

Test-taking Skills as a Mediator of Test Anxiety and Test Performance in Chemistry and Physics

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Abstract

This study examined the associations among test anxiety, test-taking skills before and during the test, and test performance in Chemistry and Physics during the first quarter of the 2024–2025 school year. Using a quantitative, non-experimental design, data were collected from 207 students enrolled in Chemistry and Physics classes. Test anxiety and test-taking skills were assessed using self-report questionnaires, while test performance was measured using first-quarter test scores. Descriptive statistics, Pearson correlation, and mediation analysis were conducted. The findings showed that students reported frequent use of test-taking skills, particularly during the test, while also experiencing relatively high levels of test anxiety. Test anxiety was negatively associated with test performance in both Chemistry and Physics, whereas test-taking skills before and during the test were positively associated with test performance. Mediation analysis indicated that both forms of test-taking skills mediated the association between test anxiety and test performance. These findings suggest that the relationship between test anxiety and test performance may be partly explained by students' use of test-taking skills before and during testing. The results highlight the importance of addressing test anxiety and strengthening test-taking skills in Chemistry and Physics education.

INTRODUCTION

Chemistry and Physics are challenging subjects during the early stages of secondary and tertiary education because they require students to integrate abstract reasoning, mathematical thinking, conceptual understanding, and problem-solving skills. These cognitive demands may contribute to difficulties in achieving high levels of academic performance, particularly during the early stages of learning. Previous studies have reported that students' performance in science-related subjects often remains at average or developing levels rather than reaching mastery (Zhang et al., 2021; Hartman et al., 2022). Understanding the factors associated with students' performance in these subjects is therefore important for supporting successful science learning.

Beyond cognitive ability and prior knowledge, test anxiety and test-taking skills are important effective and behavioral factors associated with academic performance.

Anxiety refers to a psychological state characterized by cognitive preoccupation, emotional distress, and physiological arousal in evaluative situations. Previous research has linked higher levels of test anxiety with poorer academic performance, particularly in cognitively demanding learning contexts (Alshareef et al., 2025; Putwain et al., 2023). From the cognitive interference model perspective, test anxiety may interfere with task-related attention by consuming cognitive resources otherwise available for processing and responding to test demands. In contrast, test-taking skills can be viewed as adaptive self-regulatory behaviors that help students manage assessment demands. Students who effectively apply appropriate test-taking strategies may better organize their preparation, monitor their responses, and manage test-related demands, potentially supporting their academic performance (Paz-Baruch, 2023).

Importantly, test anxiety and test-taking skills may not operate independently. Anxiety may influence students' ability to apply the strategies they possess effectively. Recent evidence suggests that highly anxious students may experience difficulties in applying metacognitive and strategic behaviors during academic tasks, even when they possess adequate knowledge of relevant strategies (Albulescu et al., 2024). This suggests that test anxiety may be associated with students' use of test-taking skills, which may, in turn, relate to their performance. Examining these relationships can therefore provide greater insight into how affective and behavioral factors are connected to academic outcomes.

Recent research has increasingly examined the mechanisms underlying the relationship between test anxiety and academic achievement. Mediation approaches are particularly useful for investigating whether behavioral or cognitive factors help explain this relationship. Previous studies have identified behavioral and cognitive processes as potential mechanisms linking anxiety-related experiences with academic outcomes (Albulescu et al., 2024; Lim & Chue, 2023). However, relatively limited attention has been given to test-taking skills before and during the test as separate mediating variables, particularly in Chemistry and Physics contexts.

The conceptual model in Figure 1 is grounded in self-regulated learning and cognitive-interference perspectives. These perspectives provide a basis for understanding how an affective condition such as test anxiety may be associated with students' test-taking behaviors and, subsequently, their test performance. Test anxiety represents the affective component of the model, whereas test-taking skills represent behavioral and self-regulatory components. The model proposes that test anxiety is associated with two distinct forms of test-taking skills: test-taking skills before the test and test-taking skills during the test.

Conceptual Model

As illustrated in Figure 1, Test Anxiety is connected to Test-taking Skills Before the Test through path c and to Test-taking Skills During the Test through path b. Both forms of test-taking skills are then connected to Test Performance in Chemistry and Physics through path a. Thus, the model proposes two parallel mediation pathways. The first pathway examines whether test-taking skills before the test mediate the association between test anxiety and test performance. In contrast, the second pathway examines whether test-taking skills during the test mediate this association.

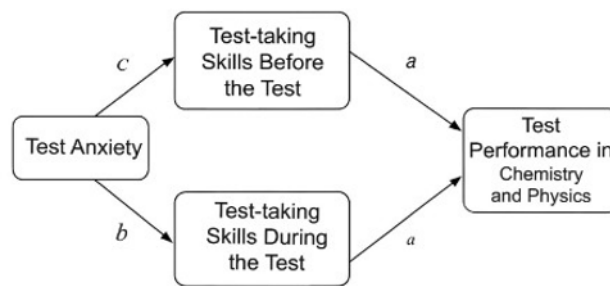


Figure 1. Conceptual Model

The first mediator, test-taking skills before the test, refers to strategies used in preparation for an assessment. These skills may involve how students organize and prepare themselves before facing test demands. The second mediator, test-taking skills during the test, refers to strategies students use while responding to test items. Distinguishing these two forms of test-taking skills matters because students may show different patterns of strategy use before and during an actual assessment.

Within the proposed model, test anxiety is expected to be associated with students' ability to employ these test-taking skills effectively. Anxiety-related cognitive preoccupation and emotional distress may interfere with students' preparation, monitoring, and strategic management of assessment demands. In turn, differences in test-taking skills may be associated with differences in test performance. The two mediation pathways therefore provide a framework for examining whether test-taking behaviors help explain the association between test anxiety and academic performance.

Despite growing interest in affective and behavioral factors in academic achievement, context-specific evidence from science education remains limited. Existing research has examined test anxiety and academic achievement across various educational contexts. Still, it has given comparatively less attention to the distinct roles of test-taking skills before and during testing in Chemistry and Physics. This gap is particularly relevant because these subjects require students to manage complex conceptual and problem-solving demands while simultaneously responding to assessment conditions.

Therefore, this study investigates the associations among test anxiety, test-taking skills before and during the test, and test performance in Chemistry and Physics among STEM learners during the first quarter of the 2024–2025 school year. Specifically, the study examines whether test-taking skills before and during the test mediate the association between test anxiety and test performance. By examining these two behavioral pathways separately, the study aims to contribute to a more nuanced understanding of how effective and test-taking factors relate to students' performance in Chemistry and Physics.

METHOD

Research Design and Participants

This study employed a quantitative, non-experimental research design using descriptive, correlational, and mediation analyses. This design was appropriate for describing the levels of test anxiety and test-taking skills and examining their associations with test performance without manipulating any study variables. Specifically, the study examined the relationships among test anxiety, test-taking skills before and during the test, and test performance.

The participants were drawn from the entire Grade 12 STEM population; therefore, the researchers employed total enumeration sampling. The sample consisted of 207 Grade 12 STEM students enrolled in Chemistry and Physics during the first quarter of the 2024–2025

school year. All participants completed the assessments administered for both subjects under the same testing conditions. The participants represented a heterogeneous group with varying levels of ability typical of students enrolled in introductory science courses. The dataset and analysis included no personal identifiable information.

Research Instruments

Test-taking skills were measured using a structured self-report questionnaire adapted from Delphine et al. (2022). The instrument comprised two subscales: test-taking skills before the test and test-taking skills during the test. The former assessed strategies related to preparation and planning, whereas the latter assessed strategy execution during testing, including reading directions, identifying keywords, managing time, and checking answers.

Test anxiety was measured using the Examination Anxiety Scale (Putwain & von der Embse, 2021), which assesses cognitive, emotional, and physiological indicators of anxiety experienced before and during examinations, including nervousness, worry, distraction, and somatic symptoms.

Before administration, an expert in the field conducted face and content validation. They were subsequently pilot tested with 80 students who were not included in the main study to assess internal consistency. The results indicated good reliability for test anxiety (Cronbach's $\alpha = .848$), while the scales for test-taking skills before the test (Cronbach's $\alpha = .706$) and test-taking skills during the test (Cronbach's $\alpha = .757$) demonstrated acceptable internal consistency.

RESULTS AND DISCUSSION

Test Anxiety

The composite mean for test anxiety ($M = 3.40$, $SD = 1.11$) indicates that students experience frequent levels of test anxiety in Chemistry and Physics (Table 1). This suggests that anxiety is a salient aspect of students' testing experience rather than an occasional occurrence.

Cognitive and emotional indicators of anxiety were particularly prominent. Students frequently reported feeling nervous even after preparation and worrying that test outcomes interfere with performance. Physiological symptoms, such as sweating, trembling, and headaches, were reported at the "Sometimes" levels, suggesting moderate somatic activation. Interestingly, indicators of calmness and confidence during tests were comparatively low. Feeling relaxed and very confident reflects limited emotional comfort in testing situations.

Test-taking Skills before the Test

The descriptive results in Table 2 indicate that students generally demonstrate frequent use of test-taking skills before the test, as reflected by the composite mean ($M = 3.47$, $SD = 1.08$), which corresponds to a "Frequently" level of practice. This suggests that, overall, students regularly engage in preparatory behaviors that support academic readiness.

Regarding individual performance measures, the results indicate high consistency in review practices, including reviewing notes several times. This aligns with recent studies in self-regulated learning, which identify reviewing notes as a key strategy for increasing retention and conceptual knowledge across scientific disciplines (Putwain & von der Embse, 2021). Students also frequently practiced effective review activities, such as reviewing notes by increasing the level of difficulty and using mnemonic techniques to remember.

Table 1. Test Anxiety of Students

Indicative Statement	Mean	SD	Frequency
1. I feel thrilled during tests.	3.86	1.09	Frequently
2. During the test, I feel an urgent need to go to the comfort room.	2.65	1.24	Sometimes
3. During the test, I feel uneasy and upset when confronted with questions I cannot answer.	3.89	1.05	Frequently
4. Even after preparing well for the test, I feel very nervous.	4.19	1.00	Frequently
5. I look at my other classmates during the test.	2.82	1.16	Sometimes
6. My hands often sweat and feel cold before and during the test.	3.31	1.34	Sometimes
7. During the test, I think I will surely pass the test.	2.84	0.91	Sometimes
8. I worry about the result of the test interfering with my performance during the test.	4.13	0.99	Frequently
9. After the test, I think most of my answers are right.	3.01	0.95	Sometimes
10. I tremble before or during the test.	2.93	1.22	Sometimes
11. During the test, I suffered from a headache.	2.94	1.30	Sometimes
12. I feel relaxed while taking a test.	2.51	1.02	Rarely
13. During the test, I often check the time.	3.62	1.19	Frequently
14. After the test, I tell myself it is over, and I did my best.	4.07	1.12	Frequently
15. I play with my pencil or pen during the test.	4.16	1.06	Frequently
16. My thoughts wander during the test.	3.74	1.04	Frequently
17. I feel very confident during the test.	2.78	0.95	Sometimes
18. I think about current events in my life during the test.	3.05	1.16	Sometimes
19. My mouth becomes dry before or during the test.	3.15	1.24	Sometimes
20. I feel very jittery during the test when I am not sure about the answer.	3.71	1.08	Frequently
21. Before or during the test, I think other students are better than me.	4.03	1.21	Frequently
Composite Mean	3.40	1.11	Frequently

There were, however, several preparatory activities that were less consistently practiced by the participants. Participants sometimes formed potential test questions and transformed class notes into a Q&A format. As shown by some recent studies, although these generative learning strategies are very effective, most students underuse them because of a lack of time or metacognitive knowledge ([Carpenter & Sanchez, 2025](#)).

Furthermore, students reported fewer instances of health-related preparatory activities. Students practiced refraining from last-minute revision and getting adequate sleep before an exam, sometimes to rarely. Heissel et al. ([2021](#)) suggest that students who sacrifice sleep for studying may experience reduced attention and lower test performance, highlighting the cognitive costs of insufficient sleep.

Table 2. Test-taking Skills before a Test

Test-Taking Skills	Mean	SD	Frequency
1. I do a self-test to discover what I have and have not learned before I take the test.	3.47	0.96	Frequently
2. I spend more time reviewing problem-solving topics before the test.	3.49	0.97	Frequently
3. I formulate possible test questions and use them as a detailed guide.	3.21	1.07	Sometimes
4. I review my notes more than once before the test.	4.27	0.86	Almost Always
5. I set up my review notes for a question-and-answer format that is separate from a problem-and-solution format.	3.23	1.13	Sometimes
6. I use mnemonics or codes to help me recall information	3.51	1.28	Frequently
7. I review my notes starting from the easiest to the more difficult topics.	3.97	1.10	Frequently
8. I study with one or more students before the test.	3.52	1.20	Frequently
9. I take time to pray before the start of the test.	4.10	1.12	Frequently
10. I avoid cramming a day or two before a test.	2.93	1.04	Sometimes
11. I get 8 hours of sleep the night before the test.	2.49	1.17	Rarely
<i>Composite Mean</i>	<i>3.47</i>	<i>1.08</i>	<i>Frequently</i>

Test-taking Skills during the Test

Students demonstrated stronger, more consistent use of test-taking skills during the test, as reflected in a higher composite mean ($M = 4.03$, $SD = 0.97$), corresponding to “Frequently.” This suggests that students are generally adept at implementing strategies once the test begins. Behaviors students engaged in at an “Almost Always” frequency included carefully reading instructions, identifying important words, starting with easy questions, and checking answers before submitting. These skills have been identified as critical for test-taking (Mamo & Regassa, 2025).

In addition, many respondents reported using guessing strategies and changing their answers only when, they were sure. These findings resonate well with current research on strategic test-taking decision-making being a feature of self-regulation rather than impulsivity (van Baal et al., 2025). On the contrary, time management strategies proved to be less common among the respondents. Time estimation, for instance, was used only “Sometimes”, which may suggest some difficulties in proactive time management. According to recent research, time management in high-cognitive-load tests is currently regarded as the hardest thing to do, especially in scientific disciplines like Chemistry (Wolters et al., 2025).

Test Performance in Chemistry and Physics

The distribution of 1st Quarter test scores shows that students’ academic performance in both Chemistry and Physics clustered mainly in the “Near Proficient” and “Low Proficient” levels, with relatively few students reaching the upper proficiency categories (Table 4). In Chemistry, almost half of the students fall into the “Near Proficient” category (49.8%), while a small percentage (1.4%) fell under “Not Proficient”. With a mean of 25.14 ($SD = 5.66$), most students performed near proficiency, indicating a partial understanding of the basic principles of Chemistry. This trend is supported by the current chemistry education literature, which describes introductory chemistry as a challenging course in which students find it difficult to move from rote memorization to conceptual comprehension (Sayre et al., 2025; Santos et al.,

2022). Kausar et al. (2024) note that early chemistry assessments reflect students' adjustment to symbolic representations, abstract reasoning, and multi-step problem solving, which may contribute to moderate performance outcomes in initial tests.

Table 3. Test-taking Skills during the Test

Indicative Statement	Mean	SD	Frequency
1. I read the directions before I begin answering questions.	4.62	0.68	Almost Always
2. I read over all the questions before beginning the test.	3.73	1.23	Frequently
3. I estimate how much time I can spend on each question before I begin.	3.06	1.20	Sometimes
4. I take notes of key words in questions.	4.26	0.88	Almost Always
5. I begin the test by answering the easiest questions first.	4.34	0.92	Almost Always
6. I use specific strategies when I must guess.	3.98	0.99	Frequently
7. I change answers only if I am very sure my first answer was wrong.	4.13	0.91	Frequently
8. I go back and check all my answers before I submit my answer sheet.	4.44	0.89	Almost Always
9. I reserve all problem-solving questions as the last questions to be answered.	3.73	1.07	Frequently
<i>Composite Mean</i>	<i>4.03</i>	<i>0.97</i>	<i>Frequently</i>

The same tendency was noted for Physics, where the largest group of students was characterized as “Near Proficient” (56.0%) and only 6.8% had a proficient level of understanding of Physics. The average score for Physics ($M = 27.01$, $SD = 6.29$) also aligns with the “Near Proficient” category and slightly exceeded the Chemistry mean score. Malespina et al. (2024) report that introductory physics students often struggle early in the course, particularly with tasks involving mathematical modeling and transferring conceptual knowledge. Maries and Singh (2023) report a relatively large standard deviation in physics performance, indicating significant variability among students. This aligns with research showing that performance disparities are largely caused by differences in mathematical preparation and problem-solving abilities.

Table 4. Test Performance in Chemistry and Physics

Score	Proficiency Level	Chemistry		Physics	
		f	%	f	%
45 – 50	Highly Proficient			1	0.5%
38 – 44	Proficient	3	1.4%	14	6.8%
25 – 37	Nearly Proficient	103	49.8%	116	56.0%
13 – 24	Low Proficient	101	48.8%	74	35.7%
Below 13	Not Proficient	3	1.4%	2	1.0%
Total		207	100%	207	100%
Mean		25.14		27.01	
SD		5.66		6.29	

Correlation Analysis

The result of the correlation analysis in Table 4 revealed that test anxiety was found to be highly negatively correlated with Chemistry grades ($r = -.63$) as well as moderately negatively correlated with Physics grades ($r = -.42$). The results suggest that more anxious students were inclined to have significantly worse results in subjects related to science, especially in Chemistry.

Nwafor et al. (2023) and Roy et al. (2024) both suggest that test anxiety is negatively associated with students' academic performance, with its effects appearing more pronounced in disciplines that require higher levels of symbolic reasoning, cognitive processing, and problem-solving demands. Contemporary studies increasingly emphasize that anxiety does not operate solely as an emotional reaction but also undermines students' ability to deploy effective academic behaviors (Youssef & Alibraheim, 2024). The relationships in this study show that test anxiety remains a crucial factor influencing science test results, meaning both behavioral and emotional issues should be considered when improving students' science performance, as Abera et al. (2023) note.

It is evident from the literature review that test anxiety is significantly and negatively related to students' academic performance in Chemistry and Physics. These disciplines demand symbolic processing and involve many cognitive activities. The impact of test anxiety is noted not only on psychological states but also on academic behavior, affecting their efficiency in learning and taking tests. Therefore, test anxiety remains one of the most important factors connected with success in science tests.

Table 4. Correlation Matrix

		Chemistry Score	Physics Score
Test Anxiety	Pearson r	-0.633**	-0.422**
	p	<0.01	<0.01
Test-taking Skills (Before)	Pearson r	0.567**	0.459**
	p	<0.01	<0.01
Test-taking Skills (During)	Pearson r	0.554**	0.430**
	p	<0.01	<0.01

****.** Correlation is highly significant at the 0.01 level (2-tailed).

Test-taking skills were positively correlated with both Chemistry scores ($r = .57$ before and $r = .55$ during). These relationships show that students who used better test-taking strategies performed better on science tests. The current research indicates that strategic thinking and test monitoring are especially important in STEM courses, and that even small execution errors may significantly reduce test results. Domondon (2025) emphasizes that strategic thinking and test monitoring are important skills in STEM courses, where multi-step problem-solving requires careful execution and errors in earlier steps may negatively affect overall performance. In the context of Chemistry, Lagasca et al. (2025) suggest that anxiety may interfere with students' ability to focus during revision, which can contribute to difficulties in understanding abstract concepts and performing multi-step calculations.

There is a positive relationship between test-taking skills and Chemistry test scores, both before and during examinations, with better approaches resulting in improved performance. Strategy and monitoring are vital for success in STEM, where minor mistakes can significantly affect performance. Moreover, anxiety hinders students from concentrating and revising effectively, affecting their understanding of abstract concepts and problem-solving in Chemistry. This implies that achievement in these science subjects depends not only on learners' cognitive knowledge but also on their ability to manage anxiety and use test-taking

strategies effectively.

Mediation Analysis

The correlational findings provide a foundation for the mediation analysis, supporting the interpretation that test anxiety undermines test performance partly by impairing students' strategic test-taking behavior. Higher test anxiety was strongly associated with poorer test-taking skills, both before and during the test. Test anxiety accounted for approximately 30% of the variance in each skill, indicating a substantial relationship (Table 5). Trait test anxiety significantly impairs knowledge acquisition during the exam-preparation phase. The study found that while anxiety might not always cause a "freeze" during the test, Theobald et al. (2022) suggest it may be associated with less effective learning processes and strategies, which can contribute to lower academic performance.

Study habits and exam anxiety together account for around 52% of the variance in academic outcomes, according to Turarova et al. (2025), underscoring the important role that both behavioral and emotional factors play in students' performance. It suggests a "cycle" where poor skills increase anxiety, and high anxiety further degrades the ability to use effective study strategies. Aydın and Özgeldi (2024), using hierarchical regression analysis, found that test anxiety is negatively associated with metacognitive test preparation strategies such as planning and monitoring, suggesting that these skills may be impaired under higher levels of emotional stress.

Research confirms findings that trait anxiety impacts performance in relation to studying behavior in the pre-test period. Anxiety is linked to ineffective study behavior and metacognitive strategies such as planning and monitoring, which are the very skills that tend to diminish first as anxiety levels increase. Research demonstrates that studying habits and examination anxiety contribute significantly to variance in academic achievement, and moreover, that there is reciprocity between weak study behavior and anxiety, where poor study skills enhance anxiety while high levels of anxiety inhibit good study behavior.

Table 5. Prediction of Mediators by Test Anxiety

Mediator	β	SE	p	R^2
Skills Before Test	-0.60	0.06	< .001	0.312
Skills During Test	-0.57	0.06	< .001	0.298

From Table 6, both mediators significantly predicted Chemistry and Physics scores while controlling test anxiety, and test anxiety remained significant. This indicates partial mediation, as test anxiety influences Chemistry scores directly and indirectly through test-taking skills. Test taking skills before and during the test each significantly predicted Physics scores and reduced (but did not eliminate) the effect of test anxiety. This again supports partial mediation. The models explained 46–48% of the variance in Chemistry scores and 24–25% of the variance in Physics scores.

As Yessimbekova et al. (2025) highlight, while mindfulness-based therapies may lower anxiety levels, students may also need to adopt efficient test-taking techniques to increase academic achievement. This study has furthered the current research on this topic because it reveals that test anxiety does more than coexist with ineffective test-taking strategies; it diminishes the effectiveness of these strategies.

Table 6. Mediation Models Predicting Chemistry and Physics Scores

Predictor	Chemistry Scores				Physics Scores			
	β	SE	p	R^2	β	SE	p	R^2
Test Anxiety (Skills Before model)	-4.88	0.65	< .001	0.467	-2.84	0.86	0.001	0.251
Skills Before Test	3.07	0.61	< .001		3.57	0.8	< .001	
Test Anxiety (Skills During model)	-5.00	0.65	< .001	0.462	-3.14	0.86	< .001	0.235
Skills During Test	3.02	0.62	< .001		3.22	0.83	< .001	

Akpanoko et al. (2024) established that cognitive test anxiety (specifically the "worry" component) mediates the relationship between emotional intelligence and GPA. Vasiou et al. (2025) links higher emotional intelligence to lower cognitive test anxiety, which in turn is linked to better academic performance. This suggests that test anxiety may operate as a mediating factor in this relationship.

Lowering test anxiety alone is not sufficient to bring about significant changes in academic performance unless combined with changes in test-taking strategies. The presence of test anxiety does not just go together with unproductive strategies but also leads to a reduction in student productivity. Cognitive test anxiety plays a significant role in bridging the connection between emotional intelligence and academic performance. Thus, the more emotionally intelligent students experience less cognitive test anxiety. The findings revealed a consistent pattern: test anxiety exerted a direct negative effect on science achievement, test-taking skills exerted direct positive effects, and these skills served as partial mediators of the anxiety–test score relationship. Higher test skill levels did not buffer students from the negative effects of anxiety.

CONCLUSION

The findings indicate that test anxiety is significantly associated with test performance in science subjects, particularly Chemistry and Physics. Higher levels of test anxiety were associated with lower test performance, with a stronger negative association observed in Chemistry than in Physics. In contrast, test-taking skills before and during the test were positively associated with test performance, highlighting the importance of strategic preparation and effective test-taking behaviors in science examinations.

The mediation analysis further indicated that test-taking skills before and during the test partially mediated the association between test anxiety and test performance. However, test anxiety remained significantly associated with performance after these skills were considered, suggesting that test-taking skills alone may not fully account for the relationship between anxiety and academic performance. These findings highlight that students' performance in science examinations is associated not only with their content knowledge and test-taking strategies but also with their emotional experiences during assessment. Therefore, educational efforts to support students in Chemistry and Physics should consider both the management of test anxiety and the development of effective test-taking skills.

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