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# Examining the Predictive Role of School Climate on Mathematical Efficacy: Insights from Indonesian PISA 2022 Data

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***Abstract.*** *Mathematics is a key discipline across many fields; however, data indicate that students' mathematical competence in Indonesia remains below optimal levels. One potential factor influencing this competence is students' self-efficacy in mathematics. Schools play a critical role in fostering a positive climate that enhances students' mathematics self-efficacy. This study examines the influence of school climate on students' mathematics self-efficacy in Indonesia, utilizing secondary data from the PISA 2022 dataset. The sample includes 13,439 Indonesian students, selected through a stratified proportional random sampling method. Data collection was conducted using a PISA-developed scale, tested for validity and reliability. Multiple linear regression analysis was employed, producing a significant model, $F(4, 12{,}253) = 77.594$, $p < .00$, $R^2 = .025$. These results indicate that school climate has a substantial predictive role on variations in students' mathematics self-efficacy. Specifically, factors such as school belongingness, perceived safety, and evaluation of safety risks partially influence mathematics self-efficacy. However, experiences of bullying showed no significant effect. The findings highlight the critical role of students' psychological perceptions of their school environment in shaping their self-efficacy in mathematics, emphasizing the importance of fostering positive school climates to support students' academic success.*

***Keywords****: education, mathematics self-efficacy, PISA, school climate*

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## Introduction

Mathematics, as a foundational discipline within formal education, serves a pivotal function across diverse fields and fosters the cultivation of both logical reasoning and critical thinking abilities (Ginanjar, 2019; Golding, 2018). Despite its significance, mathematics education in Indonesia has not yielded satisfactory outcomes. The 2022 Programme for International Student Assessment (PISA), conducted by the OECD, revealed a significant downturn in the academic performance of Indonesian students, particularly in key domains such as mathematics, reading, and science (OECD, 2023b).

Despite a slight improvement in Indonesia's overall ranking compared to the 2018 results, the country remains among the bottom 15 participating nations (OECD, 2023b). Notably,

Indonesia's mathematics score decreased from 379 in 2018 to 366 in 2022, representing a 13-point decline (OECD, 2023c). The decline is further underscored by data that shows that in 2018, where nearly 71% of Indonesian students did not attain Level 2, the threshold for basic mathematical competency. This figure rose to 82% in the 2022 PISA results, indicating widespread difficulties in mathematical problem-solving and reinforcing the urgency of Indonesia's ongoing learning crisis (Liestari et al., 2024).

Students' confidence in their mathematical abilities, commonly referred to as mathematics self-efficacy, plays a critical role in enhancing their performance in the subject. (Street et al., 2024; Zakariya, 2022). Among various psychological constructs, it shows one of the strongest associations with academic achievement, influencing both current outcomes and future learning (Lee & Stankov, 2018; Sorjonen et al., 2024). Bandura conceptualizes self-efficacy as the belief in one's ability to organize and perform tasks necessary to achieve specific objectives, which in turn influences motivation, persistence, and performance (Bandura, 1993). These perceptions of capability are not uniform; they vary according to the demands and characteristics of the task at hand (Linnenbrink & Pintrich, 2003), and measuring self-efficacy within specific subjects improves its predictive accuracy. Mathematical self-efficacy reflects students' confidence in solving problems, completing tasks, and succeeding in mathematics-related contexts (Cuevas & Berou, 2016). This domain-specific belief influences students' attitudes, motivation, and academic engagement in mathematics (Agbornu & Edekor, 2020; Santosa & Bahri, 2022).

In Indonesia, research on self-efficacy remains limited in scale and scope, with few studies examining its relationship to school climate. Most existing studies focus on educators. For example, Arum et al. (2024) teacher self-efficacy plays a significant role in cultivating a positive school climate through collective efficacy and interpersonal relationships. In a similar vein, Parapat et al. (2023) reported a significant correlation between school climate and teacher self-efficacy within an early childhood education (PAUD) context; however, the scope of their study was limited to a single institutional setting. Expanding the focus to students, Islamiyah and Ansyah (2025) demonstrated that a supportive school climate, combined with high self-efficacy, enhances learning motivation among junior high school learners, suggesting that feelings of safety and belonging may enhance engagement.

At a broader level, Dadeh (2021) explored how school climate correlates with students' mathematics self-efficacy using Indonesia's TIMSS 2011 dataset. However, the study lacked analytical precision, as it addressed multiple outcomes without clearly delineating the mechanisms by which school climate affects mathematics self-efficacy. More recent findings underscore the importance of mathematics self-efficacy in shaping student achievement. Muhtadi et al. (2022) emphasized, through a meta-analysis, the role of motivation as both a motivational

driver and a predictor of success in mathematical tasks. Likewise, Suparman and Juandi (2022) found that students who perceive themselves as competent are more likely to engage actively and perform better in mathematics.

Building on these insights, the present study investigates the influence of school climate on students' mathematics self-efficacy in Indonesia, drawing on secondary data from PISA 2022. The use of PISA data provides a strong foundation due to its wide population coverage, consistent cross-national methodology, and rigorous sampling procedures that accurately reflect student populations (OECD, 2023b). While prior research has acknowledged the importance of school climate, few studies have systematically examined its specific indicators in relation to mathematics self-efficacy. To the authors' knowledge, no existing research has extensively utilized large-scale datasets, such as PISA, for this purpose.

Therefore, the novelty of this study lies in its comprehensive approach to analyzing both the overall effect of school climate and the distinct contributions of each indicator, offering empirical insights into how school climate shapes students' confidence and engagement in mathematics learning. Investigating school climate within the context of Indonesian education is essential, as it reflects the nation's distinct cultural and educational characteristics. Prior research has demonstrated that various dimensions of school climate, such as safety, teacher support, and student engagement, are positively associated with academic outcomes (Al Hija & Araidy, 2023). For Indonesian students, a supportive school climate can foster a sense of belonging and academic confidence, both of which are crucial for enhancing mathematics self-efficacy (Zeinalipour, 2022). The PISA 2022 dataset enables cross-national comparisons, highlighting Indonesia's specific challenges and strengths in fostering effective school environments.

To clarify the distinction between general and specific self-efficacy, such as mathematics self-efficacy, *general self-efficacy* reflects a person's broad belief in their capacity to handle challenges across various life domains, shaped by accumulated experiences (Scholz et al., 2002). While it supports understanding of resilience and general motivation, it lacks precision in forecasting performance in specific academic contexts. In contrast, mathematics self-efficacy captures learners' self-perceived competence in executing math-related tasks, such as solving equations or interpreting data. Due to its task-specific nature, it is a more accurate and powerful predictor of math achievement and student engagement (Pajares, 1996; Usher & Pajares, 2009). As Bandura (2006) noted, self-efficacy is most effective when measured at the level of the specific task.

Mathematics self-efficacy, therefore, represents a belief that mediates the relationship between mathematical ability, experience, and students' performance scores (Pajares & Kranzler, 1995; Shimizu, 2025). It serves as a mediator between mathematical ability and

experience, influencing both anxiety levels and academic performance (Betz & Hackett, 1983; Shimizu, 2025). Students with strong mathematics self-efficacy consistently outperform those who doubt their own abilities (Bandura, 1993). Students with strong mathematics self-efficacy exhibit a high level of interest in learning mathematics and experience minimal anxiety when confronted with mathematical problems (Zhu et al., 2024). Additionally, they are more likely to enjoy mathematics and engage positively with the subject. (Mazana et al., 2018).

Yanto et al. (2023) identified mathematics self-efficacy as a central factor contributing to students' learning outcomes, highlighting its impact on both cognitive and affective dimensions of the educational experience, particularly in solving mathematical problems featured in the PISA assessment. Similarly, findings from PISA 2012 revealed that self-efficacy consistently has a positive correlation with high academic achievement (OECD, 2023a). This relationship may be attributed to the fact that students with high mathematics self-efficacy are more capable of organizing and executing the necessary actions to solve mathematical problems (Santosa & Bahri, 2022). Accordingly, mathematics self-efficacy is widely recognized as a central factor in shaping and predicting students' proficiency in mathematics.

Several factors contribute to the development of mathematics self-efficacy, including family influence, peer influence, and the role of schools (Bandura, 1997; Schunk & Pajares, 2010). Teachers play a pivotal role in implementing diverse learning activities, employing innovative approaches, methods, and models to achieve educational objectives at all levels of education (Maulidia et al., 2020). These learning processes are inherently linked to the role of schools, which serve as crucial spaces for skill development since students spend a significant portion of their time there (Haraldstad et al., 2019). Furthermore, research by Takdir et al. (2020) highlighted the central influence of institutional, familial, and communal support in shaping learning environments conducive to the development of student self-efficacy.

School environment and learning environment are conceptually aligned with the notion of school climate (OECD, 2019). Anderson (1982) affirms that a positive school climate contributes meaningfully to improved academic performance among students. In the PISA framework (OECD, 2023a), school climate is commonly defined as the overall quality and character of school life. Key elements of school climate that shape students' personal development and academic success include the physical conditions of the school, relationships between the principal and staff, interactions between teachers and students, norms among students, and students' sense of comfort and safety within the school environment (OECD, 2019).

The presence of a positive school climate has been consistently linked to enhanced higher levels of academic achievement, higher levels of school engagement, positive personal development, and reduced behavioral issues (Daily et al., 2020; Konold et al., 2018). In such an

environment, students feel safe, teachers provide support, parents actively participate in school activities, and all stakeholders collaborate to maintain a constructive and encouraging atmosphere (OECD, 2019). Muallifah et al. (2020) emphasized that a school climate fostering comfort, optimism, and enthusiasm enhances students' engagement and reinforces their confidence in their ability to succeed.

According to PISA 2022, indicators of school climate mainly involve students' feelings of inclusion, exposure to bullying, perceived safety, and vulnerability to school-based risks (OECD, 2022). A school environment characterized by positive social interactions and belongingness contributes to elevated self-efficacy, which is consistently associated with improved academic performance (Zysberg & Schwabsky, 2021). Research by Yi et al. (2024) also demonstrates that a sense of belonging significantly influences self-efficacy and academic resilience. According to PISA 2022, 87% of students in Indonesia reported that they easily made friends at school, while 86% felt accepted. However, 16% expressed feelings of loneliness at school, and 13% reported feeling excluded or like strangers (OECD, 2023b).

Experiences of bullying refer to students feeling victimized or being subjected to bullying behaviors. Bullying in schools often hinders students' development and negatively affects their psychological well-being (Yu & Zhao, 2021). Victims of bullying may experience stress, discomfort, fear, sadness, feelings of worthlessness, and a loss of self-confidence (Anggraini et al., 2020). Consequently, these experiences can have a negative impact on students' self-efficacy (Liu et al., 2023). According to PISA 2022, approximately 25% of girls and 30% of boys reported being victims of bullying or intimidation at least several times a month (OECD, 2023b).

Feeling safe at school is related to students' overall well-being and life satisfaction. A perceived sense of safety within the school environment contributes to students' feelings of belonging, overall well-being, and self-assurance in their learning capacities (OECD, 2023d), so that in mathematics learning, students who feel safe and comfortable will experience a decrease in anxiety and an increase in mathematics self-efficacy. Students' feelings of safety at school are linked to how teachers manage the learning process when students encounter difficulties, which in turn influences students' attitudes at school (Porter et al., 2024). In Indonesia, student-reported safety concerns include 4% feeling insecure en route to school, 6% within classrooms, and 17% in other school locations (e.g., hallways, cafeteria, restrooms) (OECD, 2023b).

Students' sense of safety is closely linked to the presence of minimal school safety risks. Such risks encompass various forms of violence, including vandalism, threats, physical altercations, gang activity, and possession of weapons on school premises. If these incidents occur, they can undermine students' feelings of security, hinder teachers' ability to perform

effectively, and ultimately diminish the overall quality of teaching and learning (Masekela et al., 2024). Across OECD countries, the most commonly reported school safety risks include vandalism (20% of students) and threats from peers (20%). Other frequent incidents include physical altercations on school property resulting in injuries (17%). Less common but concerning issues include gang presence at school (12%) and students carrying guns or knives (11%). Based on the explanation of each school climate indicator, it can be inferred that these indicators may partially influence students' mathematics self-efficacy. Therefore, it is essential to carefully prepare and optimize the school climate to encourage students in developing mathematics self-efficacy, which has a substantial impact on students' ability to learn and perform in mathematics.

This study investigates the influence of school climate on students' mathematics self-efficacy in Indonesia, drawing on secondary data from PISA 2022. The use of PISA data provides a robust foundation due to its wide population coverage, consistent cross-national methodology, and rigorous sampling procedures that accurately reflect student populations (OECD, 2023b). While prior research has acknowledged the importance of school climate, few studies have systematically examined its specific indicators in relation to mathematics self-efficacy. To the author's knowledge, no existing research has extensively utilized large-scale datasets, such as PISA, for this purpose. Therefore, the novelty of this study lies in its comprehensive approach to analyzing both the overall effect of school climate and the distinct contributions of each indicator, offering empirical insights into how school climate shapes students' confidence and engagement in mathematics learning. Investigating school climate within the context of Indonesian education is essential, as it reflects the nation's distinct cultural and educational characteristics. Prior research has shown that multiple facets of school climate,such as safety,teacher support, and student engagement, are positively correlated with academic outcomes (Al-Hija & Araidy, 2023). For Indonesian students, a supportive school climate can foster a sense of belonging and academic confidence, both of which are crucial for enhancing mathematics self-efficacy (Zeinalipour, 2022). The PISA 2022 dataset offers a robust quantitative foundation for examining these dynamics, enabling cross-national comparisons and highlighting Indonesia's specific challenges and strengths in fostering effective school environments.

This study is anchored by a core research question that seeks to examine how school climate influences students' mathematics self-efficacy in Indonesia, using the nationally representative PISA 2022 dataset. This study offers a novel contribution by breaking down school climate into its core components, an area that remains underexplored in current literature. Accordingly, this study formulates five research questions to investigate how various dimensions of school climate relate to mathematics self-efficacy among students in Indonesia. (1) How does

overall school climate relate to mathematics self-efficacy among Indonesian students? (2) To what extent does a sense of belonging at school influence students' mathematics self-efficacy? (3) What is the relationship between experiences of bullying and students' mathematics self-efficacy? (4) Does feeling safe at school contribute to higher mathematics self-efficacy among students? (5) How does exposure to school safety risks affect students' mathematics self-efficacy?

This study offers a nuanced understanding of the educational environment's impact on students' confidence in mathematics by examining both the cumulative and individual effects of school climate indicators. This approach is critical because the school environment is a complex, interconnected system where factors like disciplinary climate, teacher support, and peer relations do not operate in isolation. Analyzing their cumulative effect offers a holistic, more realistic picture of how these various elements combine to shape a student's belief in their mathematical abilities (self-efficacy).

## Method

This study adopted a quantitative correlational design, utilizing secondary data drawn from the PISA 2022 dataset, which was accessed via the official OECD website at https://www.oecd.org/en/data/datasets/pisa-2022-database.html. The analysis aimed to examine the statistical relationships between mathematics self-efficacy and school climate indicators (e.g., safety, belonging, bullying) among Indonesian students. No experimental manipulation was involved; instead, the study relied on existing survey responses to identify patterns and associations.

### *Sample*

The sample comprises 13,439 students—6,864 females and 6,575 males—aged between 15 years and 16 years and 2 months, enrolled in formal education programs equivalent to Grade 7 or higher. Students attending special education institutions (*Sekolah Luar Biasa – SLB*) were excluded. According to OECD (2023c), the total target population for Indonesia in the 2022 cycle was approximately 3,790,800 students. To enhance representativeness and minimize sampling bias, the study employed a proportional stratified random sampling method, selecting participants from 410 schools distributed across various regions. This approach accounts for variations in school type, geographic distribution, and student demographics, thereby strengthening the generalizability and validity of the study's findings.

*Instrument for Measuring Variables*

As previously noted, this study utilizes secondary data from the PISA 2022 survey, focusing specifically on Indonesian students. All research variables were derived from the PISA 2022 Student Questionnaire (OECD, 2023c), which provides standardized and validated instruments for assessing student competencies, attitudes, and self-perceptions, particularly in the domains of mathematics self-efficacy and school climate. These instruments were developed based on established construct frameworks, rigorously reviewed by experts, and psychometrically tested to ensure both reliability and validity. To support measurement precision, PISA applies Item Response Theory (IRT). This method applies a robust psychometric model that evaluates student responses in relation to item-specific features such as difficulty level, discriminative power, and guessing probability (Shin et al., 2025). Using the 2PL model, PISA evaluates test items through two indicators: the difficulty parameter (β), which gauges how challenging an item is, and the discrimination parameter (α), which assesses how well the item separates students across ability levels. (OECD, 2023c). The internal reliability of PISA's scales is examined using Cronbach's alpha, which supports the coherence and dependability of the measured constructs.

*Mathematics Self-Efficacy*

Mathematics self-efficacy in this study was assessed using ten items from the PISA 2022 Student Questionnaire, each crafted to capture students' confidence in engaging with a variety of mathematical tasks. These items represent a continuum of competencies, ranging from interpreting visual data to applying mathematical reasoning in real-life contexts and utilizing digital tools. Students rated their confidence using a four-point Likert scale, where 1 indicated "Not at all confident" and 4 indicated "Very confident." They were asked to assess their confidence in completing selected mathematical tasks, such as extracting information from diagrams, graphs, or simulations, and interpreting mathematical solutions within real-life contexts. For example, *"How confident are you in your ability to extract mathematical information from diagrams, graphs, or simulations?"*. The complete list of items can be found in the appendices.

The validity of the mathematics self-efficacy instrument was evaluated using Item Response Theory (IRT), as mentioned earlier, specifically through the difficulty parameter (β) and discrimination parameter (α). The difficulty values for all ten items ranged from –0.28 to 0.67, indicating a moderate level of challenge, neither too easy nor excessively difficult, making the items appropriate for assessing students across varying ability levels. In terms of discrimination, nine items demonstrated strong performance with α values equal to or greater than 0.50, suggesting they effectively differentiate between students with high and low mathematics

self-efficacy. However, one item, "Coding/programming computers", recorded a lower discrimination value of $\alpha = 0.39$, falling below the ideal threshold. This suggests that students with varying levels of self-efficacy responded to this item similarly; therefore, its interpretation should be approached with caution. In addition, reliability analysis yielded a Cronbach's alpha of 0.91 for the mathematics self-efficacy scale, reflecting a high degree of internal coherence among the items. This high reliability suggests that the instrument consistently measures the intended construct across its items.

*School Climate*

The study utilized school climate data from the PISA 2022 Student Questionnaire, comprising 24 items that reflect four principal indicators: belongingness, bullying, perceived safety, and environmental safety risks within the school setting. Sense of belonging was measured through six items (e.g., "I feel like an outsider," "I make friends easily at school"), while experiences of bullying were assessed using nine items (e.g., "Other students made fun of me," "I got hit or pushed around by other students"). The feeling of safety was captured through four items (e.g., "I feel safe on my way to school," "I feel safe on my way home from school"), and school safety risks were evaluated using five items (e.g., "I saw gangs at school," "Our school was vandalized"). Please refer to the appendices for a complete list of the 24 items used in this study.

The validity of the school climate scale was also assessed using IRT, which evaluates each item based on two key parameters: item difficulty and item discrimination. The item difficulty ranged from –0.48 to 0.71. The item parameters demonstrate a well-balanced distribution, ensuring the instrument can reliably detect variation in how students perceive the measured constructs (Hambleton et al., 1991). With discrimination values spanning from 0.57 to 1.66, the items generally exhibited moderate effectiveness in distinguishing among students with differing degrees of the underlying construct (Bichi & Talib, 2018). The reliability of the school climate scale was evaluated using Cronbach's alpha, with values ranging from 0.64 to 0.85 across its four constructs. Sense of belonging ($\alpha = 0.72$), experiences of bullying ($\alpha = 0.77$), and feeling safe ($\alpha = 0.85$) demonstrated strong internal consistency, exceeding the commonly accepted threshold of 0.70. Although the school safety risks subscale yielded a lower reliability coefficient ($\alpha = 0.64$), it is considered acceptable for exploratory research purposes (Hair et al., 2010). These outcomes indicate that the items are well-aligned with the conceptual framework of school climate, effectively capturing its core dimensions.

To answer the research questions, this study explored how school climate and its related factors influence students' mathematics self-efficacy in Indonesia. The research tested the subsequent hypotheses:

H1: A positive school climate is linked to higher mathematics self-efficacy.

H2: A stronger school belongingness is positively related to mathematics self-efficacy.

H3: Bullying experiences are negatively related to mathematics self-efficacy.

H4: Students who feel safe at school tend to report higher levels of mathematics self-efficacy.

H5: Students who reported higher levels of school safety concerns tended to exhibit lower mathematics self-efficacy.

To examine these relationships, multiple linear regression analysis was conducted. Before testing the hypotheses, key statistical assumptions, including normality, linearity, homoscedasticity, and multicollinearity, were checked to ensure the model's validity. All statistical analyses were conducted using SPSS Statistics version 26.0 for Windows.

## Results and Discussion

Before conducting hypothesis testing, this study performed a series of assumption checks to ensure the robustness and validity of the multiple linear regression model. These checks included assessments of *normality*, *linearity*, *homoscedasticity*, and *multicollinearity*, which are essential for meeting the statistical assumptions that underpin regression analysis. Verifying these assumptions enhances the reliability and interpretability of the model estimates, reducing the risk of biased or misleading conclusions. The normality of residuals was examined to confirm that the error terms followed a normal distribution, which supports valid inference in hypothesis testing (Osborne & Waters, 2002). Linearity was assessed to ensure a consistent relationship between independent and dependent variables, a prerequisite for accurate coefficient estimation (Keith, 2019). Homoscedasticity, or constant variance of residuals, was tested to avoid inflated Type I error rates and ensure efficient parameter estimates (Tabachnick & Fidell, 2013). Multicollinearity was evaluated using variance inflation factors (VIF), as high intercorrelations among predictors can distort the significance and stability of regression coefficients (Hair et al., 2010). By confirming these assumptions, the study adhered to best practices in regression modeling, ensuring that its findings are both statistically sound and generalizable.

Table 1. Normality test

| Variables | N | Skewness | Kurtosis | SESk | SEKu |
|---|---|---|---|---|---|
| Sense of belonging | 13,069 | 1.231 | 3.096 | 0.021 | 0.043 |
| School safety risks | 13,067 | 2.463 | 6.607 | 0.021 | 0.043 |
| Experiences of bullying | 13,134 | 0.756 | -0.314 | 0.021 | 0.043 |
| Feeling safe | 13,142 | 0.434 | -0.767 | 0.021 | 0.043 |
| N Valid | | | 12,902 | | |

Note: Listwise deletion was used, excluding cases with missing values on any analysis variable. Consequently, valid response counts varied by variable.

Normality testing in this study involved evaluating the distribution of data through skewness and kurtosis indices. As presented in Table 1, the results indicate that the data do not meet the criteria for normal distribution. However, considering the large sample size in the PISA dataset, with valid cases for each variable ranging from 13,069 to 13,142, the central limit theorem (CLT) can be applied. As stated by the Central Limit Theorem, larger sample sizes result in the sampling distribution of the mean approaching normality, independent of the population's distributional form (Magsalay, 2025). Therefore, despite the non-normality of the raw data, the assumption of normality required for parametric analysis is considered to be met.

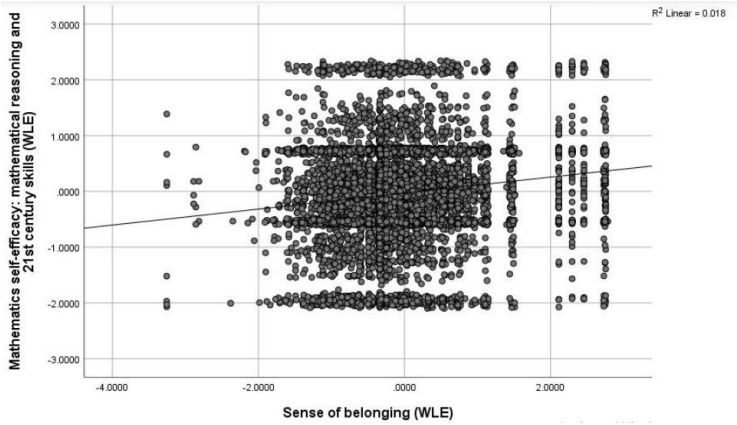


Figure 1. Sense of belonging – mathematics self-efficacy scatterplot

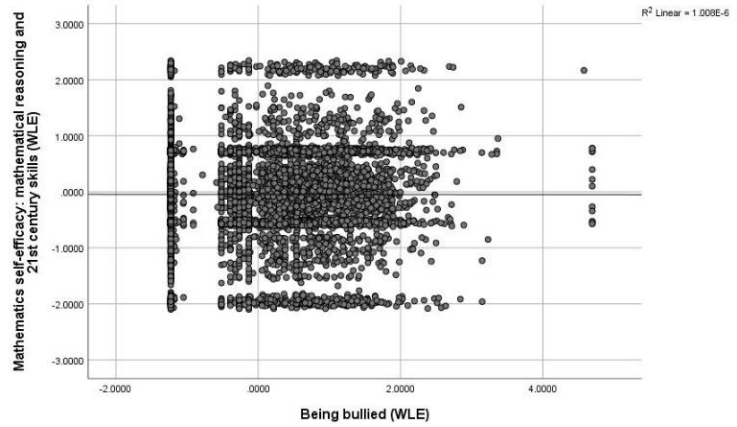


Figure 2. Experiences of bullying - mathematical self-efficacy scatter plot

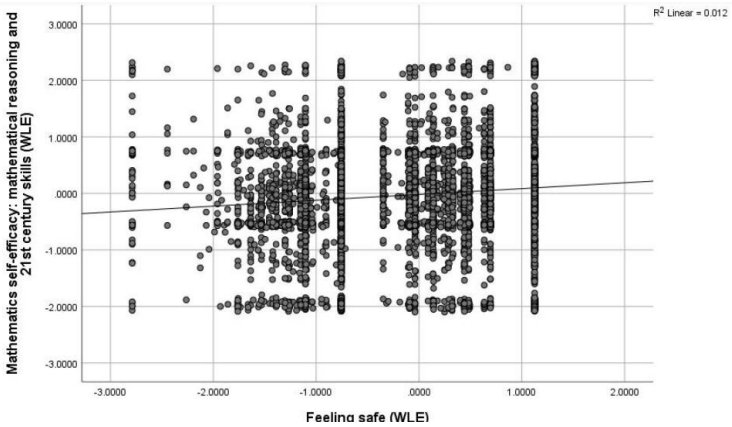


Figure 3. Feeling safe - mathematical self-efficacy scatter plot

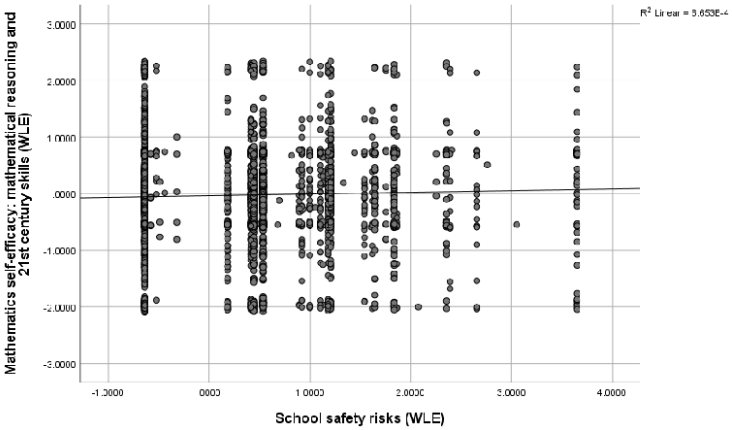


Figure 4. School safety risks - mathematical self-efficacy scatter plot

Linearity testing was conducted using scatter plots for each independent variable (school climate indicators) against the dependent variable (Mathematics self-efficacy). As illustrated in Figures 1, 2, 3, and 4, Each of the four school climate indicators showed a linear relationship with mathematics self-efficacy, suggesting consistent directional associations across constructs. The observed scatterplot patterns reveal a clear linear trend, with data points clustering around a straight line rather than dispersing randomly, thereby supporting the presence of a strong linear relationship between the predictors and the outcome variable.

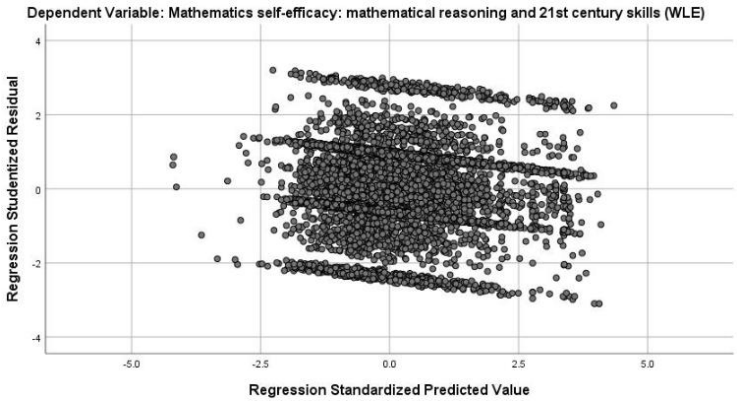


Figure 5. Homoscedasticity test scatter plot

The homoscedasticity test in this study was conducted using the scatter plot method. As shown in Figure 5, the data points are randomly dispersed and distributed both above and below the zero line, rather than clustering around a single point. This pattern indicates the absence of heteroscedasticity, this pattern supports the validity of the homoscedasticity assumption within the regression framework.

Table 2. Multicollinearity test

| Model | Collinearity Statistics | |
|---|---|---|
| | Tolerance | VIF |
| School belongingness | 0.880 | 1.136 |
| Bullying experiences | 0.866 | 1.155 |
| Perceived safety | 0.897 | 1.115 |
| Evaluation of safety risks | 0.884 | 1.131 |

The multicollinearity test is conducted by examining tolerance and Variance Inflation Factor (VIF) values. If the tolerance value exceeds 0.10 and the VIF value remains below 10, multicollinearity is unlikely to be present among the variables. Based on Table 4.10, all school climate indicators meet these criteria, with tolerance values greater than 0.10 and VIF values less than 10. Therefore, no multicollinearity exists among the school climate indicators: school belongingness, bullying experiences, perceived safety, and evaluation of safety risks.

This investigation focuses on the extent to which school climate factors affect students' mathematics self-efficacy. It utilizes secondary data from PISA 2022, comprising a sample of 13,439 students—6,864 females and 6,575 males. The research subjects are distributed across grades 7 to 12 and range in age from 15 years to 16 years and 2 months.

Table 3. F test

| Model | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Regression | 201.103 | 4 | 50.276 | 77.594 | 0.000 |
| Residual | 7,939.100 | 12,253 | 0.648 | | |
| Total | 8,140.203 | 12,267 | | | |

a. Predicted variable: Mathematics self-efficacy
b. Predictors variables: (Constant), Evaluation of safety risks, perceived safety , School belongingness, Bullying experiences

Multiple linear regression analysis was employed to test the proposed hypotheses. As shown in Table 3, the F-test yielded a value of 77.594 with degrees of freedom (4, 12, 253) and a significance level of $p < 0.05$. These results support Hypothesis 1, indicating that the school climate indicators collectively contribute to the development of students' mathematics self-efficacy in the Indonesian context.

Table 4. T test

| Model | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| (Constants) | -0.002 | 0.009 | | | |
| School belongingness | 0.123 | 0.010 | 0.115 | 12.048 | 0.000 |
| Bullying experiences | 0.008 | 0.007 | 0.010 | 1.072 | 0.284 |
| Perceived safety | 0.071 | 0.009 | 0.075 | 7.981 | 0.000 |
| Evaluation of safety risks | 0.034 | 0.011 | 0.028 | 2.995 | 0.003 |

a. Dependent variable: Mathematics self-efficacy

The t-test was used to determine whether variations in the independent variable significantly affect the outcome variable. Based on Table 4, three school climate indicators (school belongingness, perceived safety, and evaluation of safety risks) significantly influence students' mathematics self-efficacy ($p < 0.05$). Specifically, sschool belongingness ($\beta = 0.123$, $p = 0.000$), perceived safety ($\beta = 0.071$, $p = 0.000$), and evaluation of safety risks ($\beta = 0.034$, $p = 0.003$) each contribute to students' mathematics self-efficacy levels. In contrast, experiences of bullying ($\beta = 0.008$, $p = 0.284$) do not exhibit a significant effect on mathematics self-efficacy.

Table 5. Coefficient of determination

| Model | R | $R^2$ | Adjusted $R^2$ | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.157 | 0.025 | 0.024 | 0.8049417 |

a. Predictors: (Constant), School safety risks, Feeling safe, Sense of belonging, Experiences of bullying

The coefficient of determination table presents the $R^2$ (R-squared) values derived from regression analysis. The coefficient of determination ($R^2$) quantifies how much of the variability in the dependent variable is explained by the set of independent variables. As shown in Table 5, the coefficient of determination ($R^2$) is 0.025, meaning that school climate accounts for 2.5% of the variation in Indonesian students' mathematical self-efficacy. While other unexamined factors shape the remaining 97.5%, these finding highlights that even a small influence can be significant. School climate may not be the sole determinant of mathematical confidence, but its presence matters—it contributes to a broader understanding of how learning environments shape students' perceptions and abilities. This underscores the value of fostering a supportive school atmosphere, as even subtle improvements can have meaningful effects on student outcomes.

*Hypothesis 1: School Climate Positively Influences Students' Mathematics Self-Efficacy in Indonesia*

This study underscores the beneficial impact of school climate on students' mathematics self-efficacy, as evidenced by PISA 2022 data, thereby supporting Hypothesis 1. Sumar (2018) noted that school climate plays a critical role in the success of both students and teachers, particularly in enhancing self-efficacy. The findings of this analysis align with those of Samsuddin and Retnawati (2022), who highlighted school climate as a key environmental

influence on students' mathematics self-efficacy, notably at the secondary level. Furthermore, both school climate and students' constructive dispositions toward mathematics contribute meaningfully to the strengthening of mathematics self-efficacy, especially in the context of escalating academic demands (Yanto et al., 2023).

Teachers and schools play a crucial role in providing students with meaningful opportunities to learn mathematics. Ensuring access to high-quality learning materials can enhance students' understanding of mathematical concepts, ultimately contributing to the development of their mathematics self-efficacy (Zakariya, 2022). Teachers play a crucial role in helping students feel valued, supported, and understood, which positively contributes to the development of their self-efficacy (Jederlund & Von Rosen, 2023). Teacher support can also be reciprocal. Students with strong mathematics self-efficacy demonstrate high enthusiasm for learning, which is positively correlated with satisfactory mathematics achievement. In turn, strong academic performance and a high level of engagement in mathematics enhance the support students receive from teachers (Zhu et al., 2024). Moreover, a classroom environment that encourages students to express their opinions freely—without fear of making mistakes—can positively influence their perceptions of their ability to engage with mathematics lessons. (Sökmen, 2021).

*Hypothesis 2: A Stronger School Belongingness is Positively Related to Mathematics Self-Efficacy*

The data analysis reveals that a sense of belonging plays a crucial role in shaping students' mathematical self-efficacy in Indonesia. When students feel accepted, valued, and integrated into their school community, their confidence in mathematics increases, reinforcing the acceptance of Hypothesis 2 in this study. This finding aligns with Yi et al. (2024), who emphasized that students with a heightened school belongingness exhibit greater self-efficacy and resilience in academic contexts. Additionally, research by Zysberg and Schwabsky (2021) highlights that positive interpersonal relationships and a strong sense of belonging in school foster self-efficacy, which in turn contributes to improved academic achievement. Students who feel a strong sense of belonging within their school are more willing to take risks and embrace mistakes, leading to a more positive perception of their ability to navigate challenges (Sökmen, 2021). Therefore, enhancing students' sense of belonging can effectively strengthen their mathematics self-efficacy.

Culturally, the Indonesian education system places strong emphasis on collectivism and interpersonal relationships. In school environments where students experience a strong sense of community, their self-efficacy in academic tasks—particularly in mathematics—is more likely to improve. This culturally rooted supportive atmosphere fosters a positive feedback loop between

belonging and self-efficacy, thereby encouraging students to engage with complex mathematical challenges (Ergün & Avcı, 2018; Yilmaz, 2016). Similar findings have been observed in other ASEAN countries, notably Singapore, which consistently ranks among the highest in Southeast Asia. The collectivist orientation of Singaporean society, which prioritizes communal values and interpersonal connections, has been shown to enhance students' sense of belonging and, in turn, strengthen their academic resilience (Sandoval-Hernández & Białowolski, 2016).

*Hypothesis 3: Bullying Experiences are Negatively Related to Mathematics Self-Efficacy*

Hypothesis 3 was rejected, as experiences of bullying were found to have no significant impact on students' mathematics self-efficacy. This finding contrasts with a previous study that suggests bullying negatively affects mathematics self-efficacy (Liu et al., 2023). One possible explanation is that other factors could mitigate the negative effects of bullying. Factors such as effective coping mechanisms may mediate the relationship between bullying and mathematics self-efficacy among students in Indonesia (Smith, 2016). Support from teachers, parents, and peers could also mitigate the negative effects of bullying (Smith, 2016). Furthermore, a perceived sense of safety within the school environment can buffer the adverse effects of bullying, as evidenced in the study by Varela et al. (2022). A secure learning environment enables students to concentrate on their studies without the fear of violence, bullying, or other disruptions.

*Hypothesis 4: Students Who Feel Safe at School Tend to Report Higher Levels of Mathematics Self-Efficacy*

The fourth hypothesis in this study was supported, with a regression coefficient of 0.071, indicating that feeling safe positively influences students' mathematics self-efficacy. As students' sense of security increases, their confidence in mathematics also improves. A safe learning environment plays a crucial role in student learning. When students feel secure, they are more likely to participate actively in the learning process. This aligns with OECD (2023d), which states that students who feel safe at school experience higher life satisfaction and greater confidence in their ability to learn.

In the context of mathematics learning, a secure environment reduces student anxiety, thereby enhancing mathematics self-efficacy. Given that mathematics self-efficacy is a key determinant of academic success in mathematics (Santosa & Bahri, 2022), fostering a safe school climate can contribute to improved learning outcomes. In the Indonesian context, ensuring a safe school environment is critical due to various socio-economic challenges faced by students. Students from marginalized communities often encounter stressors that impact their feelings of safety. Research indicates that maintaining a safe school environment can help mitigate these effects and enable students to develop their self-efficacy in mathematics (Connell, 2018).

Globally, the relationship between school safety and academic self-efficacy is similarly recognized. Studies such as those by Graham et al. emphasize that students in schools where safety is prioritized tend to exhibit higher achievement in mathematics, as the fear of negative evaluation or harassment can diminish academic self-efficacy (Graham et al., 2021). Schools characterized by a supportive atmosphere, inclusive practices, and low levels of conflict naturally create an environment that fosters self-efficacy. For instance, Wang et al. found that perceived teacher support mediates the relationship between school climate and math anxiety, suggesting that students' feelings of safety and support from teachers significantly impact their self-efficacy beliefs in mathematics (Wang et al., 2024).

*Hypothesis 5: Students Who Reported Higher Levels of School Safety Concerns Tended to Exhibit Lower Mathematics Self-Efficacy*

The fifth hypothesis in this study was rejected, as the data analysis results indicate that the perception of school safety risks positively influences students' mathematics self-efficacy. This finding contradicts previous research, which suggests that school safety risks, such as vandalism, threats, fights, gang activity, and weapon possession, negatively impact students' mathematics self-efficacy (Masekela et al., 2024). Additionally, school safety risks, particularly violence, can hinder students from forming strong connections within the school environment (Muallifah et al., 2020).

The positive attitude demonstrated by students in response to school security risks is noteworthy. This may be attributed to their ability to develop greater resilience in the face of such challenges. Research suggests that individuals exposed to adversity, including unfavorable school security risks, tend to exhibit higher levels of resilience (Edwards et al., 2016). Resilience, in turn, fosters perseverance and confidence, enabling students to effectively overcome difficulties in mathematics learning (OECD, 2023c).

The findings of this study highlight the positive influence of school climate, particularly in terms of indicators such as sense of belonging and feeling safe, on students' mathematics self-efficacy. When students feel emotionally secure and socially included at school, they tend to exhibit stronger beliefs in their mathematical capabilities. Previous research has shown that mathematics self-efficacy serves as a mediator in the relationship between mathematical ability, experience, and students' academic performance (Pajares & Kranzler, 1995). Yanto et al. (2023) further emphasize its crucial role in mathematics learning, particularly in problem-solving tasks presented in the PISA assessment.

To support students' success in mathematics, schools must cultivate environments where learners feel secure, accepted, and emotionally connected. Schools are encouraged to adopt policies that foster a safe, inclusive, and supportive learning environment for all students

(Widiasmara et al., 2023). Emphasizing school climate as a strategic focus contributes meaningfully to both students' confidence in learning and their academic performance.

This study effectively highlights the role of school climate in shaping students' self-efficacy in solving mathematical problems. School climate dimensions, such as a sense of belonging and feelings of safety, have universal relevance in enhancing self-efficacy across diverse educational contexts. Feeling accepted in school translates into better academic emotions, which are critically linked to self-efficacy (Zysberg & Schwabsky, 2021). Educators worldwide can leverage these findings to reform curricula and school practices that enhance student well-being and motivation in mathematics. Implementing collaborative learning strategies, peer mentoring, and inclusive classroom activities can cultivate a supportive atmosphere that enhances mathematics self-efficacy. Research by Kara et al. (2025) emphasizes the significance of peer relationships in fostering student engagement and enhancing students' psychological resilience and academic success. The finding that experiences with bullying did not significantly correlate with self-efficacy implies that while bullying remains a critical issue, its direct impact on mathematics self-efficacy may be nuanced. This suggests that interventions should focus not only on anti-bullying campaigns but also on creating environments that nurture positive peer relationships. Schools can benefit from programs that promote empathy and peer support among students (Kara et al., 2025). However, it is important to acknowledge that additional factors influencing mathematics self-efficacy were not examined in this research. Future studies should aim to explore a broader range of variables that may contribute to students' mathematics self-efficacy.

## Conclusion

Based on the study's findings, school climate, considering all its indicators, collectively influences students' mathematics self-efficacy in Indonesia, as evidenced by PISA 2022 data. Specifically, school climate accounts for 2.5% of the variation in students' mathematics self-efficacy. Establishing and maintaining a positive school climate can contribute to improved mathematics self-efficacy among students. The analysis of school climate indicators in relation to students' mathematics self-efficacy revealed that most indicators had a significant positive effect. Specifically, sense of belonging, feeling safe at school, and perceived school safety risks were positively associated with students' mathematics self-efficacy. However, the experience of bullying did not show a significant relationship with mathematics self-efficacy levels. These findings provide a valuable foundation for designing targeted intervention programs that aim to strengthen students' confidence in mathematics. Moreover, the study provides important insights into the academic environment of Indonesian students, as captured in the PISA 2022 dataset.

This study successfully identified 2.5% of the variance in mathematics self-efficacy, leaving 97.5% of the variance influenced by other factors. Therefore, future research should investigate additional variables that contribute to students' mathematical self-efficacy. This study employs secondary analysis, which offers access to a large volume of high-quality data. However, the use of secondary analysis of PISA 2022 data is not without limitations. PISA 2022 data is collected on a large scale using measurement scales that have been adapted to the language of each participating country. Nonetheless, these adapted scales may be interpreted differently by students due to cultural variations. Therefore, researchers recommend incorporating primary data to complement and strengthen the findings derived from secondary data analysis.

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## Appendices

*School Climate Measures*

| Construct | Item |
|---|---|
| Sense of belonging | I feel like an outsider (or left out of things) at school. |
| | I make friends easily at school |
| | I feel like I belong at school. |
| | I feel awkward and out of place in my school. |
| | Other students seem to like me. |
| | I feel lonely at school. |
| Experiences of bullying | Other students left me out of things on purpose. |
| | Other students made fun of me. |
| | I was threatened by other students. |
| | Other students took away or destroyed things that belonged to me. |
| | I got hit or pushed around by other students. |
| | Other students spread nasty rumours about me. |
| | I was in a physical fight on school property. |
| | I stayed home from school because I felt unsafe. |
| | I gave money to someone at school because they threatened me. |
| Feeling safe | I feel safe on my way to school. |
| | I feel safe on my way home from school. |
| | I feel safe in my classrooms at school. |
| | I feel safe at other places at school (e.g., hallway, cafeteria, restroom). |
| School safety risks | Our school was vandalised. |
| | I witnessed a fight on school property in which someone got hurt. |
| | I saw gangs in school. |
| | I heard a student threaten to hurt another student |
| | I saw a student carrying a gun or knife at school |

*Mathematics Self-Efficacy Measure*

| No. | Item |
|---|---|
| 1 | Extracting mathematical information from diagrams, graphs, or simulations |
| 2 | Interpreting mathematical solutions in the context of a real-life challenge |
| 3 | Using the concept of statistical variation to make a decision |
| 4 | Identifying mathematical aspects of a real-world problem |
| 5 | Identifying constraints and assumptions behind mathematical modelling |
| 6 | Representing a situation mathematically using variables, symbols, or diagrams |
| 7 | Evaluating the significance of observed patterns in data |
| 8 | Coding/programming computers |
| 9 | Working with computer mathematics systems (e.g., spreadsheets, programming, software) |
| 10 | Calculating the properties of an irregularly shaped object |