Muslim Education Review
Vol. 3 No. 2, 2024, 262-303
https://doi.org/10.56529/mer.v3i2.318

Exploring the Relationship between Safe Learning Environments and Literacy Skills in Majority Muslim Southeast Asian Nations: Insights from PISA 2022

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Abstract

This research investigates the association of safe learning environments with literacy scores in three Southeast Asian countries with Muslim-majority populations: Brunei Darussalam, Indonesia and Malaysia. The study will use data from PISA 2022 to identify factors that promote inclusive learning environments and are related to students' literacy. The research is grounded in theoretical frameworks, such as Social Cognitive Theory, Ecological Systems Theory, and Cultural-Historical Activity Theory, to discern factors associated with students' literacy and to develop strategies for creating inclusive learning environments. The data will be analyzed using Welch's ANOVA, Post Hoc Comparison, and regression analysis. The results revealed that bullying, feeling unsafe, and school safety risks are negatively associated with students' literacy scores and highlight the importance of creating inclusive learning environments. The study's potential impact on future research and interventions is significant, making it a crucial foundation for further investigation.

Keywords: *literacy, PISA, safe learning environment, bullying, science, reading, mathematics*

Introduction

The relationship between a safe learning environment and academic achievement has become more prominent in current global education (Forget-Dubois et al., 2007; Yang et al., 2019; Klapp et al., 2023). This relationship is influenced by several factors, such as ongoing socio-economic changes and the transformative impact of technology (Durlak et al., 2011; Hargreaves & Shirley, 2021). Further, students need a safe learning environment to navigate challenges and opportunities beyond traditional academic boundaries (Muhyatun, 2023).

In this context, it is important to note that literacy skills, including science, reading and mathematics proficiency, are crucial indicators of educational achievement (Park & Kyei, 2011). The ability to comprehend, apply, and critically analyze information indicates academic success and is vital in broader personal and professional development (Mafarja & Zulnaidi, 2022). In examining this subject, it is essential to consider the complexity of the educational environment and explore the multifaceted relationships between a safe learning environment and literacy skills.

Ensuring student safety, encompassing physical and psychological well-being, is a prerequisite for fostering conducive learning environments (Musu-Gillette et al., 2017; Cefai et al., 2021). Numerous studies have highlighted the positive correlation between students' feelings of safety and academic achievements. Students who perceive their schools as safe exhibit higher levels of academic engagement, leading to improved outcomes in science, reading and mathematics (Stepanek, 2000; Gietz & McIntosh, 2014; Musu-Gillette et al., 2017; Karakus et al., 2023). Therefore, prioritizing student safety in educational institutions is essential. Creating a secure and supportive environment aids students in reaching their full potential and provides them with the skills and knowledge needed for future success.

In addition, creating a safe and positive learning environment is also crucial for science literacy. Research conducted by Darby (2005) reveals that a secure and encouraging atmosphere leads to heightened interest and engagement in science education, consequently enhancing

students' proficiency in science literacy. Additionally, Mackenzie (2020) underscores the significance of fostering a secure classroom environment, encompassing emotional and physical aspects, to establish an inclusive science classroom. Her research indicates that students' engagement is tied to a safe learning environment for effective science learning.

A safe learning environment is influenced by factors such as the frequency of students' experiences with bullying, students' feelings of safety in their learning environment, and their perception of school safety risks. This study is grounded on several theoretical frameworks, including Social Cognitive Theory (Bandura, 1986), Ecological Systems Theory (Bronfenbrenner, 1979) and Cultural-Historical Activity Theory (Vygotsky, 1978). By exploring these frameworks, this study aims to gain a deeper understanding of the factors associated with students' literacy skills and develop strategies to help create safe, nurturing and inclusive learning environments.

Social Cognitive Theory, proposed by Bandura (1986), focuses on the importance of observational learning, self-efficacy, and social influences in shaping human behavior. In this study, this theory helps us understand how students who are bullied might internalize negative experiences, which can affect their self-perception, motivation and academic performance. Ecological Systems Theory, developed by Bronfenbrenner (1979), provides a comprehensive perspective by highlighting the influence of various environmental systems on an individual's development. The microsystem, mesosystem, ecosystem and macrosystem shape a student's experiences within and beyond the school environment. This framework is crucial for understanding the contextual factors that may contribute to or mitigate the impact of bullying, feelings of unsafety, and perceived school safety risks on academic outcomes. Cultural-Historical Activity Theory, rooted in the work of Vygotsky (1978), stresses the importance of the sociocultural context in which learning occurs. It suggests that cognitive development is inseparable from cultural and social influences. In this study, it is important to understand the cultural and social factors unique to Brunei

Darussalam, Indonesia and Malaysia, as they play a crucial role in how socio-emotional factors intersect with academic success in diverse educational settings.

In this study, the interconnectedness of Social Cognitive Theory, Ecological Systems Theory, and Cultural-Historical Activity Theory is utilized to explore the impact of bullying, students feeling unsafe, and school safety risks on academic performance in math, science and reading literacy. Social Cognitive Theory investigates how students internalize negative social experiences, such as bullying, and their association with academic achievement. Ecological Systems Theory places these experiences within a broader environmental framework, illustrating how safety perceptions are influenced by interactions within and outside the school environment. Cultural-Historical Activity Theory adds a cultural dimension by emphasizing the societal and educational norms of Brunei Darussalam, Indonesia and Malaysia that shape this relationship. These theories collectively provide a holistic framework for examining how socio-emotional factors influence academic outcomes while also considering parental education and language spoken at home as control variables to address socio-economic and cultural influences.

In this study, the measured variable is the literacy scores of 15-year-old students in science, reading and mathematics. This will be assessed through the Programme for International Student Assessment (PISA) 2022, which evaluates students' proficiency in these three key subjects. The PISA considers science, reading and mathematics literacy as fundamental components of a well-rounded education. Science literacy enables individuals to engage critically with scientific concepts and issues, fostering a deeper understanding of the natural world and the role of science in society. On the other hand, reading literacy equips individuals with the skills to comprehend, analyze and evaluate various texts, empowering them to achieve personal goals and participate meaningfully as a global citizen. Mathematics literacy goes beyond basic arithmetic. It encompasses applying mathematical reasoning and problem-solving skills across different contexts, enabling individuals to make informed decisions and solve real-world problems. Together, these

literacies form the foundation for lifelong learning and active citizenship in an increasingly complex and interconnected world (OECD, 2019).

The study examines the relationship between bullying, students' feelings of unsafety, school safety risks, and students' proficiency in science, reading and mathematics literacy. Bullying, defined as repeated negative actions intended to cause harm or distress, can significantly impact students' cognitive abilities and literacy skills (Jan & Husain, 2015; Turunen et al., 2017). Bullying victimization varies across countries and can compromise students' concentration and information processing (Hosozawa et al., 2021).

The study also explores the connection between students' sense of safety in school and their literacy proficiency. Feeling safe in the school environment is associated with academic engagement and cognitive development (Mooij & Fettelaar, 2013; Maffini, 2016; Côté-Lussier & Fitzpatrick, 2016). Recently, there has been a growing concern about the impact of school safety on students' academic performance. Studies have found a strong link between perceived safety risks in schools and students' proficiency in science, reading and mathematics (MacDonald, 2005). These safety risks can include vandalism, witnessing fights, the presence of gangs, and students carrying weapons. Research by Wang and Holcombe (2010) showed that a secure school environment significantly influences students' cognitive and academic development. They found that reduced safety risks improved cognitive engagement and academic performance. Additionally, a safe school environment fosters positive behavior, creating a conducive learning atmosphere and ultimately enhancing students' academic success (Wang & Holcombe, 2010).

Recognizing the limitations of current research in Southeast Asia's educational settings is crucial (Fraser, 2002). Past studies often overlooked the complex factors affecting academic outcomes in the region, highlighting a significant research gap. Asian scholars have significantly contributed to expanding learning environments research, adapting Western questionnaires, and confirming correlations between

classroom environments and student success. For example, there is a strong positive correlation between direct instruction and reading literacy in the Philippines, whereas in Indonesia, Malaysia and Thailand, the correlation is negative. Adaptive teaching is associated with higher reading literacy scores across Brunei, Indonesia, Malaysia and the Philippines, while feedback is linked to lower scores in all those countries except Thailand (Macasaet, 2021).

This study addresses this limitation and provides a perspective that extends beyond the current knowledge, offering valuable insights for educators, policy makers and researchers (Gay, 2018). The following three research questions guide the research:

1. Are there notable differences in the science, reading and mathematics literacy scores among students participating in the PISA 2022 in Brunei Darussalam, Indonesia and Malaysia?
2. Is there a difference in safe learning environments, including bullying, feeling unsafe, and school safety risks, across Brunei Darussalam, Indonesia and Malaysia?
3. How are bullying, feeling unsafe and school safety risks associated with students' PISA science, reading and mathematics literacy scores in Brunei Darussalam, Indonesia and Malaysia?

These research questions are essential in exploring the complex relationship between socio-emotional factors and academic success across different educational contexts in Southeast Asia. Brunei Darussalam provides its citizens twelve years of free education, beginning at age five. The 21st Century National Education System (SPN21) includes four phases of schooling: primary education (ages 6–12), secondary education (ages 12–17), and a two- or three-year program culminating in the Brunei-Cambridge General Certificate of Education (GCE O Level). This system offers diverse career paths based on students' qualifications and exam results, with the option to pursue university studies through post-secondary and higher education (Jaidi et al., 2023).

Indonesia's educational system, which was expanded during the Soeharto era, mirrors the American school system. It comprises six years of free elementary school and three years of junior high school, totaling nine years of mandatory education. Furthermore, the Indonesian government has employed a 12-year compulsory education program, but it is not being optimally implemented in various regions of Indonesia (Margiyanti & Maulia, 2023). Upon completion, students can choose to attend a vocational school or senior high school before pursuing a university education (Shaturaev, 2021).

In Malaysia, primary education starts at age seven and, as of 2015, five years of secondary education have become compulsory, enforced by law. The government offers six years of free primary education and five years of free secondary education. Those seeking higher education must meet academic requirements and have the means to continue their studies (Jelas & Dahan, 2010).

The study aims to provide evidence-based insights to inform interventions and policies that enhance learning environments and academic success. According to Klem and Connell (2004), positive socio-emotional development correlates with academic achievement, supporting the integration of socio-emotional well-being in education. Durlak et al. (2011) suggest that social-emotional learning programs can improve academic performance and reduce negative behaviors. These findings contribute to global efforts to create educational environments that nurture student well-being and success.

Method

Participant (Subject) Characteristics

This study is centered on the countries of Brunei Darussalam, Indonesia and Malaysia in Southeast Asia. Each of these nations has its own unique cultural and educational setting. They are currently adapting to the challenges of a rapidly evolving education system, where students face various difficulties and opportunities, from navigating complex

social interactions to adapting to the impact of modern technology (Naafs & Skelton, 2020).

This study analyzed data from PISA 2022. The sample is 26084 students from Brunei Darussalam, Indonesia and Malaysia who participated in PISA 2022. This study examines the relationships between parents' education, language spoken at home, and safe learning environments with science, reading and mathematics literacy. The safe learning environment included bullying, feeling unsafe, and school safety risks. Table 1 provides a demographic analysis of the sample. Science, reading and mathematics literacy skills are measured by the students' performances on the science, reading and mathematics items in the PISA 2022.

Table 1. *Analysis of Sample Demographic*

Factor		Countries			Total (*n* = 26084)
		Brunei Darussalam (*n* = 5576)	Indonesia (*n* = 13439)	Malaysia (*n* =7069)	
Age (years)	Mean	15.80	15.87	15.84	15.85
Gender (%)	Female	49.2	51.1	51.1	50.7
	Male	50.8	48.9	48.9	49.3
Language spoken at home (%)	Chinese	4.4	-	-	0.9
	English	13.2	0.4	3.9	4.1
	Local language in Indonesia	-	48.9	-	25.2
	Indonesian	-	46.1	-	23.8
	Malay	77.1	-	66.1	34.4
	Mandarin	-	-	16.6	4.5
	Tagalog	0.3	-	-	0.1
	Tamil	-	-	4.9	1.3
	Another language (BRN)	4.7	-	-	1.0
	Another language (IDN)	-	3.4	-	1.7

	Another language (MYS)	-	-	8.0	2.2
Parents' Level of Education (%)	Less than ISCED level 1	0.3	2.1	1.1	1.5
	ISCED level 1	1.5	10.7	2.0	6.4
	ISCED level 2	3.0	15.9	7.3	10.9
	ISCED level 3.3	30.4	9.6	0.5	11.7
	ISCED level 3.4	12.5	29.4	24.4	24.5
	ISCED level 4	-	3.8	12.3	5.3
	ISCED level 5	14.0	4.7	26.3	12.6
	ISCED level 6	8.9	10.8	10.2	10.3
	ISCED level 7	17.8	8.9	11.0	11.5
	ISCED level 8	9.6	4.0	4.7	5.4

Research Design

The dataset from the PISA 2022 Database for Brunei Darussalam, Indonesia and Malaysia has been downloaded. Science, mathematics and reading literacy items in PISA 2022 comprised simple multiple-choice, complex multiple-choice, computer-scored open responses, and human-coded open responses (OECD, 2023). The reliability values for the cognitive domain in science literacy are 0.91, 0.85 and 0.88 in Brunei Darussalam, Indonesia and Malaysia respectively. The reliability values for the cognitive domain in math literacy are 0.92, 0.85 and 0.90 in Brunei Darussalam, Indonesia and Malaysia respectively. The reliability values for the cognitive domain in science literacy are 0.91, 0.87 and 0.88 in Brunei Darussalam, Indonesia and Malaysia respectively (OECD, 2023)

The PISA 2022 study gathered data on bullying, school safety risks, and how safe students feel at school. To collect this information, students were asked to complete a questionnaire. The bullying section of the questionnaire consisted of nine statements, including (1) being excluded by other students on purpose, (2) being made fun of by other students, (3) being threatened by other students, (4) having personal belongings taken or destroyed by other students, (5) being physically assaulted by other

students, (6) having nasty rumors spread about them by other students, (7) being involved in a physical fight on school property, (8) staying home from school due to feeling unsafe, and (9) giving money to someone at school due to being threatened. The responses to these statements were used to create a single index of exposure to bullying, with positive values indicating higher exposure to bullying than the OECD average. Students answered how often they experienced each statement, with options ranging from never or almost never, to a few times a year, a few times a month, and once a week or more. The Cronbach's alpha reliability coefficient for the bullying section was 0.76, 0.77 and 0.84 in Brunei Darussalam, Indonesia and Malaysia, respectively (OECD, 2023).

The 'Feeling Safe at School' survey includes four statements that ask students how safe they feel. The students can choose from four options (strongly disagree, disagree, agree, strongly agree) for each of the following statements: (1) on their way to school, (2) on their way from school, (3) in classrooms, and (4) at other places in school. All four statements are combined to create an index of how safe students feel. A positive value in the index indicates that students feel safer in and around school compared to the average of OECD countries. The reliability coefficient (Cronbach's alpha) for the 'Feeling Safe at School' survey was 0.81 in Brunei Darussalam, 0.85 in Indonesia and 0.87 in Malaysia, according to the OECD's report in 2023.

The school safety risks questionnaire comprises five statements that ask students to answer 'yes' or 'no' regarding events that have occurred during the previous four weeks. These events include (1) vandalism at the school; (2) witnessing a fight on school property in which someone was hurt; (3) seeing gangs in school; (4) hearing students threaten to harm another student; and (5) seeing students carrying a gun or knife at school. The five statements are combined into a single index of school safety risks. Positive values in the index indicate that students perceive greater risks at their school than the average across OECD countries. The Cronbach's alpha reliability coefficient for school safety risks was 0.62, 0.64 and 0.64 in Brunei Darussalam, Indonesia and Malaysia, respectively (OECD, 2023). Table 2 provides more details about school resource variables.

Table 2. *Independent and Outcome Variables. Adapted from PISA 2022 Technical Report*

Variable	Sub-variables	Code
Literacy	Science	PVSCIE
	Mathematics	PVMATH
	Reading	PVREAD
Bullying	Other students left me out of things on purpose	ST038Q03NA
	Other students made fun of me	ST038Q04NA
	I was threatened by other students	ST038Q05NA
	Other students took away or destroyed things that belong to me,	ST038Q06NA
	I got hit and pushed around by other students,	ST038Q07NA
	Other students spread nasty rumors about me	ST038Q08NA
	I was in a physical fight on school property	ST038Q09NA
	I stayed at home from school because I felt unsafe	ST038Q010NA
	I gave money to someone at school because they threatened me	ST038Q011NA
	Index of exposure of bullying	BULLIED
Feeling safe at school	On their way to school	ST265Q01JA
	On their way from school	ST265Q02JA
	In classrooms	ST265Q03JA
	At other places at school	ST265Q04JA
	Index of feeling safe at school	FEELSAFE
School Safety Risks	Our school was vandalized	ST266Q01JA
	I witnessed a fight on school property in which someone got hurt	ST266Q02JA
	I saw gangs in school	ST266Q03JA
	I heard students threaten to hurt another student	ST266Q04JA
	I saw students carrying a gun or knife at school	ST266Q05JA
	Index of School Safety Risks	SCHRISK
Control Variables	Language spoken at home	LANGN
	Parent's level of education	HISCED

A descriptive analysis of the data obtained from the student questionnaires on PISA 2022 has been conducted to determine the distribution, potential cleaning, and new computations. Missing data has been checked, accounting for 2.4% of school safety risks, 2.0% of bullying, 1.8% of feeling unsafe at school and 1.5% of parents' education. As the percentage of missing data is less than five percent, the complete case analysis (CCA) procedure, which analyzes cases with complete data, will be used (Langkamp et al., 2010; Baguley & Andrews, 2016).

Data Analysis

To address research questions RQ1 and RQ2, an analysis of variance (ANOVA) and multiple comparison procedures were carried out. The data was thoroughly reviewed to ensure that it met the assumptions of normality, homogeneity of variance, and independence. Normality was assessed using histograms, QQ plots, skewness, and kurtosis of residuals to confirm that the data was normally distributed. The analysis confirmed no relationship between observations in each group or the countries themselves, meeting the independence assumption. Additionally, a test for multicollinearity was conducted to identify any potential issues with collinearity between independent variables, ensuring that they were not highly correlated. However, the assumption of equal variances (HOV) was not satisfied, leading to the use of a Welch ANOVA.

Additionally, regression analysis was applied to predict science, reading and mathematics literacy scores in Brunei Darussalam, Indonesia and Malaysia. This was done by including language spoken at home, parents' education, bullying, feeling unsafe and school safety risks as covariates for research question RQ3. The assumptions of normality, homoscedasticity, linearity and independence of observation were reviewed. The normality assumption was tested and met via examination of histograms and the P-P plot of regression standardized residual. The P-P plots and histograms by residual suggested normality were reasonable. The review of skewness and kurtosis for residual also suggests normality. The scatterplot of regression standardized predicted

value with dependent variables, and the partial plots suggest that linearity is maintained. The scatterplot of unstandardized residual by unstandardized predicted value looks relatively random, suggesting that the independence of observation is maintained. Regular scatter around 0 for the residuals suggests that homoscedasticity is maintained. The assumptions appear valid for this regression model.

The significance level was defined as $p < .05$. For data analysis, IBM SPSS Statistics 9 version 27 was used. To avoid sampling issues and ensure equal representation, a weighted variable was applied following the guidelines of PISA 2022 (OECD, 2023). The following hypotheses are proposed to answer the research questions.

Hypothesis 1: There are significant differences in the science, reading and mathematics literacy scores among students participating in the PISA 2022 in Brunei Darussalam, Indonesia and Malaysia.

Hypothesis 2: There are significant differences in safe learning environments, including bullying, feeling unsafe and school safety risks across Brunei Darussalam, Indonesia and Malaysia.

Hypothesis 3: Students' PISA science, reading and mathematics literacy scores are negatively related to bullying, feeling unsafe and school safety risks in Brunei Darussalam, Indonesia and Malaysia.

Table 3. *Guideline for Each Parameter in the Model Equations*

$Science_{ij}$: Students' performance in science literacy test
$Reading_{ij}$: Students' performance in reading literacy test
$Math_{ij}$: Students' performance in mathematics literacy test
$Bullying_{ij}$: The index of exposure to bullying
$Safe_{ij}$: The index of students feeling unsafe
School $Risks_{ij}$: The index of school safety risks
$Language_{i}$: Language spoken at home
Parents' $education_{i}$: Level of parents' education

μ: The overall mean of science, mathematics, or reading literacy scores across all participating students and countries, representing the baseline level of achievement

α_j: The country-specific effect indicating the deviation from the overall mean score attributable to the country of origin

ϵ_{ij}: The residual variance of science, mathematics, or reading literacy scores not accounted for by the mean and country-specific effect

β_0: Intercept, indicating the expected proficiency level when all other variables are zero

β_1 - β_5: Regression coefficient associated with the predictors representing the extent to which each predictor influences the proficiency level

w_j: the weight assigned to each country based on sample size n_i and variance s_i^2

$\underline{X}_j$: the mean literacy score for country iii,

$\underline{X}'$: the overall weighted mean,

k: the number of groups (countries), and

F_W: the test statistic for Welch's ANOVA.

Model for RQ1

The primary research question explores variations in the mean scores of science, reading and mathematics literacy for students participating in the PISA 2022 from Brunei Darussalam, Indonesia and Malaysia. The model equations (1), (2) and (3) explain the expected literacy scores in science, reading and mathematics respectively, for each student from a particular country.

$$Science_{ij} = \mu + \alpha_j + \epsilon_{ij} \quad [1]$$

$$Reading_{ij} = \mu + \alpha_j + \epsilon_{ij} \quad [2]$$

$$Math_{ij} = \mu + \alpha_j + \epsilon_{ij} \quad [3]$$

Model for RQ2

The second research question investigates the connection between bullying, student perception of safety and school safety risks among Brunei Darussalam, Indonesia and Malaysia students who participated in the PISA

2022. Equations (4), (5) and (6) in the model illustrate the expected index of bullying, safety perception and school safety risks.

$$\text{Bullying}_{ij} = \mu + \alpha_j + \epsilon_{ij} \quad [4]$$

$$\text{Safe}_{ij} = \mu + \alpha_j + \epsilon_{ij} \quad [5]$$

$$\text{School Risks}_{ij} = \mu + \alpha_j + \epsilon_{ij} \quad [6]$$

The study used Welch's ANOVA to examine variations in mean scores between the three countries due to unequal variances. This test addressed both Research Question 1 and Research Question 2. The formula for Welch's ANOVA is:

$$F_w = \frac{\frac{1}{k-1}\sum_{j=1}^{k} \left[w_j \left(\underline{X_j} - \underline{X'} \right)^2 \right]}{1 + \frac{2(k-2)}{k^2-1}\sum_{j=1}^{k} \left[\left(\frac{1}{n_j - 1} \right) \left(1 - \frac{w_j}{w} \right)^2 \right]} \quad (7)$$

Model for RQ3

The third research question explores the association between bullying, feeling unsafe, school safety risks, and science, reading, and math literacy skills. Furthermore, covariates will be considered to ensure accurate results, including the parents' education and the language spoken at home.

$$\text{Science}_i = \beta_0 + \beta_1*(\text{language}_i) + \beta_2*(\text{Parents' education}_i) + \beta_3*(\text{Bullying}_i) + \beta_4*(\text{Safe}_i) + \beta_5*(\text{School Risks}_i) + \epsilon_i \quad [8]$$

$$\text{Reading}_i = \beta_0 + \beta_1*(\text{language}_i) + \beta_2*(\text{Parents' education}_i) + \beta_3*(\text{Bullying}_i) + \beta_4*(\text{Safe}_i) + \beta_5*(\text{School Risks}_i) + \epsilon_{ij} \quad [9]$$

$$\text{Math}_i = \beta_0 + \beta_1*(\text{language}_i) + \beta_2*(\text{Parents' education}_i) + \beta_3*(\text{Bullying}_i) + \beta_4*(\text{Safe}_i) + \beta_5*(\text{School Risks}_i) + \epsilon_i \quad [10]$$

Control Variables

This study included control variables, encompassing parents' education and language spoken at home. Previous studies have indicated the influential role of parents' education on students' literacy skills (Epstein, 2007; Baliyan et al., 2012; Wamala et al., 2013; Blums et al., 2017; Betancur et al., 2018). In addition, Kirsch et al. (2002) highlight the significance of parents' educational background in shaping their children's educational outcomes. Understanding the role of parents' education within specific cultural contexts contributes to a comprehension of the factors affecting student achievement (Elley, 1992; Kirsch et al., 2002; Bayirli et al., 2023).

Similarly, the language spoken at home is critical to students' science, reading and mathematics literacy proficiency. Elley's (1992) research underscores the role of linguistic influences on reading literacy, suggesting that the language spoken at home can significantly shape a student's attitude toward reading. Further, aligning students' primary language with the language utilized in assessments can substantially affect academic performance in science (Thomas & Collier, 2002; Wolf & Leon, 2019; Abedi et al., 2003). Therefore, the language spoken at home becomes a key aspect in understanding variations in literacy outcomes, particularly in the diverse linguistic landscape of Southeast Asian nations (Musu-Gillette et al., 2017; Elley, 1992).

In the statistical analysis, this study utilized several common abbreviations and terms, including:

- N: the total number of observations
- Degrees of Freedom (df): This represents the number of independent values or observations in a statistical calculation.
- Standard Error (SE): This indicates the variability of sample statistics used to estimate population parameters.
- Standard Deviation (SD): This measures the dispersion or spread of data points in a dataset.
- Mean (M): This represents the average value of a set of data.

- ANOVA or F Statistic (F): This is used in the analysis of variance (ANOVA) to test the equality of means across multiple groups (Mishra et al., 2019).
- t Statistic (t): This testifies whether the mean difference between two groups is statistically significant (Mishra et al., 2019).
- Significance level (p): the probability of obtaining an effect equal to or more extreme than the one observed, considering the null hypothesis is true. (Biau et al., 2010)

Results

This section focuses on presenting and analyzing the results of a data investigation that examines the differences in science, reading and mathematics literacy scores and the differences in safe learning environments among students from Brunei Darussalam, Indonesia and Malaysia. Furthermore, the relationship between students' performance in science, reading, and math literacy tests in PISA 2022 and safe learning environments will be explored based on the data from PISA 2022 for the three countries.

Research Question 1

The study analyzed the differences in science, reading and mathematics literacy scores among the students who participated in the PISA 2022 examination in Brunei Darussalam, Indonesia and Malaysia. Students' science, reading and mathematics scores had different average scores across countries. The mean scores of students from Brunei Darussalam are the highest among the three countries for science (M = 445.41, SD = 89.58), reading (M = 428.79, SD = 95.36) and mathematics (M = 440.75, SD = 79.87), followed by students from Malaysia for science (M = 416.30, SD = 74.32), reading (M = 388.08, SD = 72.86) and mathematics (M = 408.68, SD = 60.70). Students from Indonesia have the lowest scores for science (M = 382.86, SD = 65.49), reading (M = 358.57, SD = 71.23) and mathematics (M = 365.53, SD = 57.81).

Table 4. *Descriptive Statistics of Science, reading and mathematics Literacy by Country in PISA 2022*

Variable	Country	*N*	*M*	*SD*
Science literacy	Brunei Darussalam	5576	445.41	89.58
	Indonesia	13439	382.86	65.49
	Malaysia	7069	416.30	74.32
Reading literacy	Brunei Darussalam	5576	428.79	95.36
	Indonesia	13439	358.57	71.23
	Malaysia	7069	388.08	72.86
Mathematics literacy	Brunei Darussalam	5576	440.75	79.87
	Indonesia	13439	365.53	57.81
	Malaysia	7069	408.68	60.70

a. $R_{science}$ Squared = .022 (Adjusted R Squared = .022)

b. $R_{reading}$ Squared = .015 (Adjusted R Squared = .015)

c. $R_{mathematics}$ Squared = .045 (Adjusted R Squared = .045)

The UNIANOVA result (see Table 5) shows that science ($F_{2, 4187371}$ = 47139.61, p < .001), reading ($F_{2, 4187371}$ = 31932.78, p < .001) and mathematics ($F_{2, 4187371}$ = 97710.96, p < .001) literacy scores in PISA 2022 were statistically significantly different among countries. This suggests that the mean of science, reading and mathematics scores differ by country. The effect size is small for $\eta_{science}^2$ = .022, suggesting that 2.2% of the variance in science scores can be explained by country, and reading $\eta_{reading}^2$ = .015, suggesting that 1.5% of the variance in reading scores can be explained by country. The effect size is medium for η_{math}^2 = .045, suggesting that 4.5% of the variance in mathematics scores can be explained by country.

Results from the Welch ANOVA show the mean scores for science ($F_{2, 15762}$ = 37956.69, p < .001), reading ($F_{2, 15755}$ = 67940.55, p < .001) and mathematics ($F_{2, 15762}$ = 25403.86, p < .001) were significantly different among the three countries. A post hoc Games-Howell test was employed to identify the differing countries.

Table 5. *Analysis of Variance of Science, Reading and Mathematics Literacy by Country*

Variable	*Welch test*		*UNIANOVA*		*Partial* η^2
	F	*p*	*F*	*p*	
Science literacy	37956.69	< .001	47139.61	< .001	.022
Reading literacy	67940.55	< .001	31932.77	< .001	.015
Mathematics literacy	25403.86	< .001	97710.96	< .001	.045

The *t*-test for contrast 1 is significant. Thus, there is a significant difference between the average scores for science ($t_{6013.06}$ = 39.87, p = < .001), reading ($t_{6014.87}$ = 345.22, p = < .001) and mathematics ($t_{6018.93}$ = 51.67, p = < .001) in Indonesia and Malaysia with Brunei Darussalam. Further, the *t*-test for contrast 2 is also significant for science ($t_{455082.97}$ = -270.54, p < .001), reading ($t_{454505.71}$ = -218.48, p < .001), and mathematics ($t_{443558.45}$ = -361.91, p < .001). Therefore, there is a significant difference between Indonesians' and Malaysians' mean scores for science, reading and mathematics. This study uses alpha levels of .05 per test because the contrast questions are orthogonal to each other.

Table 6. *Contrast Test of Science, Reading and Mathematics Literacy*

Variable	Contrast	Value of Contrast	*SE*	*t*	*df*	*p*
Science literacy	1	46.27	1.16	39.87	6013.06	< .001
	2	-33.44	.12	-270.54	455082.97	< .001
Reading literacy	1	55.90	1.24	45.22	6014.87	< .001
	2	-29.52	.14	-218.48	454505.71	< .001
Mathematics literacy	1	53.45	1.03	51.67	6018.93	< .001
	2	-43.16	.12	-361.91	443558.45	< .001

Post hoc comparisons using the Games-Howell test indicated that the average science, reading and mathematics literacy scores in Brunei Darussalam were significantly different than in Indonesia and Malaysia. Similarly, Indonesia and Malaysia's mean scores for science, reading and mathematics literacy were also significantly different (see Table 7).

Table 7. *Multiple Comparisons of Science, reading and mathematics Literacy in Brunei Darussalam, Indonesia and Malaysia*

Variable	Country		*Mean Difference*	*SE*	*p*
Science literacy	Brunei Darussalam	Indonesia	62.99	1.16	< .001
		Malaysia	29.54	1.17	< .001
	Malaysia	Indonesia	33.44	.12	< .001
Reading literacy	Brunei Darussalam	Indonesia	70.66	1.23	< .001
		Malaysia	41.14	1.24	< .001
	Malaysia	Indonesia	29.51	.14	< .001
Mathematics literacy	Brunei Darussalam	Indonesia	75.03	1.03	< .001
		Malaysia	31.87	1.04	< .001
	Malaysia	Indonesia	43.16	.12	< .001

Research Question 2

The analysis of safe learning environments in Brunei Darussalam, Indonesia and Malaysia was based on the data from PISA 2022. The learning environment includes bullying, feeling unsafe and school safety risks. Bullying, feeling unsafe and school safety risks had different average scores across countries. The mean bullying scores in Indonesia are the highest among the three countries (M = -.115, SD = 1.08), followed by Brunei Darussalam (M = -.176, SD = 1.06). Malaysia had the lowest scores for bullying (M = -.177, SD = 1.07). The mean scores of feeling unsafe in Brunei Darussalam are the highest among the three countries (M = -.28, SD = .89), followed by Malaysia (M = -.29, SD = .89). Indonesia had the lowest scores for feeling unsafe (M = -.30 SD = .87). In addition, the mean scores of school safety risks in Indonesia are the highest among the three countries (M = -.09, SD = .76), followed by Malaysia (M = -.15, SD = .82). Brunei Darussalam had the lowest scores for school safety risks (M = -.17, SD = .98). More details are provided in Table 8.

Table 8. *Descriptive Statistics of Safe Learning Environment by Country in PISA 2023*

Variable	Country	*N*	*M*	*SD*
Being bullied	Brunei Darussalam	5576	-.176	1.07
	Indonesia	13439	-.114	1.08
	Malaysia	7069	-.177	1.07
Feeling safe	Brunei Darussalam	5576	-.28	.89
	Indonesia	13439	-.30	.87
	Malaysia	7069	-.29	.89
School safety risks	Brunei Darussalam	5576	-.17	.98
	Indonesia	13439	-.09	.76
	Malaysia	7069	-.15	.82

The UNIANOVA result (see Table 9) shows that bullying ($F_{2, 4084284}$ = 585.85, p < .001), feeling unsafe ($F_{2, 4088651}$ = 8.17, p < .001) and school safety risks ($F_{2, 4055739}$ = 940.76, p < .001) were statistically significantly different among countries. The effect sizes were very small (less than .001), suggesting that the variance in bullying, feeling unsafe and school safety risks that can be explained by country were very small. Results from the Welch ANOVA were conducted and found that the mean scores for bullying ($F_{2, 15553.83}$ = 591.31, p < .001), feeling unsafe ($F_{2, 15607.88}$ = 8.00, p < .001) and school safety risks ($F_{2, 15480.21}$ = 838.36, p < .001) were significantly different among the three countries. Subsequently, a post hoc Games-Howell test was conducted to identify variations among the countries.

Table 9. *Analysis of Variance of Safe Learning Environment by Country*

Variable	*Welch test*		*UNIANOVA*		*Partial* η^2
	F	*p*	*F*	*p*	
Bullying	591.31	< .001	585.85	< .001	.000
Feeling unsafe	8.00	< .001	8.17	< .001	.000
School safety risks	838.36	< .001	940.76	< .001	.000

The *t*-test for contrast 1 is significant. Thus, there is a significant difference between bullying ($t_{5940.07}$ = -2.20, p = .028) and school safety risks ($t_{5903.87}$ = -3.55, p = < .001) in Indonesia and Malaysia with Brunei Darussalam. On the other hand, there is NOT a significant difference in feeling unsafe ($t_{5961.21}$ = 1.12, p = .262) in Indonesia and Malaysia with Brunei Darussalam. Further, the *t*-test for contrast 2 is also significant for bullying ($t_{466136.61}$ = .06, p < .001), feeling unsafe ($t_{463973.61}$ = -3.78, p < .001) and school safety risks ($t_{454577.40}$ = 40.59, p < .001) between Indonesia and Malaysia. Therefore, there is a significant difference between the average for bullying, feeling unsafe and school safety risks between Indonesia and Malaysia. Alpha levels of .05 are employed for each test, as the contrast questions exhibit orthogonality to one another.

Table 10. *Contrast Test of Safe Learning Environment*

Variable	Contrast	Value of Contrast	*SE*	*t*	*df*	*p*
Bullying	1	-.03	.014	-2.20	5940.07	.028*
	2	.06	.001	34.16	466136.61	< .001*
Feeling unsafe	1	.01	.011	1.12	5961.21	.262
	2	-.01	.001	-3.76	5961.21	< .001*
School safety risks	1	-.05	.012	-3.55	5903.87	< .001*
	2	.06	.001	40.59	454577.40	< .001*

Post hoc comparisons using the Games-Howell test indicated that bullying and school safety risks in Brunei Darussalam were significantly different than in Indonesia but NOT statistically different than in Malaysia. Feeling unsafe in Brunei Darussalam was NOT significantly different than in Indonesia and Malaysia. While bullying, feeling unsafe and school safety risks between Indonesia and Malaysia differed significantly. More details are provided in Table 11.

Table 11. *Multiple Comparisons of Safe Learning Environment in Brunei Darussalam, Indonesia and Malaysia*

Variable	Country		*Mean Difference*	*SE*	*p*
Bullying	Brunei Darussalam	Indonesia	-.062	.014	< .001*
		Malaysia	.001	.014	.999
	Malaysia	Indonesia	-.062	.002	< .001*
Feeling unsafe	Brunei Darussalam	Indonesia	.016	.012	.358
		Malaysia	.010	.012	.658
	Malaysia	Indonesia	.006	.002	< .001*
School safety risks	Brunei Darussalam	Indonesia	-.074	.013	< .001*
		Malaysia	-.018	.013	361
	Malaysia	Indonesia	-.056	.001	< .001*

Research Question 3

A multiple regression analysis was conducted to predict students' science, reading and mathematics literacy performances. There is a statistically significant correlation between each predictor (bullying, feeling unsafe and school safety risks) with science, reading and mathematics literacy scores as the dependent variables. Further, there is a statistically significant correlation among bullying, feeling unsafe, school safety risks, language spoken at home and parents' education as predictors, except for the correlation between feeling unsafe and language spoken at home. Bullying has a very small, negative and significant correlation with science, reading and mathematics literacy scores ($r_{science}$ = -.08, p < .001, $r_{reading}$ = -.09, p < .001, r_{math} = -.07, p < .001). Feeling unsafe has a very small, positive and significant correlation with science, but it has a negative correlation with reading and mathematics literacy scores ($r_{science}$ = .01, p < .001, $r_{reading}$ = -.03, p < .001, r_{math} = -.01, p < .001). School safety risks have a small, negative and significant correlation with science, reading and mathematics literacy scores ($r_{science}$ = -.19, p < .001, $r_{reading}$ = -.21, p < .001, r_{math} = -.18, p < .001). Multicollinearity is not a problem for these data because the tolerance for each predictor variable is more than .25. Further, the results of collinearity statistics Variance Inflation Factor (VIF) are less than 4.00.

Table 12. *Correlation for Science, Reading and Mathematics Tests with Safe Learning Environment*

		1	2	3	4	5	6
1.	Science	-					
2.	Reading	.794**	-				
3.	Mathematics	.837**	.823**	-			
4.	Bullying	-.079**	-.094**	-.071**	-		
5.	Feeling unsafe	.013**	-.027**	-.010**	-.061**	-	
6.	School safety risks	-.186**	-.212**	-.183**	.359**	-.023**	-

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

The multiple regression analysis shows that the regression model is statistically significant for science ($F_{5,4019253}$ = 40143.29, p < .001), reading ($F_{5,4019253}$ = 58353.62, p < .001) and mathematics ($F_{5,4019253}$ = 47451.56, p < .001) literacy scores. This means the model provides a better fit than the null or normal model. Students' science, reading and mathematics scores can be computed based on factors such as bullying, feeling unsafe, school safety risks, the language spoken at home and parents' education. The proportion of variance in students' science, reading and mathematics literacy scores that can be explained by bullying, feeling unsafe, school safety risks, language spoken at home and parents' education is 4.8% for science, 6.8% for reading and 5.6% for mathematics. All five predictor variables (bullying, feeling unsafe, school safety risks, language spoken at home and parents' education) are statistically significant.

As for a one-unit increase in group-mean centered bullying, the science literacy score is expected to decrease by 1.07 points ($F_{5,4019253}$ = 1126.61, p < .001), the reading literacy score is expected to decrease by 1.91 ($F_{5,4019253}$ = 3055.77, p < .001), and the mathematics literacy score is expected to decrease by .68 ($F_{5,4019253}$ = 540.75, p < .001), holding other predictors constant. As one-unit increase in group-mean centered students feeling unsafe increases, the science literacy score is expected to decrease by 0.14 points ($F_{5,4019253}$ = 15.13, p < .001), the reading literacy score is expected to decrease by 3.50 points ($F_{5,4019253}$ = 7635.26, p < .001), and the mathematics literacy score is expected to decrease by 1.57 points ($F_{5,4019253}$ = 2163.18, p < .001 points, holding other predictors constant. As one-unit increase in group-mean centered school safety risks increases, the science literacy score is expected to decrease by 16.31 points ($F_{5,4019253}$ = 130689.48, p < .001), the reading literacy score is expected to decrease by 20.26 ($F_{5,4019253}$ = 172341.22, p < .001), and the mathematics literacy score is expected to decrease by 15.19 ($F_{5,4019253}$ = 137099.87, p < .001), holding other predictors constant.

Table 13. *Analysis of Regression Science, Reading and Mathematics Literacy Scores*

Literacy scores	Variables	Unstandardized Coefficients		*t*	*p*	Correlations		Toler-ance
		B	*SE*			Partial	Part	
Science	(Constant)	373.36	.07	594.59	<.001			
	Bullying	-1.07	.03	-33.57	<.001	-.017	-.016	.87
	Feeling unsafe	-.14	.03	-3.89	<.001	-.002	-.002	.99
	School safety risks	-16.31	.05	-361.51	<.001	-.177	-.176	.87
	Language at home	-.03	.00	-41.10	<.001	-.020	-.020	.99
	Parents' education	3.20	.01	239.08	<.001	.118	.116	.98
Reading	(Constant)	342.21	.07	4739.20	<.001			
	Bullying	-1.91	.04	-55.28	<.001	-.028	-.027	.87
	Feeling unsafe	-3.50	.04	-87.38	<.001	-.044	-.042	.99
	School safety risks	-20.26	.05	-415.14	<.001	-.203	-.200	.87
	Language at home	-.05	.00	-64.90	<.001	-.032	-.031	.99
	Parents' education	4.44	.01	306.78	<.001	.151	.148	.98
Mathematics	(Constant)	354.16	.06	5836.85	<.001			
	Bullying	-.68	.03	-23.25	<.001	-.012	-.011	.87
	Feeling unsafe	-1.57	.03	-.46.51	<.001	-.023	-.023	.99
	School safety risks	-15.19	.04	-370.27	<.001	-.182	-.179	.87
	Language at home	-.05	.00	-68.62	<.001	-.034	-.033	.99
	Parents' education	3.69	.01	303.12	<.001	.149	.147	.98

a. $R_{science}$ Squared = .048 (Adjusted R Squared = .048)

b. $R_{reading}$ Squared = .068 (Adjusted R Squared = .068)

c. R_{math} Squared = .056 (Adjusted R Squared = .056)

In addition, 0.02% of the total variance in science literacy scores is uniquely explained by bullying after controlling for other predictors; 0.00% of the total variance in science literacy scores is uniquely explained by feeling unsafe after controlling for other predictors; and 3.1% of the total variance in science literacy scores is uniquely explained by school safety risks, after controlling for other predictors. Thus, school safety risks contribute the largest proportion of unique explained variance in science literacy scores. On the other hand, 0.03% of the remaining variance in science literacy scores, after controlling for other predictors, is explained by bullying; 0.00% of the remaining variance in science literacy scores, after controlling for other predictors, is explained by feeling unsafe; and 3.1% of the remaining variance in science literacy scores, after controlling for other predictors is explained by school safety risks. Thus, school safety risks contribute the largest proportion of the remaining variance in science literacy scores after controlling other predictors.

Further, 0.07% of the total variance in reading literacy scores is uniquely explained by bullying after controlling for other predictors; 0.2% of the total variance in reading literacy scores is uniquely explained by feeling unsafe after controlling for other predictors; and 4% of the total variance in reading literacy scores is uniquely explained by school safety risks, after controlling for other predictors. Thus, school safety risks contribute the largest proportion of unique explained variance in reading literacy scores. On the other hand, 0.08% of the remaining variance in reading literacy scores, after controlling for other predictors, is explained by bullying; 0.2% of the remaining variance in reading literacy scores, after controlling for other predictors, is explained by feeling unsafe; and 4.1% of the remaining variance in reading literacy scores, after controlling for other predictors is explained by school safety risks. Thus, school safety risks contribute the largest proportion of the remaining variance in reading literacy scores after controlling other predictors.

In addition, 0.01% of the total variance in mathematics literacy scores is uniquely explained by bullying after controlling for other predictors; 0.05% of the total variance in mathematics literacy scores is

uniquely explained by feeling unsafe after controlling for other predictors; and 3.2% of the total variance in mathematics literacy scores is uniquely explained by school safety risks, after controlling for other predictors. Thus, school safety risks contribute the largest proportion of unique explained variance in mathematics literacy scores. On the other hand, 0.01% of the remaining variance in mathematics literacy scores, after controlling for other predictors, is explained by bullying; 0.05% of the remaining variance in mathematics literacy scores, after controlling for other predictors, is explained by feeling unsafe; and 3.3% of the remaining variance in mathematics literacy scores, after controlling for other predictors is explained by school safety risks. Thus, school safety risks contribute the largest proportion of the remaining variance in mathematics literacy scores after controlling other predictors.

Control Variables

The study examined the factors affecting students' performance in science, reading and mathematics literacy tests on the PISA 2022. The results highlighted the significant impact of the language spoken at home and parents' education levels on students' literacy scores. Students who spoke Indonesian in Indonesia and Malay in Malaysia and Brunei Darussalam scored higher on the tests compared to their peers who spoke other languages at home. The test results revealed that students in Indonesia and Malaysia with different home languages experienced decreased scores in science, reading and mathematics literacy tests. Furthermore, there was a strong correlation between parents' education and students' literacy test scores, indicating that higher parental education positively influenced students' performance. The study also showed that the language spoken at home and the level of parents' education accounted for a certain percentage of the variance in science, reading and mathematics literacy scores. Specifically, the language spoken at home accounted for 0.04% to 0.1% of the total variance, while parents' education explained 1.3% to 2.3% of the variance in literacy scores.

Discussion

This research, guided by theoretical frameworks such as Social Cognitive Theory (Bandura, 1986), Ecological Systems Theory (Bronfenbrenner, 1979) and Cultural-Historical Activity Theory (Vygotsky, 1978), investigated factors associated with creating safe learning environments and promoting literacy skills, aiming to offer insights applicable to Muslim-majority countries. The results confirmed the hypotheses regarding literacy skills and perceptions of safety in Brunei Darussalam, Indonesia and Malaysia, indicating a complex connection between educational settings and student well-being. Nonetheless, it's important to interpret these findings cautiously as they are specific to the cultural and educational contexts of the three countries under study. Therefore, while the results enhance our comprehension of the situation, broader generalizations to other regions may not be warranted.

The first and second hypotheses investigated variations in literacy skills and safe learning environments in Brunei Darussalam, Indonesia and Malaysia. The findings supported these hypotheses, demonstrating the complex association between educational environments, cultural contexts, and student well-being in Brunei Darussalam, Indonesia and Malaysia. The educational systems in three Muslim-majority countries in Southeast Asia—Brunei Darussalam, Indonesia and Malaysia—have similarities and differences. While all three prioritize Islamic education and share cultural ties, they have unique systems, cultural practices and economic conditions. Brunei Darussalam has a robust education system with a British-based curriculum and a strong emphasis on Islamic education (Gardiner & Deterding, 2019; Muhammad & Petra, 2021). On the other hand, Indonesia faces challenges in its education system due to its vast geographic area and cultural diversity (Azzizah, 2015; Esti et al., 2023). Malaysia's centralized education system blends Islamic teachings with secular subjects, reflecting its diverse culture (Lee et al., 2017). While Brunei Darussalam's wealth comes from oil and gas reserves, Indonesia and Malaysia struggle with income inequality and infrastructure development (Hill, 2002; Roslan, 2001; Handayani et al., 2022).

The varied educational systems in the Asia-Pacific region play a significant role in shaping students' reading literacy performance in PISA (Sandoval-Hernandez et al., 2022). Further, students' academic performance in Brunei Darussalam, Indonesia and Malaysia reflects common challenges influenced by cultural and socio-economic factors. While Islamic heritage and cultural ties are shared, educational systems face complexities in mathematics, reading and science achievement, often balancing religious teachings and secular subjects (Lee et al., 2017). Socio-economic disparities, access to resources, and gender further impact educational outcomes (Strand, 2014). Comprehensive approaches considering cultural sensitivities and systemic barriers are necessary. Collaborative efforts are crucial to promote inclusive and equitable education systems, fostering academic excellence and socio-economic development within Muslim-majority societies in Southeast Asia (Cerna et al., 2021).

Notable patterns emerge across the three countries regarding student safety and bullying. A considerable percentage of students in Brunei Darussalam, Indonesia and Malaysia report feelings of unsafety while commuting to school, in classrooms, and in other school areas, with rates often surpassing OECD averages (OECD, 2023). Additionally, bullying remains a prevalent issue, with a significant proportion of students reporting being victims of bullying acts, exceeding OECD averages across genders (OECD, 2023). However, there has been a decline in bullying incidents compared to previous years, suggesting some progress in addressing this concern. While efforts to create safe learning environments and combat bullying are evident, challenges persist, requiring ongoing attention and interventions tailored to the unique needs of each country. Understanding these situations is crucial for fostering inclusive educational settings that promote student well-being and academic success across the region.

The third hypothesis posits that students' PISA science, reading and mathematics literacy scores are inversely associated with bullying, feelings of unsafety and school safety risks in Brunei Darussalam, Indonesia and Malaysia. Our findings support this hypothesis. Comparing

our results with existing literature provided valuable insight and validation, particularly within the Muslim-majority countries' unique cultural and religious contexts. The observed negative correlation between bullying and literacy echoes prior studies indicating the detrimental effects of bullying on academic performance (Espelage & Swearer, 2003). Similarly, examining feelings of unsafety yielded comparable outcomes to previous research, underscoring the significance of cultural and contextual factors in shaping students' perceptions of safety, especially within Muslim-majority societies (Marchant et al., 2001).

Creating a safe learning environment is pivotal for improving science, reading and mathematics literacy, contributing to students' overall academic success. Fostering positive teacher-student relationships is fundamental, involving genuine connections and personalized support to enhance students' emotional and academic well-being (Rimm-Kaufman & Sandilos, 2011; Wang et al., 2021). This positive classroom culture also requires clear expectations and consistent rules enforcement (Marzano et al., 2003). However, promoting a safe learning environment is not without its challenges.

One significant challenge is addressing the emotional and mental well-being of students, particularly in the face of increasing stress and anxiety. Gore (2000) emphasizes promoting emotional intelligence and creating a supportive environment where students feel comfortable discussing their feelings and challenges. Moreover, the prevalence of bullying poses a threat to a safe learning space. Anti-bullying programs require proactive measures to prevent harassment and promote conflict resolution skills (Hui et al., 2011). Another challenge involves creating an inclusive learning space. Research by Gibson (2005) highlights the need for differentiated instruction and a diverse curriculum representing various cultures and backgrounds. Addressing disparities in access to resources and educational opportunities is crucial for promoting equity within the learning environment (Ainscow, 2020).

Despite these challenges, ongoing professional development for educators plays a vital role in overcoming obstacles and enhancing classroom practices. Gill and Berezina (2021) proposed that empowering Indonesian and Malaysian teachers to take charge of their own training could lead to a widespread enhancement in pedagogical practices. Continuous training ensures that teachers remain updated on the latest research and best practices, allowing them to adapt to the evolving needs of their students (Darling-Hammond, 2017). Community involvement and engagement of parents further contribute to a holistic approach, creating a collaborative network that supports the goals of a safe and enriching learning environment (Epstein et al., 2018).

Although the implementation of the intervention was comprehensive, it may face barriers rooted in cultural variations, requiring tailored approaches for effective application within the specific context of Muslim-majority societies. Acknowledging the limitations of this research is necessary, especially in the context of Muslim-majority nations. The reliance on PISA data constrains the exploration of certain variables, and the study's cross-sectional nature limits causal inferences within the unique cultural and religious context.

As suggested by Hanushek and Woessmann (2023), cultural differences influencing safety perceptions in Muslim-majority countries require further investigation. Caution is urged in generalizing findings due to divergence between the target population and accessed sample, emphasizing the need for broader representation in future studies within Muslim-majority nations. The study, focusing on three countries, introduces variability and underscores the importance of careful interpretation in the diverse contexts of these nations. The intervention embedded in the broader cultural and social context revealed significant predictors, highlighting the need for a detailed understanding of causal pathways in culturally diverse settings.

In addressing potential sources of bias and threats to internal validity, this study rigorously examined assumptions, ensuring the reliability of the regression model (Field, 2013). However, the imprecision

of measures, particularly in assessing subjective experiences like feeling unsafe within the cultural context of Muslim-majority nations, presents a unique challenge. The effect sizes, though modest, substantiated the practical significance of the results within the specific cultural and religious context.

The analysis uncovers a modest positive correlation of about 0.1 between feeling unsafe and science literacy, indicating a weak relationship. The presence of a negative regression intercept adds complexity to the findings, suggesting a precise association between the variables. The negative intercept implies that, on average, when feeling unsafe is zero, science literacy tends to be positive. Careful interpretation of both the correlation and regression results is crucial. The modest positive correlation challenges a straightforward linear association, while the negative intercept prompts further exploration into potential confounding or moderating factors influencing the observed patterns. Future research could explore additional trajectories to enhance our understanding of the association between these variables.

In conclusion, these findings contribute substantively to understanding safe learning environments and their association with literacy scores based on PISA 2022, particularly in the distinctive context of Muslim-majority countries. Beyond the specifics of the subfield, the implications extend to larger issues of educational equity and cultural sensitivity within Muslim-majority societies. By extrapolating these findings, this study affirms the centrality of creating inclusive and secure learning environments for improved academic outcomes, emphasizing the need for globally applicable interventions rooted in understanding cultural diversity, particularly within Muslim-majority nations.

Conclusion

This study provides significant insights into the factors related to the well-being of students in Muslim-majority countries. The primary hypothesis was that the differences in safe learning environments among

Brunei Darussalam, Indonesia and Malaysia would affect literacy scores. The findings support this hypothesis and reveal a negative correlation between bullying, feeling unsafe and school safety risks with literacy scores. This study provides a detailed exploration of safe learning environments consistent with previous research. This highlights the need for further investigation into cultural and contextual factors that shape students' perceptions of safety in Muslim-majority societies. This work lays a robust foundation for future research and interventions, emphasizing the importance of tailored approaches in diverse educational settings.

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