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Indonesian Junior High School Students' Science Anxiety Levels: A Cross-Sectional Study of Gender and Grade

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ABSTRACT Science anxiety is a multidimensional construct that can be influenced by both personal and environmental factors. Junior high school students are in a stage of adolescence, particularly vulnerable to mental health challenges, including anxiety. This research aims to investigate whether Junior High School students' science anxiety levels differ by gender and grade level. The researcher carried out survey research by using the SAS instrument with a 5-point Likert scale. The questionnaire comprises 28 questions divided into 2 dimensions, along with 2 open-ended questions. The survey was distributed to 1041 junior high school students, consisting of 583 females and 458 males from grades 7, 8, and 9 across various provinces in Indonesia. The collected data were analyzed with descriptive statistics, then supported by the answers to open-ended questions from the students. The findings show that the average score of science anxiety is 2.66, indicating a moderate level. Regarding gender, there are no significant differences; the average score of females is higher than that of males. Regarding grade, there is a significant difference between grade 8 and grade 7, with the highest average score being grade 7. The results showed that the science anxiety levels in junior high school students were at a moderate level, so teachers are expected to implement supportive and engaging teaching strategies that can help reduce anxiety and foster a more positive learning environment.

Keywords: Science Anxiety Levels: Junior High School Students; Gender; Grade

1. INTRODUCTION

Science is an important subject that helps students develop a comprehensive understanding of the universe and its environment. This understanding will give birth to knowledge that can be used to improve students' skills in exploring the surrounding nature. However, failure to understand science can lead to anxiety among students (Aditya Parikesit & Damiyanti, 2019). Anxiety is a feeling marked by inner unrest and discomfort, often shown through nervous actions like pacing, physical symptoms, and constant worrying. It involves distressing emotions related to the anticipation of future events, such as a sense of impending doom. Unlike fear, which is a reaction to a present or perceived danger, anxiety arises from the anticipation of a possible future threat (Kumar, 2018). Within the realm of education, tasks such as public speaking and examinations are known to intensify anxiety among students. Academic anxiety is a distressing emotional response that students often experience in educational contexts (Gogol et al., 2017). The higher an individual's anxiety level, the more likely they are to exhibit signs of academic burnout (Fernández-Castillo, 2021), feelings of helplessness (Raufelder et al., 2018), school refusal (Seçer & Ulaş, 2020), and poor academic performance (Barbosa-Camacho et al., 2022).

Adolescents are particularly vulnerable to mental health challenges, including anxiety. In Southeast Asia, about 362.2 million individuals aged 10–19 years (18.8% of the

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regional population) are adolescents. Mental health issues among adolescents, especially those related to suicide, are a major concern throughout the region, including in Indonesia (Mental Health Status of Adolescents in South-East Asia: Evidence for Action, 2017). I-NAMHS:Adolescent Mental Health Survey, 2022, reported that approximately 15.5 million young people in Indonesia are dealing with several mental health concerns, which encompass anxiety, depression, behavioral disorders, post-traumatic stress disorder (PTSD), and hyperactivity. Among adolescents aged 10 to 17 in Indonesia, 26.7% experience anxiety. Since most junior high school students in Indonesia fall within the 10–15 age range, this data highlights a pressing concern that science-related anxiety may be particularly prevalent in this group.

Science anxiety is a multidimensional construct that can be influenced by both personal and environmental factors. Personal factors include internal emotional states, as well as external influences such as family support, school environment, and societal expectations. For instance, research suggests that students with supportive family backgrounds are likely to demonstrate lower levels of anxiety in science classes, due to the encouragement and help they receive in their educational endeavors (Özbuğutu, 2021). Conversely, those from less supportive environments may face heightened anxiety due to external pressures, such as the stigma surrounding academic performance or inadequate educational resources. Additionally, the role of the school environment, including teacher attitudes and classroom dynamics, has been shown to significantly impact students' emotional responses to science subjects. A positive classroom atmosphere, characterized by open communication and supportive teaching methods, can mitigate anxiety and foster a more engaging learning experience (Amaliyah et al., 2024).

Comprehending the factors that influence anxiety in junior high school students can assist them in proactively preventing and managing anxiety. The influences on anxiety may arise from personal circumstances, family situations, educational settings, and other sources. Personal factors include low self-esteem, fear of failure, lack of confidence, and negative experiences in the science classroom. For example, students who assess their academic performance as poor are significantly more likely to report moderate to severe anxiety, while those who feel confident are less likely to experience anxiety. Family-related factors such as high parental expectations, lack of emotional support, and family conflict have also been shown to contribute significantly to student anxiety and related psychological stress. Meanwhile, school-based influences, including heavy workload, high-stakes evaluations, competitive classroom environments, and inadequate mental health support, play a critical role in triggering and exacerbating anxiety among students (Wen et al., 2020).

A commonly held belief worldwide is that men are superior to women in science, contributing to gender disparity (Lane et al., 2012). Prior investigations have shown that female students tend to have increased anxiety levels compared to male students, particularly in relation to science education. In a study conducted in junior high schools in Qatar and Nigeria, female students were found to have higher anxiety toward science learning than their male counterparts (Megreya et al., 2021; Oludipe & Dupe, 2018). Similarly, a study from China reported that the severity of anxiety was greater among female students, potentially due to various physical and psychological factors (Bao & Han, 2024). A study from Bandung, Indonesia, also found that female students have higher anxiety than male students (Nuwangi et al., 2025). The other study in Jambi, Indonesia, shows that female students tend to experience higher levels of anxiety compared to male students when facing Biology exams (Sapriani et al., 2024). Taken together, these studies consistently indicate that female students tend to exhibit higher levels of anxiety than male students across different educational contexts.

Prior studies have shown that science anxiety may also be affected by students' grade levels. For instance, Megreya et al. (2021) found that students in higher grades exhibited greater levels of anxiety compared to those in lower grades. A study conducted in Bandung, Indonesia, also found that eighth-grade students reported higher levels of science anxiety than both seventh-grade and ninth-grade students, with the lowest anxiety observed among ninth graders (Nuwangi et al., 2025). Similarly, a study conducted by Avci & Kirbaşlar (2017) revealed that anxiety levels were significantly higher among students in the upper levels of secondary education. This upward trend in anxiety as students advance through school raises critical concerns about the underlying causes. Additionally, a study by Karakaya et al. (2016) found that seventh-grade students in Turkey exhibited higher anxiety levels than both sixth- and eighth-grade students. Taken together, these studies consistently indicate that students' grade levels play a significant role in shaping their science anxiety.

Furthermore, previous investigations have analyzed science anxiety at several educational levels and genders. However, there is still a significant lack of research focusing on junior high school students in Indonesia, especially studies that involve diverse regions and large-scale samples. Existing local studies are still limited in scope. For instance, Nuwangi et al. (2025) investigated science anxiety among 205 students in the Bandung Raya area, while Rallyta & Tauhidah (2025) conducted a study involving 163 students from a single senior high school in Semarang. Although

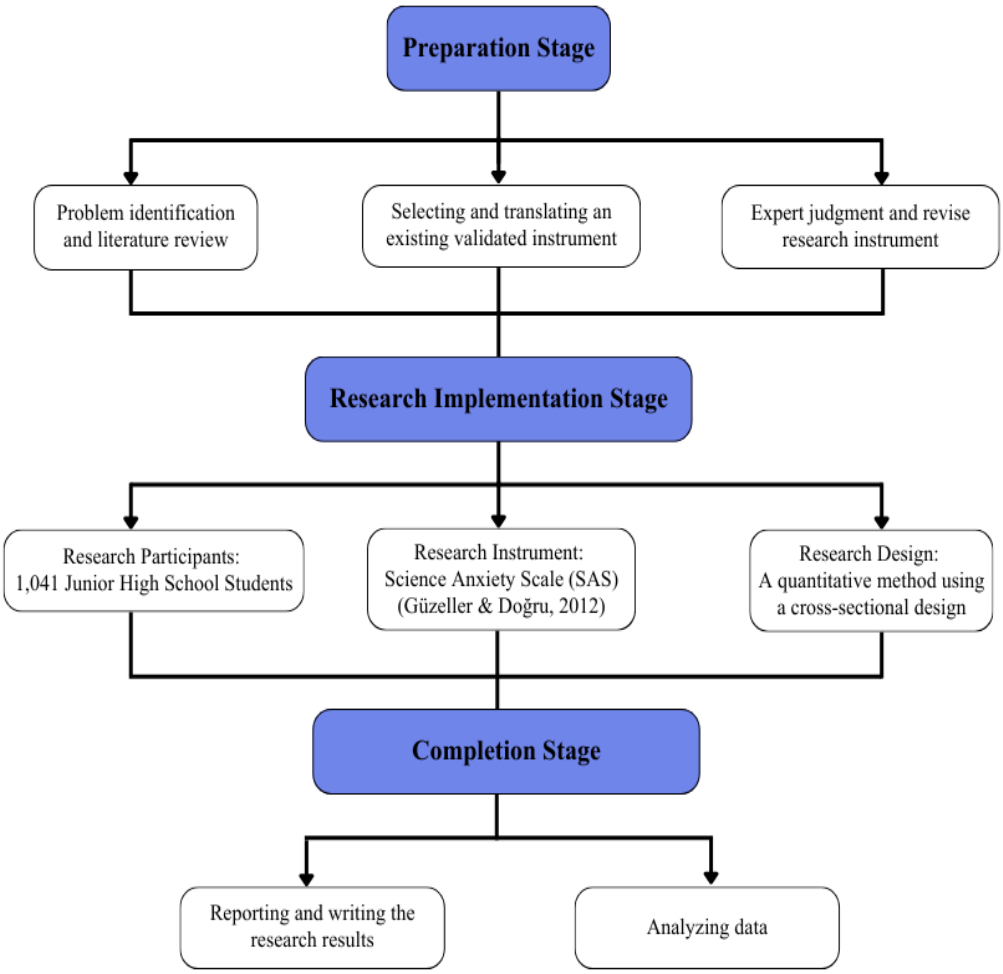

Figure 1 Research Flowchart

these studies provide valuable preliminary insights, their restricted sample sizes and regional coverage limit the generalizability of the findings. In particular, limited attention has been given to how demographic factors such as gender and grade level, along with other contributing factors, influence students' levels of science anxiety. This gap highlights the need for further research that examines these aspects to better understand and address science anxiety in the Indonesian educational context. This study covers 11 provinces in Indonesia, capturing a broad and varied representation of Indonesian junior high school students. Therefore, this study aims to investigate science anxiety levels of junior high school students towards science learning, and to examine differences in science anxiety based on gender and grade level. In addition, this study aims to explore the factors that influence junior high school students' science anxiety levels. The present study aimed to investigate responses to the subsequent research question, such as (1) How are the science anxiety levels of junior high school students towards science learning?, (2) Is there any significant difference between gender male and female in student's anxiety towards science learning?, (3) Is there any significant difference between grades 7, 8, and 9 in student's anxiety towards science learning?, and (4) What are the factors that influenced junior high school students' science anxiety levels?. The findings are expected to inform educators and policymakers in designing targeted interventions to reduce science anxiety, especially for students in Indonesia.

2. METHOD

2.1 Research Design

This research adopts a quantitative method to explore how one variable (independent) influences another (dependent) within a specific population (Kandel, 2020). This study adopted a cross-sectional design, which is a type of observational research where both the variables and outcomes are measured at the same point in time (Setia, 2016). The process of implementing the research is depicted in Figure 1.

To collect the data, the survey method was used, as it is one of the most widely applied techniques in research and is suitable for exploring a wide range of topics. Surveys consist of closed-ended questions that provide a defined set of answer options for respondents to select (Slater & Hasson, 2024). The data were collected by distributing

Figure 2 The Distribution of Participants in Indonesia

questionnaires regarding student science anxiety levels via Google Forms to junior high school students across Indonesia. The data collection period spanned from April to May 2025.

2.2 Participants

The research involved a total of 1,041 junior high school students, comprising 583 females (56%) and 458 males (44%). The participants were distributed across grade levels, with 331 students from Grade 7, 350 from Grade 8, and 360 from Grade 9. These students were spread across 11 different provinces in Indonesia, including South Sulawesi, Banten, DKI Jakarta, North Sumatra, West Sumatra, South Sumatra, West Java, Central Java, East Java, South Kalimantan, and West Nusa Tenggara. A convenience sampling method was employed in selecting the participants. The detailed distribution of the sample is presented in Table 1, and Figure 2 presents the distribution of participants across various provinces in Indonesia.

This research also presented the distribution of junior high school participants' science anxiety levels in Indonesia based on the Science Anxiety Scale (SAS). Figure 1 illustrates this distribution using a color-coded map of Indonesia: provinces with participants are shaded in dark and light brown, while provinces without participants are shaded in grey.

2.3 Research Instrument

The research instrument employed in this study was adapted from the Science Anxiety Scale (SAS) developed by Güzeller & Doğru (2012) and translated into Bahasa Indonesia. The translated instrument has been validated by two lecturers in science education. The instrument consists of two dimensions: personal and environmental. The personal dimension addresses internal emotional factors such as fear, stress, and lack of self-confidence in learning science, comprising 23 statement items. In contrast, the environmental dimension refers to anxiety influenced by external conditions, including teacher behavior, classroom experiences, and previous encounters with science, and consists of 5 items. Sample questions included personal dimension "I usually feel unhappy when learning science" and environmental dimension "I usually take a nap in the science lectures when I go to bed late or can't sleep well". Additionally, there were 2 open-ended questions: (1) What makes junior high school students happy or comfortable when learning science at school? Moreover, (2) What makes junior high school students anxious when learning science at school? The questions have been validated by two lecturers in science education. The expert judgment process was carried out in a three-phase process. Initially, the instrument was translated from English to Indonesian. Subsequently, a back-translation procedure was implemented to ensure semantic equivalence, which involved the correction of repetitive words and the enhancement of meanings. Finally, an extensive assessment

Table 1 The Distribution of Students in Terms of Grade and Gender

Variables	Number	Percentage (%)
Gender		
Female	583	56
Male	458	44
Grade		
7th	331	29.2
8th	350	33.3
9th	360	37.5
Provinces		
DKI Jakarta	825	79.25
West Java	136	13.06
Banten	40	3.84
South Sulawesi	12	1.15
North Sumatra	12	1.15
East Java	8	0.76
Central Java	4	0.38
West Nusa Tenggara	1	0.10
South Kalimantan	1	0.10
West Sumatra	1	0.10
South Sumatra	1	0.10
Total	1041	100

was conducted to examine the linguistic comparability and consistency of interpretation between the original and the translated versions. After the completion of these procedures and the necessary revisions, the instrument was deemed appropriate for utilization in this study. The scale's reliability was evaluated through Cronbach's alpha, yielding a coefficient of 0.96 for the overall scale, 0.94 for the personal dimension, and 0.77 for the environmental dimension. The instrument employed a 5-point Likert scale, which ranged from strongly disagree to strongly agree. Students responded based on their emotions, thoughts, and behaviors as outlined in each item, indicating the level of anxiety each statement triggered. Items that positively conveyed anxiety were rated from 1 (strongly disagree) to 5 (strongly agree), whereas items phrased negatively were scored in reverse, from 5 (strongly disagree) to 1 (strongly agree) (Güzeller & Doğru, 2012).

2.4 Data Analysis

The data were processed with the Statistical Package for the Social Sciences (SPSS) version 27. The normality and homogeneity tests were conducted to determine the appropriate statistical analysis to be used in this research. Descriptive statistical methods, such as the mean and standard deviation, were used to analyse the data. Additionally, a non-parametric Kruskal-Wallis test was carried out to identify significant differences in students' science anxiety levels across grade levels, and a post hoc test was applied to compare significant differences in each grade level. The Mann-Whitney U test was also utilized to assess gender-based differences in students' anxiety towards science learning. The range of scores considered for determining the anxiety levels of the students from Sanpanich (2021) is shown in Table 2.

Table 2 Examination of the Likert Scale

Mean Score	The Levels of Agreement
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

3. RESULT AND DISCUSSION

To determine the appropriate statistical test for this study, a normality test was conducted as an initial step. The results, presented in Table 3, indicate that the data are not normally distributed (Sig = <0.001; $p < 0.05$). Consequently, a non-parametric test was selected for data analysis.

3.1 Science Anxiety Levels of Junior High School Students toward Science Learning in Indonesia

This study examines the science anxiety levels of junior high school students by focusing on two key dimensions: personal and environmental. In this section, the researcher presents the results related to the first research question: "How are the science anxiety levels of junior high school students towards science learning?" The descriptive data are shown in Figure 3, with the average scores for each dimension.

The results in Figure 3 showed that the average score for the personal dimension was 2.71, and the environmental dimension had an average score of 2.62, with an overall mean of 2.66, indicating a moderate level of science anxiety among junior high school students, aligning with prior studies by Nuwangi et al. (2025) that have reported moderate levels of science anxiety.

Overall, the science anxiety level of junior high school students is a moderate level based on the levels of agreement. The findings suggest that students experience a moderate level of anxiety when engaging with science learning, as the subject is often perceived as difficult, abstract, and heavily formula-based. This perception makes

Table 3 The Results of The Normality Test

	Kolmogrov-Smirnov			Shapiro-Wilk		
Science Anxiety	Statistic	df	Sig.	Statistic	df	Sig.
	0.038	1041	0.001	0.995	1041	<0.001

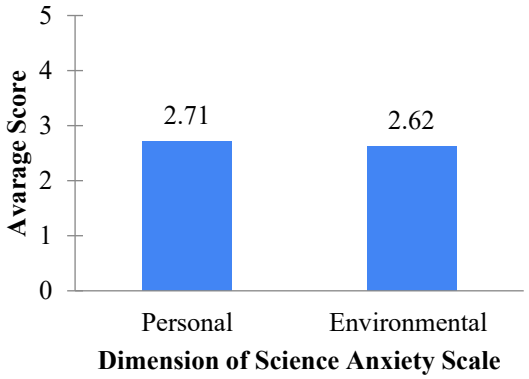

Figure 3 Average of Junior High School Students' Science Anxiety Levels in Each Dimension of Science Anxiety Scale (SAS) Instrument

scientific concepts harder to understand, particularly when students are required to solve problems involving calculations and formulas (Degorio et al., 2023; Fia et al., 2022; Muslihah et al., 2025; Özbuğutu, 2021). Furthermore, the large amount of content combined with a fast-paced learning process contributes to students feeling overwhelmed (Fia et al., 2022), while tests and examinations serve as major triggers of anxiety in science courses (Apostolidis & Tsiatsos, 2021). Additionally, social exposure during classroom activities, such as cold calling, can further increase students' anxiety levels, particularly when they fear giving incorrect answers in front of their peers (Hood et al., 2021). This anxiety may be further exacerbated by dominant or unapproachable teachers, hostile classroom climates, and unclear explanations, which can intensify anxiety, as these factors may heighten students' fear of negative evaluation and reduce their sense of psychological safety in the learning environment (Fia et al., 2022; Ghimire, 2023; Ucak & Say, 2019).

While both personal and environmental dimensions contribute to students' science anxiety, the findings indicate a different level of influence between these two dimensions. The heightened anxiety observed in the personal dimension, in contrast to the environmental dimension, aligns with prior research that underscores internal factors such as the fear of negative evaluation and diminished self-confidence as primary contributors to student anxiety. In contrast, environmental factors are generally perceived as contextual influences. While classroom conditions and pedagogical practices may exacerbate or mitigate anxiety, it seems that students' personal interpretations and emotional reactions to these experiences hold a more pivotal role in the formation of science anxiety (Rosmayanti, 2024).

The research additionally discussed the average and standard deviation of science anxiety levels among junior high school students, as indicated by the Science Anxiety Scale (SAS) across certain dimensions, which include personal and environmental. The data also reveals the

Table 4 Descriptive Statistics of Students' Science Anxiety Levels in Personal Dimension According to Science Anxiety Scale (SAS) Instrument

Number of Statements	N	Mean	SD
1	1041	2.44	0.86
2	1041	3.19	0.92
3	1041	3.47	0.97
4	1041	2.76	1.01
5	1041	2.31	0.92
6	1041	2.01	0.90
7	1041	2.34	0.84
8	1041	2.40	0.93
9	1041	3.81	0.86
10	1041	2.40	0.94
11	1041	2.57	0.98
12	1041	2.11	0.86
13	1041	2.52	0.92
14	1041	2.30	0.91
15	1041	2.95	1.20
16	1041	3.22	0.97
17	1041	2.30	0.88
18	1041	2.49	0.92
19	1041	2.69	1.13
20	1041	2.71	0.97
21	1041	3.66	1.11
22	1041	3.37	1.04
23	1041	2.35	0.88
Average		2.71	0.95

coding system, where 'P' refers to personal and 'E' refers to environmental. The findings for the personal dimension are illustrated in Table 4, and the environmental dimension is detailed in Table 5.

Table 4 presents the mean and standard deviation of students' science anxiety levels related to the personal dimension in junior high school science learning. The average score for the personal dimension is 2.71, indicating a moderate level of science anxiety. It is observed that statements number 2, 4, 3, 9, 15, 16, 21, and 22 of personal dimension have scores above the overall average. This indicated that students feel moderately to highly anxious when science learning is addressed to internal emotional factors, such as fear, stress, and lack of self-confidence in learning science (Güzeller & Doğru, 2012). The highest average score is in the item "I can't learn science no matter how much I study" (3.81), which suggests that students find it extremely hard to learn science. The lowest average value was that of the item "It is not necessary to learn science to be successful in life" (2.01), suggesting that most students still think that science is required to become successful in life.

Table 5 Descriptive Statistics of Students' Science Anxiety Levels in Environmental Dimension According to Science Anxiety Scale (SAS) Instrument

Number of Statements	N	Mean	SD
1	1041	2.89	0.93
2	1041	2.20	1.06
3	1041	2.51	0.93
4	1041	2.62	1.06
5	1041	2.90	1.01
Average		2.62	0.99

Table 5 presents the mean and standard deviation of students' science anxiety levels related to the environmental dimension in junior high school science learning. The average score for the environmental dimension is 2.62, indicating a moderate level of science anxiety. It is observed that statements number 1 and 5 of the environmental dimensions have scores above the overall average. This indicated that students feel moderately anxious in science learning influenced by external conditions, including teacher behavior, classroom experiences, and previous encounters with science (Güzeller & Doğru, 2012). The item "I am worried in case the teacher calls on me in the science class" recorded the highest mean value of 2.90. It shows that the majority of the students are apprehensive about being asked to respond during science classes, which may be attributable to a lack of adequate confidence or fear of providing incorrect answers. The item "The teacher's attitude in the science class makes me nervous" had the lowest mean score of 2.20, indicating that, in general, the students do not perceive the teacher's behavior or personality as a major element causing them anxiety in the context of science class.

3.2 Gender-based Differences in Students' Science Anxiety Levels

This section outlines the results relevant to the second research question, "Is there a significant difference in anxiety towards science learning between male and female students?" The mean and standard deviation of science anxiety among junior high school science students, categorized by gender, are presented in Table 6.

The results show that female students recorded the highest average score of 2.70, which falls into the moderate level, while male students had a slightly lower average of 2.68, also categorized as moderate. The overall mean score for science anxiety was 2.69, indicating a moderate level of anxiety among students. The data shows that females have higher anxiety than males.

The findings of the average score for the science anxiety scale based on students' gender are shown in Figure 4.

Table 6 Descriptive Statistics for Participants' Science Anxiety Scale (SAS) Regarding Their Gender

Gender	N	Mean	SD
Male	458	2.68	0.40
Female	583	2.70	0.41
Average		2.62	0.405

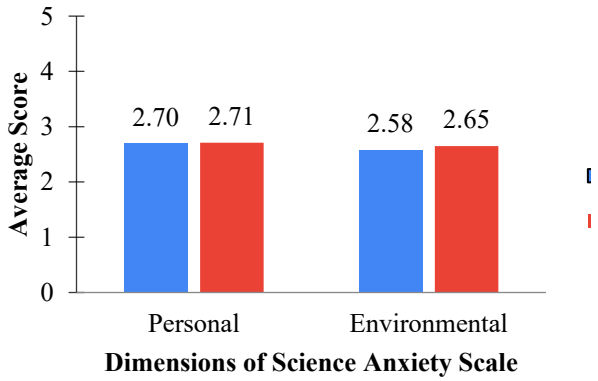

Figure 4 Average of Junior High School Students' Science Anxiety Levels in Each Dimension According to Their Gender

The survey findings in Figure 4 indicate that the scores for each dimension range from 2.58 to 2.71 on a 5-point scale. For the personal dimension, female students recorded the highest average score of 2.71, slightly above the male average of 2.70. Similarly, in the environmental dimension, females also scored higher with an average of 2.65, compared to 2.58 for males. These findings suggest that female students experience higher levels of science anxiety across both dimensions compared to their male counterparts. It indicates that females have a slightly higher anxiety from both internal and external factors. Since the data are not normally distributed, a non-parametric test, the Mann–Whitney U test, was conducted. The findings of the Mann-Whitney U test for the science anxiety scale based on students' gender are shown in Table 7.

Table 7 Mann-Whitney U Test Results for Science Anxiety Scale (SAS) According to the Students' Gender

	Science Anxiety Levels
Mann-Whitney U	128377.000
Wilcoxon W	233488.000
Z	-1.066
Asymp. Sig. (2-tailed)	0.287

The data in Table 7 shows the Mann-Whitney U test results for science anxiety scores according to the students' gender. The results show that the score for science anxiety shows no significant difference between males and females(Asymp. Sig = 0.287; $p>0.05$). There is no significant difference between males and females in science anxiety, which is explained by the fact that students fall within a similar age range (12-17), as gender-related

differences in emotional responses are generally less pronounced during early to mid-adolescence. Supporting this, a recent study of junior high school students found no significant difference in science anxiety between girls and boys, supporting the idea that, within this age range, both genders experience similar levels of anxiety related to science learning, testing, and classroom participation (Nuwangi et al., 2025).

Another possible explanation is that in today's modern world, the gender gap no longer exists or may be minimal. A recent study involving junior high school students revealed no significant difference in overall science anxiety between boys and girls, suggesting that the gender gap in science anxiety may be minimal or nonexistent in some contexts (Nuwangi et al., 2025). The gender gap in science has become minimal or nonexistent in some areas due to a combination of targeted interventions, changing cultural attitudes, and educational reforms. Key factors include the reduction of gender stereotypes, increased encouragement and support for girls in science from families, schools, and peer groups, and the implementation of inclusive educational policies and curricula that foster self-confidence and self-efficacy among all students (Beroíza-Valenzuela & Salas-Guzmán, 2024; Verdugo-Castro et al., 2022). Systematic reviews also highlight the importance of research policies, institutional support, and efforts to create more egalitarian and diverse academic environments as crucial for closing the gap (Rivera-Lozada et al., 2023). Thus, while the gender gap appears to be diminishing in some contexts, continued efforts are essential to ensure true equity across educational and scientific domains.

In the field of science, OECD (2025) notes that overall participation in higher education has become increasingly balanced, with women even surpassing men in tertiary attainment across many OECD countries. This suggests that gender disparities in science education may be narrowing, particularly in contexts where access, opportunities, and academic expectations are comparable. Furthermore, previous research indicates that gender differences in anxiety are influenced by social stereotypes, gender role expectations, age, and regional educational contexts (Xie et al., 2024). This implies that disparities in science anxiety are shaped more by socio-cultural and contextual factors than by inherent biological differences. Consequently, in more equitable educational environments, gender differences in science anxiety may become minimal or statistically non-significant.

In addition, science anxiety in this context may not be strongly gender-dependent when students experience similar academic demands and learning environments. This is consistent with Rahmawati et al. (2024), who found that although female students tended to report slightly higher anxiety, both male and female students were generally classified within the same moderate category. Because both groups faced comparable workloads, academic pressures, and institutional conditions, anxiety levels appear to be influenced more by shared academic demands than by gender differences.

Historically, gender stereotypes have shaped perceptions about females' suitability for science and may affect their engagement and confidence in scientific learning. In this study, although no statistically significant difference was found, female students tend to report slightly higher anxiety levels than male students. Previous studies consistently report that female students tend to experience higher levels of science anxiety compared to their male peers, often attributed to gender stereotypes, social expectations, and various psychological and physical factors (Bao & Han, 2024; Megreya et al., 2021). Contributing factors may include the perception of science as cognitively demanding, discomfort with certain teaching strategies, and a fear of failure (Avci & Kirbaşlar, 2017). Moreover, emotional sensitivity may play a role in this disparity. Research suggests that females are generally more sensitive to their environment and emotionally expressive, which could make them more prone to anxiety in academic settings (Wen et al., 2020). Neuroimaging studies further support the notion that males and females may process anxiety differently at the brain level, potentially leading to differences in how anxiety affects learning and performance in science subjects (Gonzalez et al., 2019). Biologically, differences in serotonin and tryptophan metabolism, influenced by sex hormones like estrogen and progesterone, make females more susceptible to anxiety, particularly during hormonal fluctuations (Piggott et al., 2019; Songtachalert et al., 2018). More broadly, gender differences in anxiety have often been examined separately through psychosocial and biological perspectives, with masculinity traits considered protective or might protect against anxiety and femininity traits associated with greater vulnerability or could increase risk (Farhane-Medina et al., 2022).

3.3 Grade-based Differences in Students' Science Anxiety Levels

In this paragraph, the researcher presents the results related to the third research question: "Is there any significant difference between grades 7, 8, and 9 in students' anxiety towards science learning?" Table 8 illustrates the mean and standard deviation of science anxiety for junior high school students, classified by grade level.

The highest average score was recorded in grade 7, with a mean of 2.74, signifying a moderate level of anxiety. Conversely, grade 8 students had the lowest average score of 2.63, which is also classified as moderate. Students in grade 9 attained an average score of 2.71, which likewise falls under the moderate category. Collectively, the mean science anxiety score for all grades was 2.69, suggesting a moderate level of anxiety among the students. The descriptive statistics findings for the science anxiety scale based on students' grades are illustrated in Table 8.

Table 8 Descriptive Statistics for Participants' Science Anxiety Scale (SAS) Regarding Their Grades

Grade	N	Mean	SD
7th	331	2.74	0.37
8th	350	2.63	0.42
9th	360	2.71	0.41
Average		2.62	0.40

The findings of the average score for the science anxiety scale based on students' grades are shown in Figure 5.

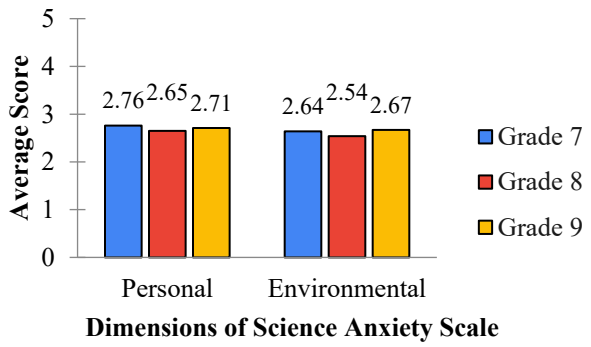

Figure 5 Average of Junior High School Students' Science Anxiety Levels in Each Dimension According to Their Grades

Figure 5 presents the survey results showing that scores across each dimension range from 2.54 to 2.76 on a 5-point scale. In the personal dimension, grade 7 students reported the highest average score of 2.76, while grade 8 students had the lowest at 2.65; both are categorized as moderate levels of anxiety. For the environmental dimension, grade 9 students recorded the highest average score of 2.67, whereas grade 8 students again showed the lowest at 2.54, also within the moderate level. These findings indicate that grade 8 students had the lowest average scores in both personal and environmental dimensions. Overall, students in grades 7, 8, and 9 experienced a moderate level of science anxiety across both dimensions. Since the data are not normally distributed, a non-parametric test, the Kruskal-Wallis test, was conducted. Presented in Table 9 are the findings from the Kruskal-Wallis test related to the science anxiety scale, organized by students' grades.

Table 9 Kruskal-Wallis Test Results for Science Anxiety Scale (SAS) According to the Students' Grades

	Science Anxiety Levels
Kruskal-Wallis H	10.077
df	2
Asymp. Sig.	0.006

The information presented in Table 10 illustrates the results of the Kruskal-Wallis test concerning science anxiety scores based on the gender of the students. The results indicate that there is a significant difference in science anxiety scores among grades 7, 8, and 9 (Asymp. Sig = 0.006; $p<0.05$). This finding aligns with prior research, which indicated a significant difference among different grade levels. One study identified significant variations in children's test anxiety across elementary school grades (Nurney & Nelson, 2022), while another study observed considerable differences in science anxiety among secondary education grades (Caymaz & Aydin, 2022). In light of the notable overall outcome, post hoc analyses were performed to ascertain the specific grade-level comparisons that accounted for the observed differences in science anxiety scores. The outcomes of the Post Hoc test for the science anxiety scale, which compares each grade, are detailed in Table 10.

Table 10 Post Hoc Test Results Comparisons of Grade for Science Anxiety Scale (SAS)

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
Grade 8-Grade 9	-47.799	22.560	-2.119	0.034	0.102
Grade 8-Grade 7	71.518	23.042	3.104	0.002	0.006
Grade 9-Grade 7	23.719	22.886	1.036	0.300	0.900

The Kruskal-Wallis H Test was conducted, revealing a significant difference in grade levels. Following this, a post hoc test was performed to compare the significant differences across each grade level. The analysis indicates that a significant difference is present between grade 8 and grade 7 (Adj. Sig = 0.006; $p<0.05$). However, there is no significant difference between grades 8 and 9, nor between grades 9 and 7.

The findings of this research indicate that students in Grade 7 exhibited the highest average science anxiety scores, with a statistically significant difference observed between Grade 7 and Grade 8, suggesting that anxiety does not necessarily increase progressively with educational level. However, this finding contrasts with other studies suggesting that students in higher grade levels tend to experience greater academic anxiety, because students who already have complex learning loads accompanied by the goal of continuing their education to advanced levels tend to feel excess academic anxiety (Karakaya et al., 2016; Santos et al., 2021; Ucak et al., 2019). This discrepancy may be attributed to contextual differences in Indonesia's education system compared to those of countries such as Turkey, particularly in terms of the implementation of the science curriculum. Türkiye's curriculum is meticulously organized, with predetermined time allocations for subtopics, providing clear guidelines for teaching. This detailed structure includes specific learning outcomes, instructional materials, and teaching aid examples. In contrast, Indonesia's time allocation has historically been more generalized and less specific. Türkiye's curriculum reform efforts, particularly since 2017, have focused on curriculum revitalization and maintaining educational

Table 11 Reasons Students Feel Happy or Comfortable When Learning Science

No.	Reason	Percentages (%)
1.	The teacher's personality or learning engagement that is fun and engaging helps students feel more relaxed and less afraid in class	27.7
2.	Learning takes place in the laboratory, and students feel more engaged and excited	18.9
3.	The teacher uses various methods or teaching approaches that make it easier for students to learn.	12.2
4.	Science lessons are interesting and fun to learn for students	15.5
5.	The student already understands the material, and they feel more confident	7.4
6.	Learning is done in groups with classmates, and students feel more comfortable working together	3.7
7.	The student already understood the material before class started	2.8
8.	The classroom environment is comfortable and conducive to learning	1.8
9.	The questions given are enjoyable or match their abilities	1.5
10.	Others (no specific reason, free time, etc.)	8.5
Total		100

quality. Indonesia, on the other hand, has experienced frequent curriculum changes, influenced by political and regional factors, which can make adaptation challenging. The Indonesian curriculum has been structured into phases (A, B, and C) for primary education, a model adopted by other countries to align with children's developmental stages. Türkiye follows a 4+4+4 system (4 years primary, 4 years lower secondary, 4 years upper secondary) (Syarif et al., 2023).

Nevertheless, this finding aligns with previous research in Özbuğutu (2021), which also reported significant differences in science anxiety levels across grade levels, particularly in anxiety related to lesson avoidance. Similarly, Ucak et al. (2019) reported that there is a significant difference in students' science course anxiety scores based on their science grades. However, their findings contrast with the results of this study, as they found that students with higher science grades tend to experience lower levels of anxiety toward science courses. These findings are further supported by research from Nuwangi et al. (2025) and Özbuğutu (2021), which suggests that students in the first year of secondary school tend to experience elevated science anxiety, potentially due to the transition of material, environment, and habits from elementary school to secondary school. The elevated anxiety observed among Grade 7 students may be attributed to the transitional period from primary to junior high school. This phase is often accompanied by significant changes in academic expectations, social environments, and school structures, which may negatively affect students' attitudes and emotional responses toward science (Beatson et al., 2023; Kaur et al., 2022; Speering & Rermie, 1996). During this transition, students frequently face unfamiliar curricula, altered classroom routines, and reduced emotional support from teachers, compared to the more nurturing environment of primary school. These factors can contribute to an increase in science anxiety, particularly if students perceive science as a more demanding or less engaging subject in the early years of secondary education (Speering & Rermie, 1996).

The findings align with previous research that recognizes the transition from primary school to Junior High School as a critical and psychologically demanding phase for students. Fréchette-Simard et al. (2022) have established that this transition correlates with elevated levels of anxiety, particularly test anxiety, stemming from increased academic expectations, performance-oriented assessments, and intensified social comparisons prevalent within secondary school environments. Notably, their research indicates that anxiety experienced during this transition serves as a mediating mechanism that connects students' prior motivation and achievements to subsequent declines in academic self-concept and performance upon entering secondary education. Further supporting this evidence, Klee & Miller (2019) demonstrated that students exhibit various trajectories of mathematics anxiety during the transition from elementary school to Junior High School, including consistently high anxiety levels and significant increases around the transition period.

Furthermore, the transition from primary education to junior high school should not be interpreted solely as an individual psychological adjustment; rather, it should be recognized as a process that necessitates structured support within the educational setting. During this period, students confront heightened academic expectations, alterations in instructional methodologies, and novel social demands, all of which may exacerbate emotional sensitivity. In this regard, the support provided by educators emerges as a critical determinant in fostering successful adaptation.

Owuor et al. (2025) underscored that the transition to junior high school can be developmentally taxing and potentially distressing, particularly because of changes in learning environments and academic requirements. Their research indicated a statistically significant positive correlation between teacher competencies and student transition outcomes, implying that teachers' pedagogical,

social, and professional skills play a substantive role in facilitating students' behavioral, cognitive, and socio-emotional adjustment. This suggests that competent and supportive educators may act as protective factors, assisting students in navigating the challenges inherent in such transitions more effectively.

Collectively, a successful transition appears to rely not only on the individual readiness of students but also on the quality of teacher support that aids in their academic and emotional adaptation.

3.4. The Factors That Influenced Junior High School Students' Science Anxiety Levels

In this section, the researcher presents the results related to the fourth research question: "What are the factors that influenced junior high school students' science anxiety levels?" Table 11 shows the answer to the open-ended question number one, namely, the reason students feel happy or comfortable when learning science.

Table 11 shows the reasons why students feel happy or comfortable when learning science. The most common reasons are that the teacher's personality or learning engagement is fun and engaging, students feel more relaxed and not afraid when learning in class, with a percentage of 27.6%. One of the students stated, "Because the teacher is very friendly and kind, also when I ask questions, the science teacher explains very well and I can understand the science lessons." These findings highlight the significant role of the teacher in creating a positive science learning experience. This is also in line with previous research by Cents-Boonstra et al. (2021) and Liaqat et al. (2023) that teachers who display enthusiasm, offer support, and create a positive classroom atmosphere foster higher levels of student engagement, while chaotic or demotivating behaviors reduce engagement. Most of the students' responses indicate that their science teacher applies a combination of student-centered learning models and direct instruction, which enhances their understanding of science content. Student-centered methods engage learners in scientific practices, encourage the use of evidence, and foster deeper conceptual knowledge, often leading to higher learning outcomes compared to traditional lecture-based teaching alone (Granger et al., 2012; Partanen, 2020). However, direct instruction remains valuable, especially for teaching complex procedures or foundational knowledge, and can improve efficiency and skill acquisition in laboratory settings (Heneghan et al., 2020; Risdianto et al., 2020). From the results, it can be seen that the factor that causes students to be happy or comfortable is the teacher.

The lowest reason that was answered by the students is that some students enjoy when the teacher gives a question to them that matches their abilities, with a percentage of 1.5%. One of the students stated, "I feel more confident and happier when the question is easy". When teachers ask questions that match students' abilities, some students feel more comfortable and even enjoy participating, as these questions help them feel competent and engaged. However, for many students, teacher questions can be uncomfortable, especially if the questions are too difficult or not well-matched to their current understanding (Smart & Marshall, 2013). Research shows that the way teachers ask questions, including the level of difficulty, the clarity, and the responsiveness to student answers, strongly influences how students feel and how much they engage in class discussions. When teachers tailor their questions to students' abilities and respond supportively, students are more likely to participate and feel positive about the experience. On the other hand, if questions are perceived as too challenging or if the teacher's approach is not supportive, students may feel anxious or reluctant to answer (Boyd, 2015; Zhou, 2024). Nonverbal behaviors, such as making eye contact and giving students enough time to think, also play a role in making students feel more comfortable and willing to participate (Asrori, 2019). Table 12 shows the results of open-ended question number two, namely, the reasons students feel anxious when learning science.

Table 12 Reasons Students Feel Anxious When Learning Science

No.	Reason	Percentages (%)
1.	Students do not understand or are not interested in the science learning	22.5
2.	Students do not feel anxious when studying science	16.5
3.	Students struggle with formulas and calculations	14.4
4.	Students feel anxious when they are suddenly asked to answer questions or are required to present in front of the class	12
5.	Students feel anxious when teachers give questions or problems that are too difficult	8.6
6.	The science teacher's teaching method is not liked by the students	4.4
7.	Students are afraid of getting low scores or have already received poor grades	4.7
8.	Students feel nervous when they are about to take a test or exam	4.7
9.	Students forgot to do or submit their assignments	3.6
10.	Students are afraid of making mistakes during experiments or using expensive tools	2.1
11.	The classroom situation or condition is not conducive to science learning activities	1.5
Total		100

The table above shows the reasons why students feel anxious when learning science. The most frequently mentioned reason is that students do not really understand or are not interested when learning science, with a percentage of 22.5%. One of the students stated, "I'm worried if I can't understand science lessons even though I've been told several times". A study by Syahputra et al. (2022) shows that some students still do not understand how science is taught and are not interested in learning science, resulting in a less effective teaching and learning process in the classroom. The students' reasons for feeling anxious when learning science align with the highest average score in the personal dimension, which suggests that students find it extremely difficult to learn science due to a lack of understanding or interest in the science subject. Many students struggle to understand how science is taught and lack interest in learning science, often because traditional teaching methods do not connect with their experiences or make the subject engaging. Research shows that students are more interested in science when lessons involve hands-on activities, real-world applications, and opportunities to use technology, rather than just focusing on content or rote learning (Swarat et al., 2012). Teacher competence, such as enthusiasm, clear explanations, and supportive classroom environments, also plays a crucial role in sparking student interest and improving understanding

The lowest reason that was answered by the students is that the classroom situation is not conducive during science learning activities, with a percentage of 1.5%. One of the students stated that "sometimes noisy classes make me anxious when I'm learning science". A classroom environment that is not conducive during science learning activities can significantly hinder students' motivation, engagement, and achievement. When classrooms are chaotic, lack teacher support, or focus only on correct answers and fast-paced instruction, students often feel less satisfied and may struggle to achieve (Nolen, 2003). Negative classroom environments can discourage students from participating and developing positive attitudes toward science (Karpudewan & Chong Keat, 2017). Students often feel anxious when the classroom environment is not conducive during science learning activities, as negative classroom conditions can heighten stress and discomfort. Research highlights that factors such as lack of teacher support, poor student cohesion, and perceived inequity in the classroom are strong predictors of anxiety among science students (Syofyan et al., 2025). A primary source of this anxiety is the fear of negative evaluation; students worry about being judged or making mistakes in front of peers, especially in active learning settings or when called on unexpectedly (Downing et al., 2020). This anxiety can be exacerbated in chaotic or unsupportive classrooms, leading to reduced motivation and lower academic performance (Syofyan et al., 2025). Conversely, Research shows that supportive, organized, and engaging classroom environments are strongly linked to higher student motivation, better attitudes toward science, and improved academic performance (Nolen, 2003; Tas, 2016).

The research findings demonstrate that the anxiety experienced by junior high school students in the domain of science is influenced by a multifaceted interplay of cognitive challenges, evaluative pressures, pedagogical methodologies, and the learning environment. Students' insufficient comprehension of scientific concepts and difficulties with mathematical formulas contribute to the perception of science as a formidable subject, thereby heightening anxiety during both learning and assessment contexts. This anxiety is further exacerbated by performance-related expectations, such as examinations, presentations, and apprehension regarding subpar academic performance. Concurrently, pedagogical elements and classroom dynamics significantly impact students' emotional responses, either intensifying or mitigating anxiety levels. Positive teacher attributes, including supportive personality traits and engaging, learner-centered instructional practices, have been identified as critical factors that foster a more comfortable and less fearful atmosphere in science classrooms. These findings underscore that science anxiety emerges from a combination of interrelated factors rather than a solitary source, highlighting the importance of both pedagogical support and emotional encouragement in the science education process.

In light of these contributing factors, research suggests that reducing science anxiety in students requires a multifaceted strategy that integrates both improvements in teaching methodologies and targeted psychological interventions. (Fia et al., 2022) emphasize that improving the quality of science education through adequate learning resources, streamlined curricula, encouraging teacher methodologies, and increased opportunities for experiential learning can mitigate students' apprehension and unfavorable perceptions of science. Furthermore, Duraku et al. (2023) provide evidence that mindfulness training implemented in the classroom effectively diminishes test anxiety related to STEM subjects by fostering emotional regulation and curbing maladaptive thought patterns. In a similar vein, Putwain & von der Embse (2021) elucidate that cognitive-behavioral interventions enable students to navigate evaluative anxiety by addressing maladaptive thoughts, enhancing coping mechanisms, and alleviating physiological manifestations of anxiety. Collectively, these insights underscore the importance of schools adopting an integrated approach that combines nurturing instructional environments with systematic emotional and cognitive regulation strategies as a means of effectively confronting science-related anxiety within routine classroom practices.

4. CONCLUSION

This research explored the science anxiety levels of junior high school students through the application of the Science Anxiety Scale (SAS) instrument. The main research aims to investigate whether Junior High School students' science anxiety levels differ by gender and grade level. In conclusion, personal anxiety levels were slightly higher than the environmental dimension. No significant difference was found based on gender, possibly due to the participants being within a similar age range (12–17). However, a significant difference was observed between Grade 7 and Grade 8, with higher anxiety in Grade 7, likely due to the transition from primary to junior high school. The personality of the teacher has been identified as a factor in alleviating anxiety, as teachers who are engaging and supportive contribute to students feeling more at ease in science classes. Conversely, a deficiency in understanding or interest in the subject frequently exacerbates students' anxiety. These insights highlight the vital importance of creating supportive classroom environments and utilizing an engaging teaching method to mitigate anxiety in science. A limitation of this study is that the participants were not drawn from all provinces in Indonesia; thus, the findings may not be representative of the entire national population. Future research is recommended to include participants from a broader range of provinces to enhance the generalizability of the results, and future research may examine the correlation between students' science anxiety and academic achievement to determine whether science anxiety significantly impacts learning outcomes. Furthermore, future research could explore effective strategies that schools might adopt to assist students in managing their anxiety related to science.

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