14 (2) (2025) 391-404

Unnes Science Education Journal
Accredited Sinta 2

https://journal.unnes.ac.id/journals/usej

Psychological Barriers in Science Education: Correlation of Science Anxiety and Academic Performance

Fitriyyatul Muslihah, Adi Rahmat, Nanang Winarno ✉

DOI: http://dx.doi.org/10.15294/usej.v13i1.20037

Universitas Pendidikan Indonesia, Indonesia

Article Info

Submitted 2025-05-23
Revised 2025-06-15
Accepted 2025-08-01

Keywords

Academic performance; Science anxiety; Science learning

Abstract

Science anxiety is a debilitating combination of anxious negative emotion and cognition in the context of science education. This study investigates the relationship between students' science anxiety and their academic performance in science learning at the junior high school level. Employing a quantitative descriptive approach with a survey-based research design, the study gathered data from 109 students aged 12 to 15 years old. The Science Anxiety was used to assess students' levels of anxiety across personal and environmental dimensions. The survey result shown that science anxiety scale scale among junior high school students is 2.31, which both of them considered as low category. The findings reveal a moderate, negative correlation ($r = -0.509$, $p < 0.001$) between students' science anxiety and their learning outcomes. This inverse relationship suggests that as students' science anxiety increases, their academic performance tends to decrease. Conversely, lower levels of science anxiety are associated with better learning outcomes. The results highlight the significant impact of psychological factors, particularly anxiety, on students' engagement and achievement in science education. Based on the students' answers to open-ended questions, they are feel comfortable when learning science at school because of kind and friendly teacher. On the other hand, students who feel anxious in learning science when they found difficulties to comprehend scientific formulas. The findings provide valuable insights for educators and policymakers to develop targeted interventions and strategies that foster a more positive and inclusive science learning experience for all students.

How to Cite

Muslihah, F., Rahmat, A., & Winarno, N. (2025). Psychological Barriers in Science Education: Correlation of Science Anxiety and Academic Performance. *Unnes Science Education Journal*, 14(2), 391-404.

✉ Correspondence Author:
E-mail: nanang_winarno@upi.edu

p-ISSN 2252-6617
e-ISSN 2502-6232

INTRODUCTION

Science education has long been a crucial component of academic curricula, equipping students with the knowledge and skills necessary to navigate the increasingly complex and technologically-driven world. However, a growing body of research suggests that many students experience a significant level of anxiety when it comes to the study of science, The difficulty of science material causes anxiety for students so that it can have an impact on learning outcomes (Arfiah & Fadly, 2024) and this emotional barrier can have a profound impact on their learning outcomes (Barbayannis et al., 2022; Hsu & Goldsmith, 2021; Parikesit, 2020). The science learning process is greatly influenced by student characteristics, one of which is anxiety (Pratama et al., 2025). Anxiety is a feeling of discomfort and unease due to discomfort or fear accompanied by an autonomic response (Halmuniati et al., 2016).

Students respond to classroom activities and achievement outcomes with a variety of emotions that can impact student success (Cooper et al., 2018). Science anxiety is a debilitating combination of negative emotions and fearful cognitions in the context of science learning (Halmuniati et al., 2016; Pratama et al., 2025; Suryanti et al., 2023). It has a variety of causes, including unpleasant experiences in scientific classrooms, science-anxious teachers in elementary and secondary schools (Maryani et al., 2024), a lack of appropriate role models, gender and racial stereotyping, and popular media preconceptions of scientists (Wentzel, 2017).

Science anxiety has been shown to significantly affect student learning (Wentzel, 1998; Wentzel & Wigfield, 1998). Students with ligh level of anxiety are unable to perform at the best of their ability (Mirawdali et al., 2018). However, researchers confirmed that students'academic achievement is a "net outcome" from both cognitive and non-cognitive attributes (Khine, 2016; Liem, 2019; Ramli et al., 2022; Siti & Mustappha, 2022; York et al., 2015). Academic performance is important for students as a result of educational experience in colleges to represent knowledge, skills, and attitudes (Mappadang et al., 2022). Academic performance are defined as the level of success of students in studying subject matter at school which is expressed in the form of scores obtained from test results regarding a number of specific subject matter (Irawati et al., 2021). Academic achievement are essentially changes in a person's behavior as a result of the learning process (Moore, 2019). These changes can be in the form of knowledge, understanding, skills and attitudes which are usually expressed in the form of numbers or letter symbols with predetermined criteria (Irawati et al., 2021), which provides information about students' abilities to understand learning material explained by the teacher in the teaching and learning process in class (Mappadang et al., 2022).

Previous research has delved into the complex interplay between students' emotional states and their academic performance (Camacho-Morles et al., 2021; Cernat & Moldovan, 2018; Dehbozorgi & Kunuku, 2024). Wentzel discussed many of the important psychological processes that mediate students' persistence, choice, and classroom behavior (Wentzel, 2020). Güzeller and Dogru developed the Science Anxiety Scale, a widely-used instrument that has enabled researchers to measure and quantify the levels of anxiety experienced by students in the context of science education. Numerous studies have leveraged this scale to explore the relationship between science anxiety and various learning outcomes, including academic achievement, self-efficacy, and motivation (Cho et al., 2020; Mete, 2021; Palmes, 2023). For instance, a study by England (2019) found that university students with higher levels of science anxiety tended to exhibit lower levels of perfomarmance and a more maladaptive approach to learning, which in turn negatively impacted their academic performance (England et al., 2019). Zhang et al., (2024) analyze the impact of mental health on the academic performance. A conducted research in the Philippines involving 400 public and private high school students revealed that overall students who had satisfactory science performance, having a low level of science anxiety and high level of self esteem (Palmes, 2023). More recent research by Rozgonjuk et al., (2024) found gender differences in science anxiety and its relationship to science test performance in high school students. Pascoe et al., (2020) have highlighted the larger impact of stress on students in secondary and higher education.

On the other hand, the existing research on science anxiety in the context of science learning in secondary education is limited, particularly within the Indonesian educational landscape. Despite the growing recognition of the importance of addressing emotional and psychological factors that impact student achievement, there appears to be a notable gap in the literature when it comes to investigating science anxiety among Indonesian learners.

The lack of research represents a critical oversight, as science anxiety can have significant

implications for students' academic performance, motivation, and engagement with scientific disciplines. Understanding anxiety in science education is crucial for improving student achievement, success, and engagement in science-related fields (Cho et al., 2020). The importance of understanding the correlation between science anxiety and academic performance in the context of science education has increasingly become a focal point of research. To encourage science learning and lessen anxiety, it's important to understand our students' level of anxiety when learning science.

The importance of understanding the correlation between science anxiety and academic performance in the context of science education has increasingly become a focal point of this research. Understanding the relationship between science anxiety and learning outcomes can inform educational strategies, curriculum design, and pedagogical interventions aimed at mitigating anxiety and promoting positive scientific learning experiences (Grimes & Gardner, 2023). These factors, science anxiety scale and academic performance play a crucial role in determining the success of students in the learning process.

By conducting rigorous research on science anxiety in Indonesia, educators and policymakers can gain a deeper understanding of the challenges faced by students and implement evidence-based approaches to support their emotional and academic development in scientific disciplines. The research questions proposed in this study are:

RQ1: How are the students' science anxiety in science learning among junior high school students?

RQ2: How are the students' academic performance in science learning among junior high school students?

RQ3: How is the correlation between students' science anxiety and academic performance in science learning among junior high school students?

METHOD

Research Design

This study uses a quantitative approach with a survey-based research design. This research aims to explore and understand trends in students' attitudes, behaviors, and characteristics without direct researcher intervention (Creswell & Clark, 2018). The study employs data source triangulation, which includes (1) structured surveys to assess science anxiety levels, (2) academic performance data from student quizzes, and (3) open-ended questions to provide contextual explanations for quantitative findings. This multisource strategy improves the reliability and validity of the research findings while preserving the quantitative foundation needed to create correlational relationships. The quantitative descriptive approach allows for a structured and systematic examination of the collected data, enabling the researchers to uncover meaningful insights, patterns, and potential relationships within the survey responses. The integration of multiple data sources provides a more comprehensive understanding of the phenomena under investigation. The research procedure is depicted in the Figure 1 as a flow chart.

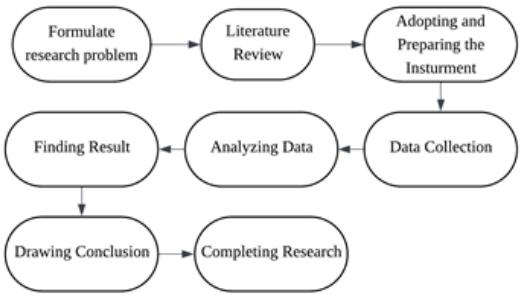

Figure 1. Research Procedure Flow Chart

Participants

Data was obtained in the first semester of the 2024/2025 academic year. Population is a set of units that possess variable characteristics under observation and for which findings of studies may be generalized (Shukla et al., 2020). 7th grade and 8th grade students from school X in Bangka, Indonesia were the population of this study, and 109 students were used as sample with the age range among 12-15 years old. The selected participants are chosen because they are available to be studied. The distribution of participants is shown in Table 1.

Table 1. Participants in the study (N=109)

Grade	Gender	Number
7	Male	38
	Female	37
	Total	75
8	Male	11
	Female	23
	Total	34
Total		109

Research Intrument

In this research, students' science anxiety was measured based on adoption of Science Anxiety Scale by Güzeller & Dogru. (2012). The scale may be used to establish anxiety situations for science classes and to evaluate whether anxiety situations show differences or not (Güzeller & Dogru, 2012). The Science Anxiety Scale by Güzeller & Dogru (2012) measures science anxiety through two key factors: (1) Personal (fear, stress, anxiety, panic, attitude, etc.) (2) Environmental (teacher and what is experienced in classroom, previous experiences there are 28 questions and each item is rated by participants on a five-point Likert scale. Likert-Scale makes it easy to read the participant's perspective (Taherdoost, 2019). Participants are instructed to read the whole set of items before rating their opinion of each item on a five-point scale, i.e., strongly disagree, disagree, uncertain/no comment, agree, and strongly agree. For language differences, instrument was translated from English into Bahasa Indonesia. For more in-depth data collection, we added 2 open-ended questions, such "What makes you feel comfortable when learning science at school?" and "What makes you uncomfortable (anxious) when learning science at school?" The instrument was applied to 109 junior high school students in Bangka Regency. Google forms was used to collect science anxiety data.

For data on students' academic performance, the researcher works with science teachers in recapitulating student quiz results for one semester to be averaged. The results of the 7th grade quiz consist of 3 chapters studied during 1 semester, including (1) nature of science, (2) substances and their changes, and (3) temperature, heat and expansion. Meanwhile, for 8th, 3 chapters are tested, consisting of; (1) introduction to cells, (2) structure and function of living things, (3) work, energy and simple machines.

Data Analysis

The science anxiety data was analyzed by calculating the average of the score gained. The data interpretationof survey result is from Wang & Shen (2023). There are (1.00-1.50 = very low, 1.51-2.50 = low, 2.51-3.50 = moderate, 3.51-4.50 = high, 4.51-5.00 = very high) (Wang & Shen, 2023).

The normality test using Kolmogorov-Smirnov shown that data was not normally distributed, we utilized Spearman correlation to assess the relationship between science anxiety and learning outcomes among junior high school students. The correlation degree between variables of Spearman's Correlation can be seen in Table 2.

Table 2. Spearman's correlation category

Grading Standards	Correlation
$\rho = 0$	No correlation
$0 < \lvert\rho\rvert \leq 0.19$	Very weak
$0.20 \leq \lvert\rho\rvert \leq 0.39$	Weak
$0.40 \leq \lvert\rho\rvert \leq 0.59$	Moderate
$0.60 \leq \lvert\rho\rvert \leq 0.79$	Strong
$0.80 \leq \lvert\rho\rvert \leq 1.00$	Very Strong
1.00	Monotomic correlation

(Zar, 2005)

In this research, all of the data was calculated using IBM SPPS Statistics 26.

RESULT AND DISCUSSION

Result of Students' Science Anxiety

RQ1: How are the students' science anxiety in science learning among junior high school students?

This study used a validated instrument to assess students' level of science anxiety, which includes feelings of tension, fear, and worry experienced by some students when interacting with science-related content and activities. Table 3 presents the means and standard deviations of the measured science anxiety.

Table 3. Mean and Standard Deviation of Stucents' Science Anxiety

Items	N	Mean	ST. Dev
Personal			
SA01	109	2.14	1.17
SA02	109	2.85	1.05
SA03	109	2.90	1.22
SA04	109	2.13	0.95
SA05	109	1.83	0.91
SA06	109	1.50	0.96
SA07	109	2.06	1.03
SA08	109	1.77	0.93
SA09	109	2.40	1.06
SA10	109	2.15	1.05
SA11	109	2.30	1.00
SA12	109	2.03	1.05
SA13	109	2.14	1.01
SA14	109	2.27	1.08
SA15	109	3.07	1.33

Items	N	Mean	ST. Dev
SA16	109	2.54	1.07
SA17	109	1.74	0.93
SA18	109	2.08	0.94
SA19	109	2.18	1.16
SA20	109	2.31	1.07
SA21	109	3.36	1.29
SA22	109	2.28	1.00
SA23	109	1.94	0.99
Environmental			
SA24	109	3.19	1.24
SA25	109	1.93	0.96
SA26	109	2.36	1.14
SA27	109	2.36	1.21
SA28	109	2.88	1.16
AVERAGE		2.31	1.07

To better understand the dynamics of science anxiety, this study employed a validated instrument the Science Anxiety Scale to assess students' levels of anxiety across two key dimensions: personal and environmental. The personal dimension reflects an individual's internal, cognitive and affective responses to science, while the environmental dimension captures the influence of the surrounding learning context, such as the classroom atmosphere and teaching approaches (Güzeller & Dogru, 2012).

Table 4 presents the mean scores for each of these dimensions, providing insights into the relative prevalence and distribution of science anxiety among the participating students.

Table 4. Science anxiety scale on each dimension

	Anxiety scale	Category
Personal	2.27	Low
Environmental	2.46	Low

Based on the data presented in the table, the environmental dimension of science anxiety has a higher mean value of 2.46 compared to the personal dimension with a mean value of 2.27. This suggests that environmental factors related to classroom setting and atmosphere have a relatively more influence on students' science anxiety compared to personal factors.

The open-ended responses provided further insight into these findings. Some students reported experiencing learning difficulties due to inadequate explanations from their teachers, indicating that teaching quality may contribute to science anxiety. In addition, 18.6% of respondents identified problematic classroom conditions, such as noise and lack of cleanliness, as negatively impacting the learning atmosphere.

These environmental factors have the potential to disrupt students' concentration, comfort and ability to engage effectively with the subject matter. Noisy and unclean classroom environments can create distractions and make it difficult for students to focus on the subject matter, thereby increasing anxiety and discomfort.

In addition, analysis of the specific survey question (SA28) showed that students were specifically concerned about the questions asked in science classes. This is in line with the open-ended responses, where students expressed discomfort and anxiety when asked to solve problems in front of peers. This also along with anpther response where students experience fear of making mistakes during science learning.

Furthermore, the analysis of statement SA07, "The thought of learning science makes me uncomfortable," shown an average response of 2.06. While this score is not particularly high, it reveals an important pattern in students' anxiety scale. Despite the majority of students indicating relatively low levels of concern, a few percent of students said that they felt really anxious about learning science. Notably, these same students who expressed high anxiety about science learning also showed consistent responses in SA11 "I don't have the self-confidence for learning science", indicating lower confidence levels when beginning science lessons. This correlation between learning anxiety and confidence levels provides valuable insights into the interconnected nature of students' emotional responses to science education.

This observation is consistent with the theoretical framework proposed by Hashempour and Mehrad (2015), which identifies various factors contributing to student anxiety, such as anticipatory concerns related to past and future experiences, heightened self-awareness, and the pressure to achieve academic success. The alignment of responses between SA07 and SA11 among students with high anxiety reinforces this theoretical perspective, suggesting that anxiety in science education is not merely an isolated emotional reaction but rather part of a larger constellation of academic stressors.

Another point to highlight, students demonstrated considerable anxiety concerning the potential of obtaining the lowest science scores in their class, as reflected in their answers to the Science Anxiety questionnaire. The item SA21,

"I'm afraid my science score is the lowest in the class," received the highest mean response of 3.36 among the 27 statements evaluated in the survey, highlighting a widespread concern regarding academic underachievement. The high mean score suggests that the fear of being perceived as academically inferior by peers creates substantial psychological pressure on students, which may adversely influence their learning experiences and overall academic performance. This social-comparative dimension of science anxiety is consistent with prior research that emphasizes the importance of academic self-concept and peer comparison in shaping students' emotional reactions to educational challenges (Wolff et al., 2018). Additionally, the prominence of this specific anxiety indicator among the 27 statements suggests that strategies aimed at alleviating science anxiety should not only concentrate on enhancing subject matter understanding but also prioritize the establishment of a less competitive classroom environment and promotion of a more supportive educational setting, thereby reducing pressure associated with peer comparisons.

RQ2: How are the students' academic performance in science learning among junior high school students?

In the context of science education, academic performance is important because portraying students' inherent productivity and ability when learning science (Darling-Hammond et al., 2020; Ganyaupfu, 2013; Mappadang et al., 2022). In this research, students' academic performance was assessed from the results of science quizzes for one semester with each grade having completed 3 learning chapters from Merdeka Curriculum. The following are topics tested in grade 7 and grade 8 was shown in the Table 5.

Table 5. Science Quiz Topic for Each Grade

Grade 7	**Average Score**
Nature of science	93.6
substances and their changes	86.2
temperature, heat and expansion	75.6
Total Average	85.1
Grade 8	
Introduction to cells	83.2
structure and function of living things	80.3
work, energy and simple machines	70.5
Total Average	78.04

From the data above, it can be seen that topics that are more related to calculations and formulas get a smaller average score compared to other topics. In Grade 7, students exhibited remarkable competence in comprehending nature of science, achieving a score of 93.6, followed by a solid understanding of substances and their transformations at 86.2. Conversely, their performance in areas concerning temperature, heat, and expansion was considerably lower, at 75.6. This patterns implies that students in this grade may encounter greater difficulties with abstract physical concepts compared to more fundamental scientific ideas (Muzammila Akram et al., 2023; Ramdas & Yashoda, 2020). Meanwhile, results for Grade 8 reveal a distinct pattern that merits thorough quiz. Although students exhibited commendable performance in biology-related subjects, such as introduction to cells (83.2%) and the structure and function of living organisms (80.3%), there was a significant drop in their performance in areas concerning work, energy, and simple machines (70.5%). The overall average for Grade 8 (78.04%) is lower than that of Grade 7, which may be linked to heightened complexity of curriculum and more abstract characteristics of physics concepts in the topic (Ramdas & Yashoda, 2020). This observation is consistent with prior studies indicating that students often struggle with physics-related topics that require more sophisticated mathematical and conceptual understanding (Wangchuk et al., 2023).

This shows that students have difficulty in applying theory or information related to formulas. If it is related to the results of students' answers to the science anxiety questionnaire in question SA02 which reads "I become nervous when I have to learn formulas and new material in science lessons" and shows an average score of 2.85 (moderate category). On the one hand, students' fear of formulas can also be seen from their answers when answering open-ended questions, where the majority answered that they felt anxious when they found difficulties to understand scientific formulas, this along with studies have revealed remarkable difficulties of students with formulas both at school and at university (Fauzi & Suryadi, 2020; Korpershoek et al., 2020; Taskin & Bernholt, 2015). Then the second most common answer was about complexity of scientific content makes it hard for them to understand. This is of course in line considering that their quiz results had lower scores on topics that contained formula calculations and more complex content.

A more in-depth analysis can be conducted by examining the comparative average scores for

each class, as illustrated in Figure 1.

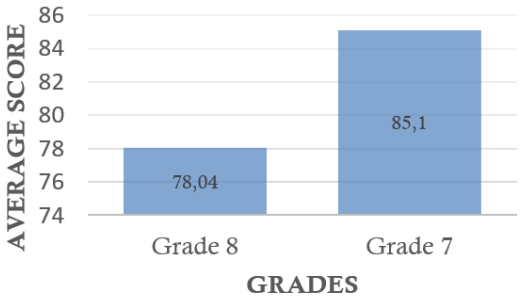

Figure 2. Average of Students' Academic Performance on Each Grade

Based on Figure 1, grade 8 and grade 7 show marked differences in their average quiz scores, thus showing an interesting pattern in academic achievement. Where grade 8 has a mean score of 78.04 out of 34 students, grade 7 has a mean of 85.10 out of 75 students. The difference in performance might be attributed to the increasing complexity of the science curriculum in grade 8, which introduces more abstract concepts and demanding topics. This study aims to examine relationship between junior high school science students' academic performance and their science anxiety using a Gu¨zeller (2012) questionnaire. The lower average quiz score for grade 8 students could be directly related to higher Science Anxiety Scale score observed in this grade level, as seen in the comparison in Table 6. The table indicates that the Science Anxiety Scale score for grade 8 students is 3.42, which is considerably higher than the 2.32 score for grade 7 students.

Table 6. Comparison of Science Anxiety Scale with Students Academic Performance on Each Grade

Grade	SA Scale	Average Score
8	3.42	78.04
7	2.32	85.10

Looking at the data, it suggests that 8th grade students show higher levels of science anxiety than 7th grade students. One potential explanation for this finding is the increasing complexity and depth of the science curriculum as students' grades increase. The science content and concepts covered in 8th grade may be more challenging and demanding compared to the content in 7th grade, which may contribute to the higher levels of science anxiety observed in 8th grade students.

This finding is related to the open-ended question number 2 response in Category V, where students view science as a challenging subject with material that is difficult to understand. This answer was mostly given by 8th grade students out of a total of 21.08% of respondents stating that the complexity of scientific content made it difficult to understand.

Apart from that, students' academic achievements also show a suitable pattern. The average score of 8th students (78.04) is lower than the average score of 7th students (85.10). The inverse relationship between science anxiety and academic performance suggests that the higher levels of anxiety experienced by 8th grade students may have a negative impact on their overall academic achievement in science. While some students excel in science, many find learning the complex discipline decidedly difficult. Science is a subject comprised of a plethora of rules and principles. Without a firm grasp of these rules, and an understanding of what they mean, students will struggle to understand scientific information (Palmes, 2023). There are several reasons why students may struggle to learn these scientific principles and therefore, have difficulty comprehending the discipline. This difficulty leads to anxiety on the subject often leads to problems concentrating while studying and remembering, which makes the student feel helpless and at risk of failure (England et al., 2019; Hashempour & Mehrad, 2015).

Although our findings indicate a significant correlation between science anxiety and academic achievement, it is important to acknowledge that the variation in quizzes scores across topics (ranging from 70.5 to 93.6) cannot be attributed solely to anxiety levels. The observed differences likely reflect a complex interaction of factors, including topic complexity, cognitive demands, students' prior knowledge, teaching approaches, and curriculum sequencing effects. For example, more abstract concepts such as 'temperature, heat, and expansion' and 'work, energy, and simple machines' showed lower mean scores, suggesting that topic difficulty and inherent cognitive load may interact with anxiety levels to impact performance. Our study focused specifically on science anxiety as one contributing variable in this multifaceted learning environment, recognizing that academic performance results from the dynamic interaction between affective factors (such as anxiety), cognitive variables, and contextual elements of the learning process.

Students' Response Toward Open-Ended Questions

The study involves collecting qualitative

data from students by asking them two open-ended questions. After gathering the responses, the researchers analyze and group them into distinct categories based on the similarities and patterns found in the students' answers. The categorization process is flexible, with the number of categories potentially differing for each question. Through this approach, the researchers aim to systematically understand and interpret the students' perspectives and thoughts.

Q1: What makes you feel comfortable when learning science at school?

Category I: Students find science lessons enjoyable when they are exciting and fun. The 21.66% who reported this positive experience suggest that interactive and dynamic teaching methods can make science more engaging. By transforming complex scientific concepts into interesting and accessible content, teachers can help students overcome potential learning barriers and develop a more positive attitude towards science education.

Category II: Kind and friendly teachers play a crucial role in making students feel comfortable during science lessons, as evidenced by 31.94% of student responses. When educators create a supportive and welcoming classroom environment, they help reduce student anxiety and build confidence. This positive approach encourages students to engage more openly with scientific content, transforming the learning wentzelexperience from potentially intimidating to enjoyable and accessible.

Category III: The perception that science lessons are easy to understand represents an important aspect of student learning experiences, with 7.98% of responses highlighting this perspective. This relatively low percentage suggests that many students still find science challenging

Category IV: 22.8% of students valuing teachers who provide detailed and understandable insights into scientific concepts. By offering thorough, step-by-step explanations, teachers can effectively bridge the gap between students' existing knowledge and new scientific information, reducing learning anxiety and creating a more supportive educational environment.

Category V: The physical learning environment plays a subtle yet significant role in students' comfort during science education, with 5.7% of students highlighting the importance of a conducive classroom setting. A quiet and clean classroom creates an optimal learning atmosphere that minimizes distractions and supports cognitive focus, allowing students to engage more effectively with scientific content.

Category VI: 14.82% of students identifying these practical sessions as a source of comfort in science education. Laboratory and group practicum represent a valuable educational approach that enables students to experience science through direct, hands-on learning. Besides, students have no worries for being wrong because they usually do it together with their partner.

Category VII: 21.66% Students said that their high interest is a big motivator for studying science. The activity such as study, discuss new material or formulas makes them feel enjoyable when learning science. They display a tremendous interest in discovering new and exciting topics, previously unknown to them.

Category VIII: Despite representing only 3.42% of responses, 4 students said that fun learning methods and multimedia presentations can can help reduce students' anxiety, increase motivation, and make complex scientific concepts more accessible and memorable.

To provide a clearer visualization of the distribution of students' responses to the open-ended question 'What makes you feel comfortable when studying science at school?', the data is categorized into eight main categories and presented in the form of a pie chart in Figure 3.

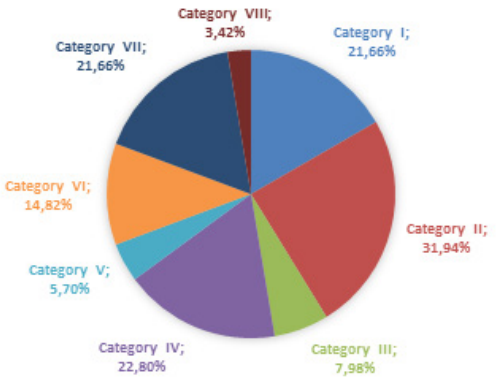

Figure 3. Visualization of the distribution of students' responses to the Q1

The examination of students' responses to what makes them comfortable when learning science reveals multiple bound elements that work together to create a favorable science learning environment. The data show that emotional aspects are most important, with approximately 54% of respondents (Categories II and VII combined) emphasizing the value of supportive teacher connections and inherent enthusiasm in science. Pedagogical approaches are also important, with around 44% of students (Categories I

and IV) emphasizing engaging teaching methods and clear explanations that make complicated subjects understandable. Furthermore, environmental and experiential elements (Categories III, V, VI, and VIII) account for around 32% of responds, emphasizing the importance of hands-on learning experiences, appropriate physical environments, and multimedia integration. It should also be noted that one student can response various answers so that one student's response can be divided into several categories.

Q2: What makes you uncomfortable (anxious) when learning science at school?

Category I: Students experience discomfort and anxiety during science learning when they encounter difficulties solving assigned problems. Specifically, out of the total responses collected, 9 participants, representing 11.16% of the sample, reported feeling uncomfortable and anxious in science classrooms when they struggle to complete the given tasks.

Category II: Among the participants surveyed, 8 individuals, accounting for 9.92% of the total respondents, reported feeling uncomfortable and anxious during required to solve problems in front of their classmates or respond to direct questions from their teacher. This suggests that the experience of being publicly called upon to demonstrate academic knowledge can trigger significant emotional stress for some students during instructional settings.

Category III: Out of total participants surveyed, 35 respondents, representing 43.4% of the sample, reported difficulties comprehending scientific formulas and how to use them effectively. This high percentage indicates that formula comprehension and application pose a substantial challenge.

Category IV: 18.6% of respondents identified classroom conditions as problematic, with issues such as noise and lack of cleanliness negatively affecting the learning atmosphere. These environmental factors of being noisy and dirty potentially disrupt students' concentration, comfort, and ability to effectively engage with academic content.

Category V: Among the participants surveyed, 21.08% of respondents expressed that the complexity of scientific content makes it hard to understand. This significant percentage suggests that the intricate nature of scientific concepts and the intellectual demands of the subject create substantial learning barriers for students

Category VI: A subset of students struggle with maintaining concentration during science classes, with 6 participants, representing 7.44% of the total sample, reporting difficulties staying alert and attentive. These students described experiencing drowsiness, which impedes their ability to effectively engage with and absorb scientific content.

Category VII: Students experience fear of making mistakes during science learning. Out of the total participants surveyed, 10 respondents, accounting for 12.4% of the sample, reported being afraid of providing incorrect answers. This fear of being wrong suggests that students feel significant psychological pressure during scientific educational experiences.

Category VIII: Among the participants surveyed, 7 respondents, representing 8.68% of the total sample, specifically identified examination and assessment as sources of anxiety or discomfort. These assessment tools appear to create heightened pressure and emotional response among students.

Category IX: A portion of students experience learning challenges due to insufficient explanations from their teachers. Specifically, 5 participants, accounting for 6.2% of total sample, reported a lack of comprehensive or clear instruction from their science educators. This indicates inadequate pedagogical communication can create barriers to understanding scientific concepts.

Category X: A subset of students reported experiencing no significant obstacles in their science learning. Among the participants surveyed, 12 respondents, representing 14.88% of the total sample, indicated that they did not encounter any notable challenges or difficulties during their science education.

To provide a clearer visualization of the distribution of students' responses to the open-ended question 'What makes you uncomfortable (anxious) when learning science at school?', the data is categorized into eight main categories and presented in the form of a pie chart in Figure 4.

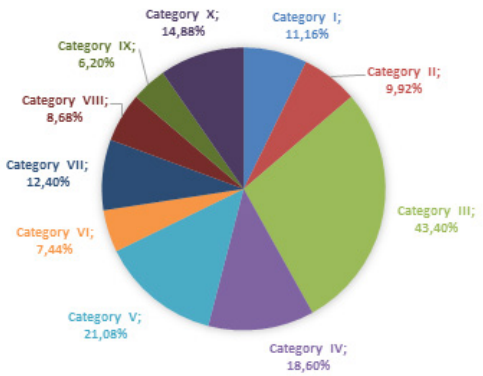

Figure 4. Visualization of the distribution of students' responses to the Q1

The review of students' anxiety sources in scientific learning identifies three major issue domains. Cognitive difficulties are common, with over 60% of replies citing issues with formula understanding, content complexity, and problem solving (Categories I, III, V). Affective components account for around 34% of concerns, including worry of public speaking, making mistakes, and assessment anxiety (Categories II, VII, and VIII). Environmental and pedagogical concerns account for around 25% of responses, with an emphasis on classroom settings and instructional clarity (Categories IV and IX). Notably, 14.88% of pupils reported no significant obstacles, whereas 7.44% had difficulty concentrating. These data indicate that scientific anxiety is caused by a number of interconnected causes, necessitating comprehensive therapies that target cognitive, emotional, and contextual aspects of the learning environment.

The Correlation Between Students' Science Anxiety and Student Academic Performance

The data distribution is not normally distributed, this research technique uses Spearman's Rho method to test the correlation between components or variables. The result of the correlation test using Spearman's Rho shows that science anxiety has a negative correlation with learning outcomes with a value of $r = -0.509$. The statistical significance of this correlation is supported by the obtained (ρ -value of 0.000, which falls well below the conventional significance threshold of 0.05 ($\rho < 0.05$). The distribution can be seen in Table 7.

Table 7. Result of Spearman's Correlation between Science Anxiety Scale and Academic Performance

Variables	Correlation (r)	Sig (ρ)	Category
Correlation between science anxiety and learning outcomes	-0.509	0.000	Moderate correlation, negative correlation

The observed negative correlation coefficient of -0.509 reveals a significant inverse relationship between students' science anxiety and their learning outcomes, demonstrating a moderate to strong negative association between these variables. This statistical finding carries substantial practical implications for educational contexts. When students experience lower levels of science anxiety, they tend to achieve higher learning outcomes, and conversely, higher anxiety levels are associated with diminished academic performance. Cho's (2020) correlational research results found a significant negative correlation between science anxiety and science achievement. It can be concluded that science anxiety makes a negative contribution to the development of science achievement (Cho et al., 2020). This inverse relationship suggests that students who feel more comfortable and less anxious in their science classes are better positioned to engage effectively with the learning material, participate more actively in classroom activities, and ultimately demonstrate stronger academic achievement (Pascoe et al., 2020). In addition, these results are in line with a systematic review conducted by Hashempour and Mehrad (2015), which concluded that academic anxiety has a negative impact on success because anxious students think too much about themselves, do not focus on the learning process, have a shorter memory span, and poor emotional intelligence (Hashempour & Mehrad, 2015).

The psychological comfort these students experience likely enables them to focus more on understanding concepts rather than being hindered by anxiety-related cognitive barriers. This can come from both personal and environmental sources. In open-ended question 1, the majority of students answered that the thing that made them more comfortable studying science was a friendly teacher. This is in line with Wentzel (1998) reports significant links between middle school students' assessments of teacher behavior reflecting dimensions of caring and positive aspects of student motivation, including pursuit of social and academic goals, mastery orientations toward learning, and academic interest (Wentzel & Wigfield, 1998). They may be more willing to ask questions, participate in discussions, and tackle challenging problems, all of which contribute to enhanced academic performance (Hsu & Goldsmith, 2021). Conversely, students experiencing higher levels of science anxiety might face cognitive interference that impedes their learning process, potentially leading to reduced participation, decreased engagement, and subsequently lower academic achievement. This in line with research that found students' success in completing science learning assignments is determined not only by their self-efficacy but also by their level of anxiety (Maryani et al., 2024). Anxiety influences students' motivations for participation in educational activities (Afdal et al., 2019).

This finding underscores the importance of creating supportive learning environments that minimize student anxiety and promote psychological safety in science education. Furthermore, the variation in sample sizes (75 versus 34 students) raises important methodological considerations about the representativeness and generalizability of these findings. While the larger sample size in grade 7 might provide a more reliable indication of typical performance at this level, the smaller grade 8 sample, though still statistically meaningful, may be more susceptible to individual variations in student performance.

Based on what has been explained, several steps that can be taken to reduce anxiety in learning science among students include the use of technology-based learning platforms that can address the 43.4% of students who have difficulty understanding formulas by providing interactive visualizations and self-learning modules. This indicates that teachers are required to design learning that is appropriate for the current conditions, one of which is by creating innovative, creative, and enjoyable learning media (Sukarini & Manuaba, 2021). Reducing distractions and anxiety triggers can be achieved by fostering an empowering classroom atmosphere (Hsu & Goldsmith, 2021) and using innovative tools that enhance learning experiences and reduce anxiety during classroom assessments (Husain et al., 2025). On the other hand, although science anxiety and learning outcomes are correlated, it is important to note that improving learning outcomes is equally important as reducing science anxiety in students. Some studies indicate that learning outcomes can be improved through inquiry-based science learning (Aditomo & Klieme, 2020), focusing on the use of effective scientific approaches (Firman; et al., 2018), and implementing problem-based learning models (Ali et al., 2023). These findings align with the results of the student questionnaire, where students reported feeling more comfortable and motivated to learn when appropriate teaching methods and multimedia are used. Additionally, interactive and dynamic teaching methods can make science more engaging, enabling students to focus on the material and become more involved in the learning process. Studies shows that problem-based learning model can affect students' anxiety level science learning outcomes (Nurofah et al., 2024; Suryanti et al., 2023). Another research by Pratama et al. (2025) found that project-based learning is a solution to reduce students' science learning anxiety.

CONCLUSION

In conclusion, this research examined the intricate relationship between science anxiety and academic performance in junior high school students, thereby addressing a significant gap in the comprehension of how emotional and psychological factors affect science learning achievement. By conducting a thorough analysis of quantitative data gathered from students, the study uncovered several important findings related to the prevalence of science anxiety, patterns in academic performance and the intricate correlation between these two variables. The empirical evidence from this study reveals notable conclusions about the correlation between science anxiety and academic performance among junior high school students. The quantitative analysis indicated a scientific anxiety scale score of 2.31, indicating a poor category classification. The statistical study found a moderate negative correlation ($r = -0.509$, $p < 0.001$) between students' scientific anxiety levels and learning results, indicating a significant inverse association between these variables. This association coefficient implies that high levels of science anxiety are associated with poor academic achievement, whereas pupils with lower anxiety levels tend to obtain better learning results.

The secondary data, obtained through open-ended questionnaires, provided valuable insights into the factors influencing students' anxiety levels. A recurring theme emerged regarding the crucial role of instructor characteristics in mediating science anxiety. Specifically, students reported experiencing greater comfort and engagement in science learning when taught by educators who exhibited approachable and supportive pedagogical dispositions. This finding underscores the significance of positive teacher-student relationships in creating an optimal learning environment. Conversely, the analysis identified a primary anxiety trigger among students: the comprehension of scientific formulas. This cognitive challenge appears to be a substantial source of academic stress, potentially impeding students' mastery of scientific concepts. These findings contribute to the growing body of literature emphasizing the intricate interplay between psychological factors and academic achievement in science education, particularly highlighting how emotional states and teaching approaches can significantly influence learning outcomes. These results have important implications for educational practice, suggesting that interven-

tions aimed at reducing science anxiety, coupled with supportive teaching approaches, may be instrumental in enhancing students' scientific learning experiences and academic performance. Further research might explore specific pedagogical strategies that effectively minimize formula-related anxiety while maintaining rigorous academic standards.

REFERENCES

Aditomo, A., & Klieme, E. (2020). Forms of inquiry-based science instruction and their relations with learning outcomes: evidence from high and low-performing education systems. *International Journal of Science Education*, 42(4), 504–525. https://doi.org/10.1080/09500693.2020.1716093

Afdal, A., Alizamar, A., Ilyas, A., Zikra, Z., Taufik, T., Erlamsyah, E., Sukmawati, I., Ifdil, I., Ardi, Z., Marjohan, M., Netrawati, N., Zahri, T. N., Putriani, L., Fikri, M., Munawir, M., Syahputra, Y., Astuti, A. D., Trizeta, L., Erwinda, L., … Asmarni, A. (2019). Contribution of statistical anxiety to student learning outcomes: Study in Universitas Negeri Padang. *Journal of Physics: Conference Series*, 1157(4). https://doi.org/10.1088/1742-6596/1157/4/042126

Ali, L. U., Wahyuni, W., Azmar, A., Jumawal, J., & Fitriana, I. M. (2023). Improving Science Learning Outcomes by Applying Problem-Based Learning Model. *Jurnal Pendidikan Fisika*, 11(2), 173–182. https://doi.org/10.26618/jpf.v11i2.9913

Arfiah, S. N., & Fadly, W. (2024). *View of Effectiveness of the Self Regulated Learning Model using the SAVI Method to Reduce Anxiety in Learning Science*.pdf.

Barbayannis, G., Bandari, M., Zheng, X., Baquerizo, H., Pecor, K. W., & Ming, X. (2022). Academic Stress and Mental Well-Being in College Students: Correlations, Affected Groups, and COVID-19. *Frontiers in Psychology*, 13(May), 1–10. https://doi.org/10.3389/fpsyg.2022.886344

Camacho-Morles, J., Slemp, G. R., Pekrun, R., Loderer, K., Hou, H., & Oades, L. G. (2021). Activity Achievement Emotions and Academic Performance: A Meta-analysis. *In Educational Psychology Review* (Vol. 33, Issue 3). https://doi.org/10.1007/s10648-020-09585-3

Cernat, V., & Moldovan, L. (2018). Emotional problems and academic performance of students in manufacturing. *Procedia Manufacturing,* 22, 833–839. https://doi.org/10.1016/j.promfg.2018.03.118

Cho, M. T., Aye, T. T., & Lecturer, A. (2020). Relationship between science anxiety and science achievement of grade 8 students in selected basic education schools in Myanmar. *December*, 4–5.

Cooper, K. M., Downing, V. R., & Brownell, S. E. (2018). The influence of active learning practices on student anxiety in large-enrollment college science classrooms. *International Journal of STEM Education*, 5(1). https://doi.org/10.1186/s40594-018-0123-6

Creswell, J. W., & Clark, V. L. P. (2018). *Designing and Conducting Mixed Methods Research (3rd ed.)*. SAGE Publications.

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science,* 24(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791

Dehbozorgi, N., & Kunuku, M. T. (2024). Exploring the Influence of Emotional States in Peer Interactions on Students' Academic Performance. *IEEE Transactions on Education*, 67(3), 405–412. https://doi.org/10.1109/TE.2023.3335171

England, B. J., Brigati, J. R., Schussler, E. E., & Chen, M. M. (2019). Student anxiety and perception of difficulty impact performance and persistence in introductory biology courses. *CBE Life Sciences Education,* 18(2), 1–13. https://doi.org/10.1187/cbe.17-12-0284

Fauzi, I., & Suryadi, D. (2020). The Analysis of Students' Learning Obstacles on the Fraction Addition Material for Five Graders of Elementary Schools. *Al Ibtida: Jurnal Pendidikan Guru MI,* 7(1), 33. https://doi.org/10.24235/al.ibtida.snj.v7i1.6020

Firman;, Baedhowi;, & Murtini, W. (2018). International Journal of Active Learning The Effectiveness of The Scientific Approach to Improve Student Learning Outcomes. *International Journal of Active Learning*, 3(2), 86–91. http://journal.unnes.ac.id/nju/index.php/ijal%0AThe

Ganyaupfu, E. M. (2013). Teaching Methods and Students' Academic Performance. *International Journal of Humanities and Social Science Invention ISSN (Online*, 2(9), 2319–7722. www.ijhssi.org

Grimes, Z., & Gardner, G. (2023). Conceptions of Disciplinary Anxiety across Science, Technology, Engineering, and Mathematics (STEM) Contexts: A Critical and Theoretical Synthesis. *Journal of Research in Science, Mathematics and Technology Education*, 6(SI), 21–46. https://doi.org/10.31756/jrsmte.212si

Güzeller, C. O., & Dogru, M. (2012). Development of Science Anxiety Scale for Primary School Students. *Social Indicators Research*, 109(2), 189–202. https://doi.org/10.1007/s11205-011-9894-6

Halmuniati, Hasiati, Wui, L., & Awad, F. B. (2016). *Pengaruh Motivasi Belajar Dengan Tingkat Kecemasan Dan Hasil.* 70–76.

Hashempour, S., & Mehrad, A. (2015). The effect of anxiety and emotional intelligence on students ' learning process faculty of human ecology. *Journal of Education & Social Policy*, 1(2), 115–122.

Hsu, J. L., & Goldsmith, G. R. (2021). Instructor strategies to alleviate stress and anxiety among col-

lege and university STEM students. *CBE Life Sciences Education*, 20(1), 1–13. https://doi.org/10.1187/cbe.20-08-0189

Husain, M., Maryani, I., Fauzia, S. N., & Hartanto, D. (2025). Boosting Engagement and Reducing Anxiety : The Impact of Quizizz on Science Learning in Elementary Classrooms. *Journal of Pedagogy and Education Science*, 4(02), 199–211. https://doi.org/10.56741/IISTR.jpes.00877

Irawati, I., Ilhamdi, M. L., & Nasruddin, N. (2021). Pengaruh Gaya Belajar Terhadap Hasil Belajar IPA. *Jurnal Pijar Mipa*, 16(1), 44–48. https://doi.org/10.29303/jpm.v16i1.2202

Khine, M. S. (2016). Non-Cognitive Skills and Factors in Educational Success and Academic Achievement. *Non-Cognitive Skills and Factors in Educational Attainment*, 3–9. https://doi.org/10.1007/978-94-6300-591-3_1

Korpershoek, H., Canrinus, E. T., Fokkens-Bruinsma, M., & de Boer, H. (2020). The relationships between school belonging and students' motivational, social-emotional, behavioural, and academic outcomes in secondary education: a meta-analytic review. *Research Papers in Education*, 35(6), 641–680. https://doi.org/10.1080/02671522.2019.1615116

Liem, G. A. D. (2019). Academic performance and assessment. *Educational Psychology*, 39(6), 705–708. https://doi.org/10.1080/01443410.2019.1625522

Mappadang, A., Khusaini, K., Sinaga, M., & Elizabeth, E. (2022). Academic interest determines the academic performance of undergraduate accounting students: Multinomial logit evidence. *Cogent Business and Management,* 9(1). https://doi.org/10.1080/23311975.2022.2101326

Maryani, I., Selvi, H., Cahyani, D., & Ulfah, A. (2024). *Self- Efficacy , Anxiety Level , and their Effects on Students ' Self - Persistence in Learning Science*. 8(4), 585–594.

Mete, P. (2021). Structural Relationships between Coping Strategies, Self-Efficacy, and Fear of Losing One's Self-Esteem in Science Class. *International Journal of Technology in Education and Science,* 5(3), 375–393. https://doi.org/10.46328/ijtes.180

Mirawdali, S., Morrissey, H., & Ball, P. (2018). Academic anxiety and its effects on academic performance. *International Journal of Current Research*, 10(06), 70017–70026.

Moore, P. J. (2019). Academic achievement and social and emotional learning. *Educational Psychology*, 39(8), 981–983. https://doi.org/10.1080/01443410.2019.1643971

Muzammila Akram, Dur-i-Shahwar Aslam Khan, Waqas Mahmood (Corresponding author), & Abida Sher. (2023). Conceptual Difficulties of Primary School Students in Learning the General Science: A Sequential Explanatory Mixed Method Research Design. *International Journal of Social Science & Entrepreneurship,* 3(3), 313–329. https://doi.org/10.58661/ijsse.v3i3.205

Nurofah, A., Dwirahayu, G., & Satriawati, G. (2024). Pengaruh model problem-based learning terhadap kemampuan pemecahan masalah dan kecemasan matematika siswa The influence of problem-based learning models on students ' problem-solving abilities and mathematical anxiety. *Linear: Journal of Mathematics Education*, 5(2).

Palmes, H. (2023). *Science Anxiety, Self-Esteem, and Science Performance: a Correlational Study.* September, 969–973. https://doi.org/10.5281/zenodo.8379977

Parikesit, A. A. (2020). Kecemasan Terhadap Mata Ajar Ilmu Pengetahuan Alam (Ipa) Pada Siswa Sekolah Dasar Dan Menengah. *Manajemen Pendidikan*, 14(2), 82–90. https://doi.org/10.23917/jmp.v14i2.4387

Pascoe, M. C., Hetrick, S. E., & Parker, A. G. (2020). The impact of stress on students in secondary school and higher education. *International Journal of Adolescence and Youth*, 25(1), 104–112. https://doi.org/10.1080/02673843.2019.1596823

Pratama, D. B., Fadly, W., & Winarno, N. (2025). Project Based Learning Berbasis Kegiatan Sains Aestetik: Tinjauan Metode Ganda Terhadap Kecemasan Belajar Siswa. *Jurnal Ilmu Pendidikan Dan Pembelajaran*, 27(2), 635–637.

Ramdas, B., & Yashoda, G. (2020). Investigating the learning difficulties of physical science at secondary school level. *ACADEMICIA: An International Multidisciplinary Research Journal,* 10(10), 1252. https://doi.org/10.5958/2249-7137.2020.01291.4

Ramli, M., Susanti, B. H., & Yohana, M. P. (2022). Indonesian Students' Scientific Literacy in Islamic Junior High School. *International Journal of STEM Education for Sustainability*, 2(1), 53–65. https://doi.org/10.53889/ijses.v2i1.33

Rozgonjuk, D., Täht, K., Soobard, R., Teppo, M., & Rannikmäe, M. (2024). The S in STEM: gender differences in science anxiety and its relations with science test performance-related variables. *International Journal of STEM Education,* 11(1), 45. https://doi.org/10.1186/s40594-024-00504-4

Shukla, T., Dosaya, D., Nirban, V. S., & Vavilala, M. P. (2020). Factors extraction of effective teaching-learning in online and conventional classrooms. *International Journal of Information and Education Technology*, 10(6), 422–427. https://doi.org/10.18178/ijiet.2020.10.6.1401

Siti, Z. Z., & Mustappha, M. (2022). A literature review of the academic achievement of college students. *Journal of Education and Social Sciences*, 20(1), 11–18.

Sukarini, K., & Manuaba, I. B. S. (2021). Pengembangan Video Animasi Pembelajaran Daring Pada Mata Pelajaran IPA Kelas VI Sekolah Dasar. *Jurnal Edutech Undiksha*, 9(1), 48–56. https://doi.org/10.23887/jeu.v9i1.32347

Suryanti, N. N. B., Margunayasa, I. G., & Diki. (2023). Dampak Model Pembelajaran Berbasis Masalah dan Tingkat Kecemasan Siswa Terhadap Hasil Belajar IPA Siswa Kelas V SD. *Jurnal Ilmiah Pendidikan Profesi Guru,* 6(1), 120–132. https://doi.org/10.23887/jippg.v6i1.59272

Taherdoost, H. (2019). What Is the Best Response Scale for Survey and Questionnaire Design. *International Journal of Academic Research in Management (IJARM)*, 8(1), 1–10. https://ssrn.com/abstract=3588604

Taskin, V., & Bernholt, S. (2015). Students' Understanding of Chemical Formulae: A review of empirical research. *International Journal of Science Education*, 36(1), 157–185. https://doi.org/10.1080/09500693.2012.744492

Wang, F., & Shen, Z. (2023). Research of Theme-based Teaching's Effectiveness in English Language Education. *The Educational Review, USA*, 7(7), 962–967. https://doi.org/10.26855/er.2023.07.020

Wangchuk, D., Wangdi, D., Tshomo, S., & Zangmo, J. (2023). Exploring Students' Perceived Difficulties of Learning Physics. *Educational Innovation and Practice, 6(August).* https://doi.org/10.17102/eip.6.2023.03

Wentzel, K. R. (1998). Social relationships and motivation in middle school: The role of parents, teachers, and peers. *Journal of Educational Psychology*, 90(2), 202–209. https://doi.org/10.1037/0022-0663.90.2.202

Wentzel, K. R. (2017). Teacher-student relationships, motivation, and competence at school. *In The Routledge International Handbook of Social Psychology of the Classroom*. https://doi.org/10.4324/9781315716923

Wentzel, K. R. (2020). Motivating Students to Learn. *In Educational Psychology*. https://doi.org/10.4324/9781410610218

Wentzel, K. R., & Wigfield, A. (1998). Academic and Social Motivational Influences on Students' Academic Performance. *Educational Psychology Review*, 10(2), 155–175. https://doi.org/10.1023/A:1022137619834

Wolff, F., Helm, F., Zimmermann, F., Nagy, G., & Möller, J. (2018). On the effects of social, temporal, and dimensional comparisons on academic self-concept. *Journal of Educational Psychology,* 110(7), 1005–1025. https://doi.org/10.1037/edu0000248

York, T. T., Gibson, C., & Rankin, S. (2015). Defining and measuring academic success. *Practical Assessment, Research and Evaluation*, 20(5), 1–20.

Zar, J. H. (2005). Spearman Rank Correlation. Encyclopedia of Biostatistics, July 2005. https://doi.org/10.1002/0470011815.b2a15150

Zhang, J., Peng, C., & Chen, C. (2024). Mental health and academic performance of college students: Knowledge in the field of mental health, self-control, and learning in college. *Acta Psychologica*, 248(49), 104351. https://doi.org/10.1016/j.actpsy.2024.104351