creativity of school students. *International Electronic Journal of Mathematics Education*, *9*(1), 25-37.

Winograd, G., & Rust, J. P. (2014). Stigma, awareness of support services, and academic help-seeking among historically underrepresented first-year college students. *Learning Assistance Review (TLAR)*, *19*(2).

Wolter, I., & Hannover, B. (2019). Gender role self-concept at school start and its impact on academic self-concept and performance in mathematics and reading. In *Bildung Psychology* (pp. 56-78). Routledge.

Ye, L., Posada, A., & Liu, Y. (2019). A review on the relationship between Chinese adolescents' stress and academic achievement. *New directions for child and adolescent development*, *2019*(163), 81-95