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Gender Perspective: Self-Efficacy and Academic Stress of Middle School Students in Science Education

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ABSTRACT

This research aims to examine the influence of gender on self-efficacy and academic stress in middle school students in science subjects. A quantitative approach using a 40-item questionnaire consisting of measures of self-efficacy and academic stress, each containing 20 items, was administered. This research involved 51 students (consisting of 24 Males and 27 Females) in the ninth grade from private secondary schools in Bandung, Indonesia. Data analysis uses descriptive and inferential statistical techniques using Microsoft Excel and IBM SPSS software. The results showed significant gender differences in self-efficacy and academic stress. Male students show higher levels of self-efficacy than female students, while female students experience lower academic stress. These findings suggest potential interventions to increase self-efficacy and reduce academic stress in science courses, emphasizing gender-specific strategies.

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1. INTRODUCTION

Education at the secondary school level is a crucial phase in students' intellectual and social development (Suryawati & Osman, 2017). One important aspect of secondary school learning is understanding and mastering science subjects. This is because science subjects can hone critical thinking and analytical skills and can foster interest and curiosity (Sasson *et al*., 2018; Jesionkowska *et al*., 2020; Saiful *et al*., 2020). In addition, the application of science concepts is needed in everyday life and is used as a basis for technology development. Even though science has an important role, it cannot be denied that science is a difficult subject for students because of its complexity, and most of its concepts are abstract and theoretical (Kubiatko & Vaculová, 2011; Forbes *et al*., 2013; Hubers *et al*., 2022). This can cause students to experience stress. Academic stress refers to mental pressure when academic demands exceed an individual's abilities (Rafidah *et al*., 2009). According to Prabu (2015), stress is defined as a condition caused by a mismatch between the desired situation and the individual's biological, psychological, or social system. As a result, prolonged stress can hurt students' cognitive function, motivation, learning, and holistic well-being (Tus, 2020). Additionally, students who experience high levels of academic stress may face difficulties in developing their self-confidence regarding their ability to understand science concepts (Yikealo *et al*., 2018).

Several previous studies have investigated the factors causing academic stress among secondary school students in the science context. A study conducted by Prasad *et al*. (2022) found excessive school work to be the main cause of academic stress in students in grades eight to ten. In addition, according to Bakshi and Babu (2017), difficulties in understanding complex and abstract scientific concepts trigger stress for some middle school students (Bakshi & Babu, 2017). This is also supported by Setiakarnawijaya *et al*. (2015), who revealed that feelings of incompetence and lack of instrumental support from teachers were also associated with increased academic stress in science students. Prolonged exposure to stress has the potential to cause students to experience anxiety, low self-concept, and decreased motivation to learn. Although previous studies have succeeded in investigating the factors that cause academic stress, there is still little research that investigates the academic stress factors that cause gender (Areepattamannil *et al*., 2023).

Self-efficacy is a person's belief in his or her ability to organize and carry out the actions necessary to achieve the desired results (Wang & Tsai, 2016; Bandura 1977). Furthermore, despite expectations, self-efficacy plays a significant role as a motivator for each person since it is frequently associated with success in reaching particular objectives (Lin & Tsai, 2013; Jansen *et al*., 2015). Along with cognitive capacity, effort, and perseverance are major factors in students' self-efficacy. Therefore, to improve each person's future successes, self-efficacy needs to be raised (de Laat & Watters, 1995). Because the discussion about self-efficacy is interesting, it turns out to have a big influence on a person's success and future.

Many researchers have reported research on self-efficacy. Based on research conducted by Juan *et al*. (2018), the findings reveal a positive relationship between self-efficacy and science achievement and suggest a need to also focus on non-cognitive aspects to improve science achievement. In the research by Van Rooji *et al*. (2017) found that self-efficacy is directly correlated with internal characteristics like academic interests and cognitive needs, as well as external factors like academic activities outside of school; the need for academic interest and cognition is particularly significant. Middle school teachers can support the growth of their students' academic self-efficacy and, consequently, raise their chances of success in the transition to college by concentrating on meeting their demands for cognition

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and academic curiosity. Therefore, to find out how to increase students' self-efficacy, it is important to look for the factors that influence it. This is supported by Bandura (1977), who revealed that some factors or indicators influence self-efficacy, such as internal and external factors. Internal factors such as personal experience, physiological state, and self-understanding, physiological state. Meanwhile, external factors such as role models, social support, feedback, and social norms. Although previous research has revealed factors that influence self-efficacy from various internal and external factors. However, there is still little research that explains the influence and role of gender on self-efficacy.

Based on the explanation above, this study aimed to analyze students' self-efficacy and academic stress based on gender in science learning in secondary school. The novelty of this study lies in its focus on middle school students, specifically ninth graders, and how their experiences of self-efficacy and academic stress in science learning are gendered. In addition, this study contributes to the role and influence of gender on students' self-efficacy and academic stress. Thus, it can help students manage academic stress and increase self-efficacy, especially in understanding and mastering science subjects. It is hoped that deeper knowledge of these dynamics can lead to the development of more effective learning methodologies and psychological support programs. Not only that, this study is also intended as a resource for science educators or as input for the development of school regulations that will provide a friendly and safe learning environment.

2. METHODS

The following is the detailed information regarding the methodology parameters that we used:

(i) Participants: The participants' characteristics used in this study were based on purposive sampling. The participants' characteristics used in this study were 51 ninth-grade students from a private middle school in Bandung. A total of 51 students consisted of 24 male students (47%) and 27 female students (53%).

(ii) Data Collection Tools and Instruments: In the study, the instrument used was a questionnaire. The questionnaire consists of 2 sections, namely self-efficacy and academic stress. Here, there are two types of questionnaire statements, namely positive and negative statements. The number of statement items in the questionnaire was 40, consisting of self-efficacy and academic stress, each with 20 items. The questionnaire was made in the form of a Google form.

(iii) Procedure Experimental: The experimental procedures carried out in this study began by first conducting a literature review related to self-efficacy and academic stress. Then, we prepared a questionnaire obtained from the literature review in the form of a Google form. After that, questionnaires were distributed to ninth-grade students through teachers at the private secondary schools in Bandung City.

(iv) Data Analysis: Data from the Google Form questionnaire was processed using Microsoft Excel and IBM SPSS software and then scored on a Likert scale. Descriptive statistics, such as percentage calculations per indicator and overall percentages by gender (**Tables 1** and **2**), elucidated science indicator levels influencing self-efficacy and academic stress. Inferential statistics identified gender-based differences in self-efficacy and academic stress, preceded by normality and homogeneity tests. If the data exhibited a normal distribution, the t-test was applied; otherwise, the Wilcoxon and Mann-Whitney tests were used.

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Table 1. The Percentage categories of self-efficacy were adopted from Devi *et al*. (2021).

Percentage (%)	Category
0 – 35	Very low
40 – 54	Low
55 – 69	Moderate
70 – 84	High
85 – 100	Very High

Table 2. Percentage categories of academic stress were adopted from Hendrayana (2014)**.**

Percentage (%)	Category
0 – 37	Very low
37 – 52	Low
53 – 68	Moderate
69 – 84	High
85 – 100	Very High

3. RESULTS AND DISCUSSION

Based on the research that has been carried out, the results of descriptive analysis of self-efficacy and academic stress based on gender are obtained, as well as statistical inferential analysis. **Table 3** shows the results of descriptive statistical calculations of self-efficacy and academic stress based on gender. Based on the calculation results in Table 6, a total of 51 subjects got a minimum score and a maximum score for self-efficacy of 40 and 65, respectively. Descriptive statistics of the mean and standard deviation for self-efficacy were 53.90 and 4.784, respectively. Meanwhile, 51 subjects obtained a minimum score and a maximum score for academic stress of 40 and 67, respectively. The mean and standard deviation for academic stress were 54.59 and 5.432, respectively. From the data in **Table 3**, it is known that the average academic stress is higher than self-efficacy. In addition, the standard deviation value of academic stress is a higher standard deviation value compared to self-efficacy.

Table 3. Descriptive statistics of self-efficacy and stress academic based on gender.

Indicator	N	Maximum	Minimum	Mean	Std.
Self-efficacy	51	40	65	53.90	4.784
Academic stress	51	45	67	54.59	5.432

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standard deviation value of academic stress is a higher standard deviation value compared to self-efficacy.

Table 4 presents the gender-based categorization of self-efficacy and academic stress. Overall, 24 male students achieved a total score of 1860, with an average self-efficacy percentage of 69%, indicating a moderate level. Similarly, 27 female students scored 1791 in total, with an average self-efficacy percentage of 66%, also reflecting a moderate level. However, while male students experienced a moderate level of academic stress, with an average percentage of 67% based on a total score of 1608, female students faced higher academic stress levels. Their average percentage was 69%, derived from a total score of 1855, categorizing them in the high-level category. This suggests that female students generally encounter higher academic stress than their male counterparts. Moderate stress levels among male students may positively impact individual performance and self-efficacy, but high academic stress levels among female students could lead to adverse consequences, affecting both students and the learning process (Goel & Bardhan, 2016; Mulyadi et al., 2016).

Table 4. The total, average percentages, categorization of self-efficacy and academic stress based on gender.

	N	Types of Gender	Total score	Average percentage (%)	Category
Self-efficacy	24	Male	1860	69	Moderate
	27	Female	1791	66	Moderate
Academic	24	Male	1608	67	Moderate
Stress	27	Female	1855	69	High

Table 5 presents the total, average percentage, and categories of self-efficacy based on gender. The average indicators of student self-efficacy based on gender are measured in five categories, namely understanding concepts, critical thinking skills, work practices, daily applications, and science communication. The first indicator, the percentage of conceptual understanding of male and female students, is 70 and 68, respectively, which means they are included in the high and medium categories. The second indicator, the percentage of critical thinking abilities of male and female students, is 67 and 64, respectively, which means they are in the medium category. The third indicator, the percentage of practical work for male and female students, is 70 and 68, respectively, which means they are in the high and medium categories. The fourth indicator, the daily application percentage of male and female students, is 72 and 68, respectively, which means they are in the high and medium categories. Then the fifth indicator, the percentage of science communication for male and female students, is 68 and 67, respectively, which means they are in the medium category. Overall, male students' self-efficacy is higher than female students. However, the indicators of science communication and critical thinking skills for male and female students are at the same level, namely moderate.

Table 5. the total, average percentages, and categorization of self-efficacy based on gender.

Indicator	Male (%)	Category	Male (%)	Category
Conceptual understanding	68	Moderate	70	High
Critical thinking ability	64	Moderate	67	Moderate
Practical work	68	Moderate	70	High
Everyday application	64	Moderate	72	High
Science Communication	67	Moderate	68	Moderate

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The first indicator, the behavior of male and female students, respectively, is 68 and 70, which is categorized as high, which means it is in the high and medium categories. The second indicator, the percentage of affective influence of male and female students, is 64 and 67, respectively, which means they are in the medium category. The third indicator, the percentage of cognitive level of male and female students, is 68 and 70, respectively, which means they are included in the medium and high categories. Then, in the fourth indicator, the physiological percentage of male and female students is 67 and 68, respectively, which means it is in the medium category. From the data in **Table 6**, overall, the academic stress of female students is higher than that of male students. Female students experience higher levels of academic stress, especially in behavioral and cognitive aspects. This can be caused by academic pressure that may be related to difficulty understanding complex scientific concepts.

Table 6. The total, average percentages, and categorization of academic stress based on gender.

Indicator	Male (%)	Category	Female (%)	Category
Behavioural	72	High	76	High
Affective	68	Moderate	67	Moderate
Cognitive	62	Moderate	65	Moderate
Physiological	66	Moderate	68	Moderate

Results from **Table 7** indicate that both male and female groups exhibit p-values exceeding 0.05 for self-efficacy, suggesting normal distribution. Specifically, for self-efficacy, both male ($p = 0.085 > 0.05$) and female ($p = 0.156 > 0.05$) groups met the normality test criteria. This implies that self-efficacy scores are normally distributed within both gender groups, enabling the use of parametric statistical tests to evaluate gender-based differences in science subjects. Similarly, for academic stress, both male ($p = 0.541 > 0.05$) and female ($p = 0.812 > 0.05$) groups met the normality test criteria. Consequently, parametric tests can be applied to explore potential gender differences in academic stress in science subjects.

Table 7. Normality test results using the shapiro-wilk test.

	Gender	Statistic	df	Sig.
Self-Efficacy	Male	0.927	24	0.085
	Female	0.944	27	0.156
Stress Academic	Male	0.965	24	0.541
	Female	0.978	27	0.812

Table 8 displays the outcomes of the Levene homogeneity test, assessing variance homogeneity in self-efficacy and academic stress across various measurement approaches. Results indicate significant homogeneity of variance for self-efficacy across mean ($p = 0.723$), median ($p = 0.739$), median with customized df ($p = 0.739$), and trimmed mean ($p = 0.734$). These results, with p-values > 0.05, signify homogeneous data, supporting the use of parametric tests for statistical analysis. Similarly, for academic stress, homogeneity of variance was observed across mean ($p = 0.267$), median ($p = 0.312$), median with customized df ($p = 0.313$), and trimmed mean ($p = 0.260$), allowing for the utilization of parametric tests in statistical analysis.

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Table 8. Levene's homogeneity test.

		Levene Statistic	df1	df2	Sig.
Self-Efficacy	Based on the Mean	0.127	1	49	0.723
	Based on the Median	0.113	1	49	0.739
	Based on Median and with adjusted df	0.113	1	42.41	0.739
	Based on the trimmed mean	0.117	1	49	0.734
Stress Academic	Based on the Mean	1.262	1	49	0.267
	Based on the Median	1.043	1	49	0.312
	Based on Median and with adjusted df	1.043	1	45.05	0.313
	Based on the trimmed mean	1.299	1	49	0.260

Table 9 presents the results of the independent t-test to evaluate significant differences in self-efficacy based on gender. Based on Table 9, the results of the independent t-test show that there is a significant difference in self-efficacy between male and female gender groups (p = 0.726, p = 0.544 > 0.05). This means that there is statistical evidence to support the existence of significant differences in the level of self-efficacy between male and female participants in this sample.

Table 10 shows the results of the independent t-test to evaluate significant differences in academic stress based on gender. The results of the independent t-test show that there is a significant difference in academic stress between male and female gender groups (t = 1.250, p = 0.216 > 0.05). This means that, based on the samples taken, there is sufficient statistical evidence to state that there is a significant difference in the level of academic stress between male and female participants.

Table 9. Independent t-test self-efficacy based on gender.

	Gender	N	Mean	Std. Deviation	Sig. (2-tailed)
Self-efficacy	Male	24	55.13	3.555	0.726
	Female	27	56.33	2.828	0.544

Table 10. Independent t-test Stress academic based on gender.

	Gender	N	Mean	Std. Deviation	Sig. (2-tailed)
Academic stress	Male	24	54.21	6.122	1.250
	Female	27	54.93	4.811	0.926

The descriptive statistical analysis of self-efficacy and academic stress indicators based on gender in science subjects reveals that both male and female students generally exhibit moderate self-efficacy levels. However, critical thinking skills and science communication indicators show lower percentages, indicating a lack of confidence among ninth-grade students in these areas. According to Bandura (1997), verbal persuasion, such as positive feedback, significantly influences communication skills and self-efficacy. Teachers play a crucial role in providing such encouragement and support, as recognized by Costigan and Brink (2020) and Liu *et al*. (2021). Science teachers can implement several strategies to enhance self-efficacy in science communication (Zhang et al., 2020; Hsu et al., 2021; Ying et al., 2021):

(i) Offering positive feedback and praise for completing science assignments successfully
(ii) Providing motivation and encouragement

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(iii) Introducing positive role models in science or inviting professionals from the field to inspire students
(iv) Facilitating collaborative projects to boost students' confidence through teamwork
(v) Engaging mentors or tutors to offer constructive guidance and support
(vi) Implementing project-based learning to allow students to plan, execute, and evaluate scientific projects, fostering confidence through successful completion.

Poor critical thinking skills in students stem from their perception of incapability and lack of confidence in their communication abilities. Enhanced communication skills instill confidence and foster a willingness to inquire. Encouraging questioning in science activities nurtures students' cognitive abilities (Sutani, 2021). However, fear of teachers, making errors, and public embarrassment often stifle students' questioning (Supriyatno *et al*., 2020). Educators must prioritize enhancing students' self-efficacy as it profoundly impacts learning. Science teachers can implement the following solutions to boost students' self-efficacy in critical thinking (Saepuloh *et al*., 2021; Kozikoglu, 2019; Phan, 2009):

(i) Encourage open-ended questioning to stimulate critical analysis, evaluation, and synthesis
(ii) Design research-based assignments promoting investigation and deep understanding
(iii) Adopt project-based learning for practical problem-solving and application of scientific concepts
(iv) Present scientific dilemmas necessitating solution formulation and evaluation
(v) Teach students to discern reliable information sources from unreliable ones
(vi) Integrate technology to broaden information access and enhance digital literacy
(vii) Provide field exploration opportunities to connect theory with real-world applications
(viii) Foster reflective practices to help students assess their learning process and overcome challenges

The independent t-test results indicate differences between male and female students, supporting descriptive statistics indicating overall disparities in self-efficacy. Male students typically exhibit higher social influence and responsibility, contributing to their confidence, which is shaped by family, school, and societal environments (Fan & Williams, 2010). Creating supportive environments and equal skill development opportunities can elevate student self-efficacy. Conversely, female students often face lower self-efficacy due to limited exposure to successful female role models in certain fields, affecting their perception of success possibilities.

Based on statistical findings, male students experience moderate levels of academic stress, while females endure high levels. Both genders face heightened stress in behavioral aspects. Elevated stress levels can negatively impact student performance, leading to procrastination in completing assignments. Causes of academic stress include the complexity of science material, high expectations from oneself, parents, or teachers, fear of failure, challenging assignments or exams, and uncertainty about future career prospects (Azila-Gbettor *et al*., 2015; Djamahar *et al*., 2020; Mujahidah & Astuti, 2019).

These differences are attributed to hormonal variances, as hormones like estrogen and progesterone in women, and testosterone in men, influence stress responses (Haleem *et al*., 2015). Estrogen may offer stress protection and mood enhancement, while progesterone may have a calming effect and reduce anxiety (Budde *et al*., 2010; Weekes *et al*., 2006). Cortisol, the primary stress hormone, is influenced by estrogen and progesterone levels, potentially affecting stress sensitivity (Budde *et al*., 2010; Weekes *et al*., 2006). For men, testosterone, primarily associated with physical characteristics, can heighten stress responses and foster aggressive behavior (Budde *et al*., 2010; Weekes *et al*., 2006).. Cortisol also plays a key role in

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men's stress response, with its release influenced by testosterone levels (Budde *et al*., 2010; Weekes *et al*., 2006). However, stress responses are individualized and influenced by genetics, life experiences, and environmental factors, while psychological factors like context and interpretation also impact stress management strategies. It is important to remember that these factors are complex and cannot be categorized in absolute terms. Each individual is unique, and many variables influence how hormones work in the context of stress. Further studies are needed to understand more deeply the interactions between hormones and responses to stress in females and males.

4. CONCLUSION

This research has succeeded in analyzing self-efficacy and academic stress based on gender differences in middle school students. Based on the findings, male students' self-efficacy is higher than female students on all indicators. Apart from that, it was also found that there were differences in the self-efficacy of male and female students. Not only self-efficacy, but it turns out that male students have lower academic stress than female students. This indicates that high self-efficacy means low academic stress.

Hopefully, this research can be used as a reference source in identifying self-efficacy and academic stress factors; apart from that, this research can also help teachers design learning strategies that consider self-efficacy and academic stress based on gender.

Future research discusses more fully the relationship between self-efficacy and academic stress, especially in relation about cause this discussion will be interesting and provide broader insight into dealing with problems.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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