The Influence of the Learning Environment on Students' Motivation to Learn Mathematics

Robert Harianja[1*], Taruly Tampubolon[2]

[1] Universitas Sisingamangaraja XII Tapanuli, Indonesia

Abstract: The learning environment plays a crucial role in shaping students' motivation, especially in mathematics, a subject that often triggers anxiety and demands high reasoning skills. This study aims to analyze the influence of the learning environment's physical, social, and emotional dimensions on students' motivation to learn mathematics at SMPN 4 Siborongborong, a rural school with unique challenges. Using a quantitative explanatory approach with a cross-sectional design, data were collected from 30 eighth-grade students through adapted and validated instruments: the What Is Happening In this Class? (WIHIC) questionnaire for learning environment and the Academic Motivation Scale (AMS) for learning motivation. Data were analyzed using multiple linear regression with SPSS version 25. The findings reveal that the emotional dimension of the learning environment significantly affects students' motivation ($\beta = 0.347$; $p < 0.05$), while the physical and social dimensions do not show statistically significant effects. The model explains 53.2% of the variation in learning motivation, indicating a strong relationship between the learning environment and student motivation. The results underscore the importance of fostering a favourable emotional climate in the classroom to enhance engagement and reduce math-related anxiety. These findings contribute to developing evidence-based strategies to improve mathematics learning outcomes in rural educational settings.

Keywords: Learning environment; Motivation to learn mathematics; Students

Introduction

The learning environment is a critical determinant in shaping student motivation, especially in mathematics subjects requiring high reasoning and often triggering anxiety (Trigueros et al., 2020; Zebua et al., 2022). Empirical studies show that learning motivation contributes significantly to mathematical problem-solving ability, from 12.8% to 23.2% (Zebua et al., 2022). These findings underscore that a supportive learning environment increases motivation and serves as a foundation for students' academic achievement in a complex field such as mathematics.

However, psychological challenges such as math anxiety are often the main obstacles. This anxiety reduces motivation and hinders the development of metacognitive strategies and academic performance

(Trigueros et al., 2020). Learning environments need to be designed to minimize emotional distress through active learning methods, constructive feedback, and recognition of students' efforts (Arthur et al., 2022; Doño & Mangila, 2021). Positive learning experiences, as shown by Oyedeji (2017), have proven to increase students' interest and reduce resistance to math.

On the other hand, the social environment and emotional support of educators also play a central role. Research by Mata et al. reveals that granting autonomy and recognition of students' progress significantly increases their intrinsic motivation. This is in line with the findings of Oyedeji (2017), which states that variations in motivation—such as intrinsic and extrinsic motivation—impact students' attitudes toward mathematics. Thus, a collaborative and responsive social environment is key to building student engagement.

The local context of SMPN 4 Siborongborong emphasizes the complexity of these challenges. The school faces a heterogeneity of students' abilities and limited physical facilities despite adopting innovative strategies such as the Team Games Tournament (TGT) method, which increases math scores from 66.67% to 91.67% (Hutagalung, 2020). Similar efforts through audiovisual media have also been proven to increase student participation (Harahap et al., 2024). However, disparities in socioeconomic backgrounds—such as parents' education levels and family income—remain a holding factor (Sirwanti et al., 2019).

The challenges are even more complex in the wake of the COVID-19 pandemic, where the transition to online learning has led to technical issues, a lack of resources, and an unsupportive home environment (Fauzy & Nurfauziah, 2021; Nur, 2021). This condition exacerbates math anxiety and reduces student engagement, underscoring the urgency of adapting the physical and digital learning environment to maintain student motivation in crises.

Furthermore, the linkage between physical, social, and emotional environments in shaping student engagement cannot be ignored. Adequate facilities (Ernawati et al., 2022) and outdoor learning (Khoiri et al., 2024) Increase student focus, while parental and teacher support strengthens motivation (Galugu & Amriani, 2019; Gani & Suriyawati, 2019). However, an unsafe emotional environment due to bullying practices can undermine student engagement (Tari et al., 2024). Therefore, a holistic learning environment that combines these three aspects is urgently needed.

This study aims to analyze the influence of the learning environment on the motivation to learn mathematics at SMPN 4 Siborongborong—a rural school with unique characteristics that have not been widely explored in the literature. This study fills the research gap in the Indonesian context by examining the physical, social, and emotional dimensions. It provides evidence-based recommendations to optimize the learning environment in schools with similar challenges.

Method

This study uses an explanatory quantitative approach with a cross-sectional design to analyze the influence of the learning environment (physical, social, emotional) on students' motivation to learn mathematics. Independent variables are measured through three dimensions of the learning environment, while dependent variables are in the form of the level of motivation to learn mathematics. The research instrument was adapted from a standardized questionnaire: What Is Happening In this Class? (WIHIC) for the learning environment and the Academic Motivation Scale (AMS) for motivation, which is modified according to the context of SMPN 4 Siborongborong. The instrument was validated through validity and reliability tests with Cronbach's Alpha coefficient ($\alpha > 0.7$). Before the main data collection, instrument trials were carried out on 30 students outside the sample to ensure clarity and consistency of the questions.

The research population included all grade VIII students of SMPN 4 Siborongborong, which amounted to 30 students. Data was collected through a closed questionnaire distributed directly in the school environment, with technical guidance to minimize filling bias. Data analysis was carried out in two stages: (1) descriptive statistics (mean, standard deviation) to describe the profile of the learning environment and student motivation, and (2) multiple linear regression analysis using SPSS software version 25 to test the influence of each dimension of the learning environment. Classical assumption tests include normality (Kolmogorov-Smirnov), linearity (scatterplot), and multicollinearity (VIF < 10). The ethical aspects of the research are maintained through written consent from the principal, parents, and students, as well as the anonymity of the respondents' identities.
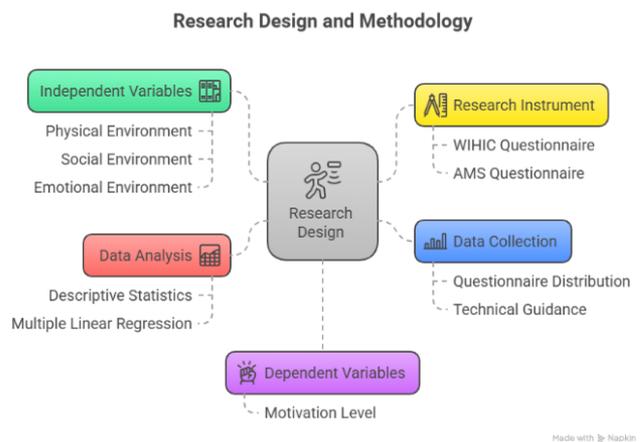

Figure 1. Research Design and Methodology

Result and Discussion

Result
Respondent Characteristics

Table 1. Gender Distribution

Valid	Frequency	Percentage (%)	Valid Percenttage (%)	Cumulative Percentage (%)
Man	14	46.7	46.7	46.7
Woman	16	53.3	53.3	100.0
Total	30	100.0	100.0	

Table 2. Distribution of Parental Education

Valid	Frequency	Percentage (%)	Valid Percenttage (%)	Cumulative Percentage (%)
PT	3	10.0	10.0	10.0
SD	7	23.3	23.3	33.3
SMA	8	26.7	26.7	60.0
SMP	12	40.0	40.0	100.0
Total	30	100.0	100.0	

Based on Tables 1 and 2, it is known that most of the respondents are women (53.3%), with the dominant parental education background in junior high school (40%) and high school (26.7%). The heterogeneity of parents' education levels indicates variations in students' socioeconomic status, potentially affecting access to learning resources outside of school.

Descriptive Statistics

Table 3. Statistics Descriptive

Variable	N	Min	Max	Mean	Std. Deviation	Variance	Skewness	Std. Error (Skewness)	Kurtosis
Physical Environment	30	2.00	5.00	3.7667	1.00630	1.013	-0.365	0.427	-0.858
Physical Environment	30	2.00	5.00	3.5000	0.97379	0.948	0.000	0.427	-0.890
Physical Environment	30	1.00	5.00	2.3333	1.15470	1.333	0.581	0.427	-0.580
Social Environment	30	2.00	5.00	4.2667	0.86834	0.754	-0.906	0.427	-0.802
Social Environment	30	2.00	5.00	3.8000	0.99655	0.993	-0.466	0.427	-0.711
Social Environment	30	2.00	5.00	4.1000	0.88474	0.783	-0.525	0.427	-0.736
Emotional Environment	30	1.00	5.00	2.3000	1.11880	1.252	0.620	0.427	-0.333
Emotional Environment	30	2.00	5.00	4.1000	1.06188	1.128	-0.952	0.427	-0.289
Emotional Environment	30	2.00	5.00	4.2667	0.86834	0.754	-0.906	0.427	-0.802
Motivation	30	2.00	5.00	4.0000	1.11417	1.241	-0.801	0.427	-0.695
Motivation	30	2.00	5.00	4.0667	0.94443	0.892	-0.403	0.427	-1.217
Motivation	30	2.00	5.00	4.1667	1.05318	1.109	-1.114	0.427	-0.079
Motivation	30	1.00	5.00	2.1000	1.21343	1.472	0.789	0.427	-0.492
Motivation	30	1.00	5.00	2.1667	1.20583	1.454	0.670	0.427	-0.633

Based on the results of a descriptive analysis of 30 respondents, it was found that the social and emotional environment received the highest average score (between 4.10 and 4.27), which indicates that respondents felt quite comfortable and positive about both aspects. The physical environment has a moderate average value (between 2.33 and 3.77), suggesting room for improvement in the existing facilities or physical conditions. Meanwhile, motivation showed considerable variation, with an average value between 2.17 and 4.50, indicating a significant difference in perception or motivation level between indicators. The data show a relatively normal distribution because the skewness and kurtosis values are within reasonable limits to be used for advanced analysis.

Based on Table 4, it is shown that the learning environment (physical, social, and emotional) together have a strong relationship with student motivation, demonstrated by the value of R = 0.729. These three environmental variables explain about 53.2% of motivational variations (R Square = 0.532). In comparison, the rest (46.8%) is influenced by factors other than the model, such as family support or personal learning style. After adjusting for the number of variables and sample size, the model remained able to explain 47.8% of motivational variations (Adjusted R Square = 0.478). The average prediction error of this model is relatively small (0.17), which indicates fairly good accuracy. However, additional variable exploration is still needed to improve the model's predictive power.

Linear Regression Test

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.729ᵃ	.532	.478	.17293

a. Predictors: (Constant), Emotional_Environment, Physical_Environment, Social_Environmen

b. Dependent Variable: Motivation

Table 5. ANOVA Test Results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	0.882	3	0.294	9.836	< 0.001ᵇ
Residual	0.778	26	0.030		
Total	1.660	29			

a. Dependent Variable: Motivation

b. Predictors: (Constant), Emotional_Environment, Physical_Environment, Social_Environment

Based on Table 5, it shows that a regression model consisting of physical, social, and emotional environments significantly predicts student motivation ($F_{(3,26)}$ = 9.836; *p* < 0.001). A Sig. value of 0.000 (less than 0.05) indicates that at least one learning environment variable significantly influences motivation. In other words, this model is statistically feasible because it can explain differences in student motivation better than models without independent variables.

Table 6. Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics
		B	Std. Error	Beta	t	Sig.	Tolerance
1	(Constant)	1.940	0.453		4.278	< .001	
	Physical_Environment	-0.090	0.130	-0.122	-0.691	0.495	
	Social_Environment	0.102	0.063	0.368	1.619	0.118	

a. Dependent Variable: Motivation

Based on the Coefficients table, only the emotional environment significantly affects student motivation (B = 0.347; Sig. = 0.034), where every 1-point increase in the emotional environment will increase motivation by 0.347 points. Meanwhile, the physical (B = -0.090; Sig. = 0.495) and social (B = 0.102; Sig. = 0.118) environments were not significant, although the social environment showed a positive influence. The VIF value of all variables was below 10 (1,718–2,867), indicating the absence of serious multicollinearity problems. Thus, the emotional environment is the dominant factor in predicting student motivation. In contrast, the physical and social environment must be explored further, considering additional variables or more specific contexts.

Reliability Test (Cronbach's Alpha)

Table 7. Reliability Statistics

Cronbach's Alpha	N of Items
0.764	4

Table 8. Item-Total Statistics

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Physical_Environment	10.9111	1.737	0.629	0.713
Social_Environment	10.0556	0.564	0.824	0.778
Emotional_Environment	10.5556	1.591	0.807	0.647
Motivation	10.8111	1.875	0.677	0.734

Based on the reliability test results, Cronbach's Alpha value of 0.764 indicates that the research instrument consisting of four items (Physical Environment, Social Environment, Emotional Environment, and Motivation) has good reliability. This value is above the threshold of 0.70, which is generally considered sufficient to demonstrate adequate internal consistency. The Item-Total Statistics results also show that all items have a Corrected Item-Total Correlation value above 0.60, meaning each item correlates well with the total scale and is worth defending. In addition, none of Cronbach's Alpha if Items Deleted value is higher than the total alpha (0.764), so no items need to be deleted. Thus, the four indicators can be used together as a single reliable scale to measure the constructs under study.

Discussion

The results of this study show that the learning environment, especially the emotional environment, significantly influences student learning motivation at SMPN 4 Siborongborong. This is evidenced by the regression analysis results, which showed that only the emotional environment variable significantly contributed to student motivation (B = 0.347; Sig. = 0.034). These findings reinforce the view that emotional factors such as comfort, security, and positive relationships with teachers and peers are vital in shaping students' enthusiasm for learning, especially in complex subjects like mathematics. This condition aligns with research by Trigueros et al. (2020), which states that mathematics anxiety can hinder academic motivation and performance. Hence, a conducive emotional environment becomes an urgent need.

In addition, the descriptive analysis also showed that the social and emotional environment obtained the highest average score (4.10–4.27) compared to the physical environment, which was at a moderate level (2.33–3.77). This suggests that although students feel quite socially and emotionally comfortable, there are deficiencies in physical aspects such as classroom facilities, lighting, or learning aids. This finding aligns

with the real conditions at SMPN 4 Siborongborong, where infrastructure limitations remain the main challenge in optimally supporting the learning process. Ketut et al. (2021) and Asiah & Dewi (2021) also emphasized that the quality of physical facilities and infrastructure is essential in building a learning environment that encourages student engagement and learning outcomes.

Interestingly, although the physical and social environment did not have a statistically significant effect in this study, the positive coefficient value in the social environment (B = 0.102; Sig. = 0.118) indicated its potential contribution to motivation if further developed. This is reinforced by Mata et al. (2012), who found that social support from teachers, such as granting autonomy and recognizing students' efforts, can increase motivation to learn. Therefore, the role of teachers as social facilitators who encourage collaboration and recognition in the learning process is vital, especially in mathematics, which requires intensive guidance and empathy for students' difficulties.

The heterogeneous educational background of parents—dominated by junior high school and high school graduates—is also an important variable that deserves attention. This variation reflects students' diverse socioeconomic status that affects access to learning resources outside of school. Research by Sirwanti et al. (2019) shows that parental background correlates with students' mathematics learning outcomes. In the context of SMPN 4 Siborongborong, this challenge became even more evident when the COVID-19 pandemic shifted the learning process to the online realm, which widened the gap in access to learning, especially for students from families with low education and economic levels.

Overall, this study confirms the importance of designing a learning environment that accommodates the physical aspect and provides strong social and emotional support. These findings support the recommendations of Fadda et al. (2022) and Qawaqneh et al. (2023) that learning strategies that encourage motivation, reduce anxiety, and provide positive feedback are crucial in improving student learning achievement, especially in mathematics subjects. Therefore, a holistic and sensitive educational approach to students' emotional needs should be a priority in developing learning policies and practices in schools.

Conclusion

Based on the research results, it can be concluded that the learning environment plays a vital role in shaping the motivation of students to learn mathematics at SMPN 4 Siborongborong. The findings show that all three dimensions of the learning environment—physical, social, and emotional—could explain 53.2% of the variation in learning motivation. Among the three, the emotional climate was the only dimension significantly affecting students' motivation. This shows that a sense of security, comfort, and freedom from psychological pressure in the learning process is the main factor that encourages students' engagement and enthusiasm for learning about mathematics, especially in the context of schools with limited resources and post-pandemic challenges.

Although the social and physical environment do not show a statistically significant influence, they can potentially create a conducive and enjoyable learning atmosphere. Therefore, educational interventions need to be focused on strengthening the emotional aspects of students in the classroom, such as building supportive teacher-student relationships, avoiding practices that create anxiety, and making learning spaces that value student participation and effort. These results provide important implications for developing school policies and learning strategies that holistically improve the learning environment, especially those oriented towards emotional support, which is key to improving student motivation and learning outcomes, especially in complex subjects such as mathematics.

Conflicts of Interest
The authors declare no conflict of interest.

References

Arthur, Y. D., Dogbe, C. S. K., & Asiedu-Addo, S. K. (2022). Enhancing Performance in Mathematics Through Motivation, Peer Assisted Learning, And Teaching Quality: The Mediating Role of Student Interest. *Eurasia Journal of Mathematics, Science and Technology Education*, *18*(2), em2072. https://doi.org/10.29333/EJMSTE/11509

Asiah, K., & Dewi, I. Y. M. (2021). Analisis Pengelolaan Pendidikan Berbasis Nilai Pesantren Melalui Program Wajib Belajar Diniyah Jenjang SMP Negeri di Kabupaten Sumenep. *Tarbiyatuna*, *14*(1), 20. https://doi.org/10.36835/tarbiyatuna.v14i1.741

Doño, M. J. A., & Mangila, B. B. (2021). Mathematics Teacher'S Engagement and Students' Motivation To Learn Mathematics. *Infinity Journal*, *10*(2), 285–300. https://doi.org/10.22460/infinity.v10i2.p285-300

Ernawati, L., Kurniasari, N. I., & Ayu Ningrum, D. S. (2022). Pengaruh School Wellbeing Terhadap Student Engagement. *QUANTA: Jurnal Kajian Bimbingan Dan Konseling Dalam Pendidikan*, *6*(1), 24–29. https://doi.org/10.22460/q.v6i1p8-16.2929

Fadda, D., Pellegrini, M., Vivanet, G., & Zandonella Callegher, C. (2022). Effects of digital games on student motivation in mathematics: A meta-analysis in K-12. *Journal of Computer Assisted Learning*, *38*(1), 304–325. https://doi.org/10.1111/jcal.12618

Fauzy, A., & Nurfauziah, P. (2021). Kesulitan Pembelajaran Daring Matematika Pada Masa Pandemi COVID-19 di SMP Muslimin Cililin. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *5*(1), 551–561. https://doi.org/10.31004/cendekia.v5i1.514

Galugu, N. S., & Amriani, A. (2019). Motivasi Berprestasi Sebagai Mediasi Pada Hubungan Antara Dukungan Sosial dan Keterlibatan Siswa di Sekolah. *JURKAM: Jurnal Konseling Andi Matappa*, *3*(2), 72. https://doi.org/10.31100/jurkam.v3i2.414

Gani, A. A., & Suriyawati, S. (2019). Pengaruh Partisipasi Orang Tua Siswa Terhadap Motivasi Anak Sekolah di Madrasah Aliyah Hidayatullah Mataram. *CIVICUS : Pendidikan-Penelitian-Pengabdian Pendidikan Pancasila Dan Kewarganegaraan*, 79. https://doi.org/10.31764/civicus.v0i0.850

Harahap, T. N., Napitupulu, T. M., Nainggolan, R. B., Naibaho, D., & Pardede, B. P. (2024). Pengaruh Penggunaan Media Audio Visual Oleh Guru Pendidikan Agama Kristen Dan Budi Pekerti Terhadap Keaktifan Belajar. *Sinar Kasih Jurnal Pendidikan Agama Dan Filsafat*, *2*(4), 12–24. https://doi.org/10.55606/sinarkasih.v2i4.402

Hutagalung, S. L. (2020). Peningkatan Prestasi Belajar Matematika dengan Menggunakan Metode Pembelajaran Kooperatif Tipe TGT (Team Games Tournament) Pada Siswa Kelas VII Negeri 4 Siborongborong. *Attractive : Innovative Education Journal*, *2*(2), 125. https://doi.org/10.51278/aj.v2i2.56

Khoiri, M., Kusyairi, K., & Hasan, S. (2024). Mengeksplorasi Pengaruh Lingkungan Belajar Luar Ruangan terhadap Keterlibatan Siswa dalam Penulisan Puisi: Studi Kasus di Lingkungan Pantai. *CENDEKIA : Jurnal Penelitian Dan Pengkajian Ilmiah*, *1*(5), 231–239. https://doi.org/10.62335/mmzt4k80

Mata, M. de L., Monteiro, V., & Peixoto, F. (2012). Attitudes towards Mathematics: Effects of Individual, Motivational, and Social Support Factors. *Child Development Research*, *2012*, 1–10. https://doi.org/10.1155/2012/876028

Ni Ketut, E., Purwati, N. K. R., Putri, N. W. S., & Wardika, I. W. G. (2021). Pelatihan GeoGebra Sebagai Media Pembelajaran Inovatif. *Puan Indonesia*, *2*(2), 164–174. https://doi.org/10.37296/jpi.v2i2.36

Nur, A. S. (2021). Potret Pembelajaran Matematika Pada Masa Pandemi. *Jurnal Pendidikan Matematika (Jupitek)*, *4*(1), 27–35. https://doi.org/10.30598/jupitekvol4iss1pp27-35

Oyedeji, S. O. (2017). The Effects of Students' Motivational Factors on their Attitudes toward Mathematics. *International Journal of Evaluation and Research in Education (IJERE)*, *6*(4), 277. https://doi.org/10.11591/ijere.v6i4.10770

Qawaqneh, H., Ahmad, F. B., & Alawamreh, A. R. (2023). The Impact of Artificial Intelligence-Based Virtual Laboratories on Developing Students' Motivation Towards Learning Mathematics. *International Journal of Emerging Technologies in Learning*, *18*(14), 105–121. https://doi.org/10.3991/ijet.v18i14.39873

Sirwanti, S., Nursyam, A., & Ningsi, E. (2019). Pengaruh Tingkat Pendidikan, Pekerjaan dan Pendapatan Orang Tua terhadap Prestasi Belajar Matematika Siswa. *Delta-Pi: Jurnal Matematika Dan Pendidikan Matematika*, *8*(2). https://doi.org/10.33387/dpi.v8i2.1370

Tari, I. D. A. E. P. D., Karpika, I. P., & Setiyani, R. Y. (2024). Dampak Praktik Perundungan terhadap Partisipasi dan Kesejahteraan Siswa: Kajian Holistik di Sekolah. *Buletin Edukasi Indonesia*, *3*(01), 38–45. https://doi.org/10.56741/bei.v3i01.496

Trigueros, R., Aguilar-Parra, J. M., Mercader, I., Fernández-Campoy, J. M., & Carrión, J. (2020). Set the controls for the heart of the maths. The protective factor of resilience in the face of mathematical anxiety. *Mathematics*, *8*(10), 1–11. https://doi.org/10.3390/math8101660

Zebua, A., Hendriana, H., Subandar, J., & Sugandi, A. I. (2022). the Relationship Between Learning Motivation With Mathematical Problem Solving Ability in Class Xi Students. *MaPan*, *10*(2), 312–322. https://doi.org/10.24252/mapan.2022v10n2a4