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The Relationship between Classroom Emotional Climate (CEC) and Biology Learning Outcomes in the Independent Curriculum at SMAN Kota Tangerang Selatan

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ABSTRACT

This research aims to analyze class emotional climate relationships and how it significantly contributes to affecting learning outcomes at SMAN Kota Tangerang Selatan. The method research used is through survey by leveraging correlational technique. In total, there are 93 students as sample from seven different schools that took probability sampling technique with the kind of cluster sampling. Data gathering on this research is taking questionnaire called Classroom Emotional Climate (CEC) and the biology learning study document called Final Exam as instrument. The research outcomes showed positive, significant, and intense relationship between classroom emotional climate and the biology learning outcomes. Classroom emotional climate influencing 35.28% towards biology learning outcomes and the rest were affected by others. Classroom emotional climate stage and biology learning outcomes are at the middle level with each are graded 73.57% and 71.49%

1. Introduction

The quality of education in Indonesia is still considered low compared to other countries worldwide. Based on the PISA (Programme for International Student Assessment) survey results from 2018 released in 2019, Indonesia ranks 74th out of 79 countries, placing it among the six lowest positions (Kurniawati, 2022). One aspect that significantly influences education is the teacher, who interacts directly with students as subjects and objects in the learning process (Suprihatiningrum, 2017). The teacher, as the main actor, should possess competencies, one of which is pedagogical competence. In pedagogical competence, for example, it includes the teacher's ability to understand the characteristics of students from various aspects such as social, moral, cultural, emotional, and intellectual (Arif, 2017).

Thus, the demand for teachers to understand these aspects will lead them to create interactions with their students.

The establishment of good interactions will create a harmonious relationship and an engaging learning environment. In other words, creating harmonious relationships among students, between students and teachers, and students' perceptions of their classroom is an integral part of the learning environment, which is vital for effective learning (Rahmawati et al., 2023). Learning environment is influenced by numerous factors, one of which is emotional aspect, as emotional climate is shaped by classroom interactions that can be positive, such as joy and humor, or negative, such as conflict (Gazelle, 2006). Effective learning experiences are generated when the learning environment possesses a good social and emotional climate (Aliyyah et al., 2022). Consequently, teachers must actively develop a supportive learning atmosphere, maximizing educational outcomes alongside engaging teaching methodologies.

Research on the learning environment began with Walberg and Anderson in 1968 and Moos and Trickett in 1974, and it has since been developed by (Fraser, 2013) and continues to this day. Several countries, including Canada, China, the United Kingdom, France, Germany, Israel, Singapore, and the United States, have underscored the significant role of the learning environment in enhancing school quality and promoting students' academic well-being (M.-T. Wang et al., 2020). One of the studies on the learning environment by (Reyes et al., 2012) states that the emotional climate of the classroom, or the social and emotional interactions involving students, peers, and teachers, has been shown to influence learning outcomes. Additionally, the emotional climate in the classroom also affects students' motivation to engage actively in the learning process (Urdan & Schoenfelder, 2006).

One study on the learning environment states that classroom emotional climate or social and emotional interactions involving students and their peers, as well as their teachers, can influence learning outcomes. Additionally, the emotional climate in the classroom also affects students' motivation to actively participate in the learning process. The teacher's ability to build good emotional interactions with students in the classroom can be measured using the Classroom Emotional Climate (CEC). The CEC instrument has been validated and used in various countries and educational levels, but it is still limited in certain fields of study. It is interesting to study the classroom emotional climate in the field of science education, particularly biology.

Biology is one of the science subjects where students are directed to develop their knowledge into skills for problem-solving through a scientific approach (Zulfiani et al., 2009). Through this process, students gain relevant direct experiences with their environment (Karimah et al., 2024). The success of implementing a scientific approach heavily depends on the teacher's role. One of the research projects by (Rahmawati & Fauziyah, 2019) states that one issue in biology education is the teacher-centered approach, which reduces social interaction and student activity in the classroom, leading to decreased learning outcomes. Based on the above description, research on the relationship between Classroom Emotional Climate

(CEC) and biology learning outcomes has not been widely reported. Therefore, it is necessary to conduct research to analyze the correlation between Classroom Emotional Climate (CEC) and students' learning outcomes to obtain objective data and add variability to the survey results in schools.

2. Methodology

A. Research Design

This research is quantitative study using a survey method with a correlational technique. The data used in the survey method is obtained from the use of questionnaires. Correlational research aims to determine a relationship between two or more variables. The correlation coefficient indicates the degree of relationship between the measured variables. This correlational study is capable of analyzing various variables that are considered to be related to one another (Darmadi, 2021). In this study, the correlation between two variables will be examined, namely the relationship between the emotional climate of the class and biology learning outcomes at SMAN Kota Tangerang Selatan.

B. Site and Participant

In this study, the research was conducted at SMAN Kota Tangerang Selatan during the odd semester from January to February of the 2024/2025 academic year. A probability sampling method, specifically cluster sampling, was employed (Gumanti et al., 2016). The first sampling stage involved selecting one school from each of the seven districts within the city. In the second stage, students from class XI who were enrolled in biology courses at the selected schools formed the sample population. Random sampling was then applied to choose participants from this group.

C. Data and Collection Technique

Data collection in this study was conducted using questionnaires and documentation. The questionnaire method was used to collect data on the classroom emotional climate to understand students' perceptions of the classroom emotional climate. The CEC questionnaire consists of a five-point Likert scale: never, rarely, sometimes, often, and always (Indrawan & Yaniawati, 2017). The questionnaire was distributed to students directly via Google Forms. The documentation method was used to obtain data on learning outcomes, specifically the students' final exam scores in biology.

D. Instrumentation

The instrumentation used in this study was a questionnaire of students' perceptions of the emotional climate of the classroom, namely the Classroom Emotional Climate (CEC) instrument, which was developed by (Fraser, 2013). This instrument consists of 50 items that have been transliterated and used in research conducted by

(Rahmawati et al., 2021). The validated instrument is 44 items and has a reliability value of 0.949 which is a very high reliability value (Ramadhani & Bina, 2021). The CEC instrument has 8 dimensions represented by 3-6 statements in each dimension. The dimensions include care, control, clarity, challenge, motivation, consolidation, collaboration, and attitude.

E. Data Analysis

Collected research data are presented through measures such as averages, scores, standard deviations, percentages, and score categorizations. Categorizing the data helps to highlight the highest and lowest scores, thereby providing clearer interpretive value (Saiffudin, 2020). Table 1 displays the categorization of scores obtained from the research questionnaire.

Table 1. Score Categorization of the Questionnaire

Formula	Score	Category
$X > M + 1,8SD$	$X > 191$	Very High
$M + 0,6SD < X \leq M + 1,8SD$	$172 < X \leq 191$	High
$M - 0,6SD < X \leq M + 0,6SD$	$152 < X \leq 172$	Medium
$M - 1,8SD \leq X \leq M - 0,6SD$	$132 \leq X \leq 152$	Low
$X < M - 1,8SD$	$X < 132$	Very Low

The Final Exam scores of the students were used to determine their knowledge level in biology. Using standard deviation to categorize students in the class, scores can be divided into three groups to determine students' standings (Arikunto, 2018). The following presents the position of students' Biology learning outcomes in table 2.

Table 2. Categorization of Biology Learning Outcomes

Formula	Score	Category
$X > M + 1SD$	$X > 90$	High
$M - 1SD \leq X \leq M + 1SD$	$53 \leq X \leq 90$	Medium
$X < M - 1SD$	$X < 53$	Low

Data analysis technique used in this study is correlation analysis. Correlation analysis plays a role in analyzing the strength of the relationship between independent and dependent variables based on the correlation coefficient ranging from -1 to +1. To test the research hypothesis regarding the influence of each variable, correlation analysis is conducted after ensuring that the obtained data meets the assumptions of normality and linearity. If the correlation coefficient obtained is -1, then the relationship between the variables is negative. If the correlation coefficient obtained is +1, then the relationship between the variables is positive. However, if the correlation coefficient is 0, it means there is no relationship between the variables. The interpretation of the correlation coefficient can be seen in table 3 below (Gunawan, 2015).

Table 3. Interpretation of Correlation Coefficient

Value Interval (+)	Category	Value Interval (-)
0,000 – 0,199	Very Low	(-0,800) – (-1,000)
0,200 – 0,399	Low	(-0,600) – (-0,799)
0,400 – 0,599	Medium	(-0,400) – (-0,599)
0,600 – 0,799	High	(-0,200) – (-0,399)
0,800 – 1,000	Very High	(-0,00) – (-0,199)

Normality tests are carried out to determine whether the data for each variable has a normal distribution. If the data are normally distributed, then parametric statistical techniques cannot be used to analyze the population (Firdausi, 2023). This research uses the Kolmogorov-Smirnov test with a significant level of 0.05. In addition, a linearity test is also used, which is one of the prerequisite tests used to conduct correlation analysis or linear regression. The linearity test is carried out to identify the existence of a linear relationship between two or more variables (Yuliardi & Nuraeni, 2017). This research was conducted using SPSS version 26

3. Result and Discussion

Data on students' perceptions of the classroom emotional climate were obtained through a questionnaire distributed to 93 students at SMAN Kota Tangerang Selatan. The CEC questionnaire consists of 44 items with 8 dimensions: Care, Control, Clarity, Challenge, Motivation, Consolidation, Collaboration, and Attitude. The results of the questionnaire on students' perceptions of the classroom emotional climate based on schools are shown in the following table 4.

Table 4. Results of the Classroom Emotional Climate Questionnaire at SMAN Kota Tangerang Selatan

Sample Research	Score	Average	Standard Deviation	Percentage (%)	Category
SMAN A	2.078	173,17	7,493	78,71%	High
SMAN B	1.805	138,85	7,140	63,11%	Low
SMAN C	1.450	161,11	13,697	73,23%	Medium
SMAN D	1.500	166,67	11,597	75,76%	Medium
SMAN E	2.112	162,46	9,519	73,85%	Medium
SMAN F	1.814	151,17	11,900	68,71%	Low
SMAN G	4.294	171,76	15,587	78,07%	Medium
Total	15.503	161,86	16,399	73,57%	Medium

Based on the table, the average score of students' perceptions of the classroom emotional climate at SMAN Kota Tangerang Selatan is 161.86 with a standard deviation of 16.399, resulting in an overall percentage of 73.57%. The questionnaire results for each school category vary. The highest questionnaire score is shown by SMAN A with a score of 173.17, while SMAN B has the lowest score of 138.85. Other senior high schools obtained scores in the medium category.

The description of perceptions about classroom emotional climate can also be seen based on the dimensions of the questionnaire shown in Figure 1 in the form of the following graph.

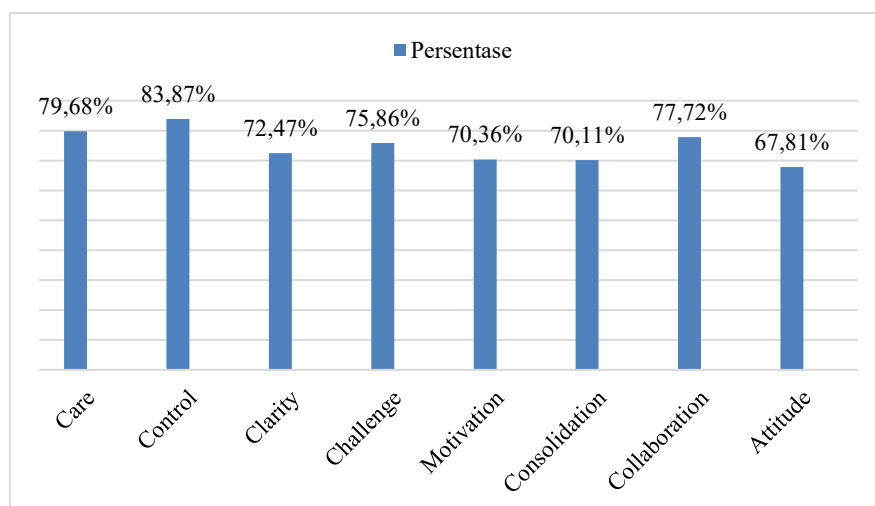


Figure 1. Results of the Dimension Classroom Emotional Climate Questionnaire at SMAN Kota Tangerang Selatan

Figure 1 shows the percentage results of each dimension of the emotional climate of the class. Based on the Figure, the highest percentage is shown by the “Control” indicator with a score of 83.87%. Meanwhile, the lowest percentage is shown by the “Attitude” indicator with a score of 67.81%. Descriptive analysis of the biology learning outcomes of students at SMAN Kota Tangerang Selatan shows the average score and standard deviation as seen in the following table 5.

Table 5. Biology Learning Outcomes of Students at SMAN Kota Tangerang Selatan

Sample Research	Score	Average	Standard Deviation	Category
SMAN A	1.053	87,75	4,003	Medium
SMAN B	605	46,54	15,846	Low
SMAN C	707,5	78,61	9,024	Medium
SMAN D	662	73,56	10,126	Medium
SMAN E	695	53,46	16,058	Medium
SMAN F	755	62,92	5,724	Medium
SMAN G	2.171	86,84	2,656	Medium
Total	6648,5	71,49	18,369	Medium

Based on the table 5, the biology learning outcomes at SMAN Kota Tangerang Selatan have an average of 71.49 with a standard deviation of 18.369. The highest biology learning outcome is shown by SMAN A with a score of 87.75, while SMAN B has the lowest score of 46.54. Other senior high schools obtained scores in the medium category.

The following table 6 presents the results of the Kolmogorov-Smirnov test for the variables used in this study.

Table 6. Results of the Kolmogorov-Smirnov Test

Tests of Normality	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Classroom Emotional Climate	.067	93	.200*	.983	93	.287
Biology Learning Outcome	.184	93	.000	.887	93	.000

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Based on the statistical test results using the Kolmogorov-Smirnov and Shapiro-Wilk tests, it is found that one variable has a significance value of less than 0.05, indicating that the data for both variables are not normally distributed. Therefore, the correlation analysis used is the Spearman Rank correlation test because the research data from the two variables are not the same, are ordinal, and are not normally distributed. Table 7 presents the results of the linearity test, which aims to determine whether a linear relationship exists between two or more variables in this study.

Table 7. Results of the Linearity Test

ANOVA Table							
			Sum of Squares	df	Mean Square	F	Sig.
Biology Learning Outcome * Classroom Emotional Climate	Between Groups	(Combined)	19779.343	52	380.372	1.351	.163
		Linearity	10363.113	1	10363.113	36.799	.000
		Deviation from Linearity	9416.230	51	184.632	.656	.923
	Within Groups		11264.646	40	281.616		
	Total		31043.989	92			

Based on the results of the linearity test, the calculated F value is $0.656 < \text{the table F value of } 4.30$. This indicates that the classroom emotional climate variable and biology learning outcomes have a linear relationship. Additionally, the obtained probability value of $0.923 > 0.05$ at a 5% significance level indicates that both variables have a linear relationship. Hypothesis testing is conducted to test the existence of a relationship between independent and dependent variables using statistical techniques. The results of the regression analysis can be seen in the following table 8.

Table 8. Results of Simple Linear Regression Test

Model	Unstandardized coefficients B
(Constant)	-33.266
Classroom Emotional Climate	0.647

Based on the output, the derived regression equation is $Y = (-33.266) + 0.647X$. The constant value of -33.266 suggests that in the absence of a classroom emotional climate ($X=0$), the predicted biology learning outcome would be -33.266, although this value is not practically meaningful and primarily serves a mathematical baseline. The regression coefficient of 0.647 indicates that for every 1% increase in the classroom emotional climate, students' biology learning outcomes are predicted to increase by 0.647 units. This positive coefficient reflects a direct and positive influence of classroom emotional climate on biology learning outcomes.

For the next analysis, Spearman Rank correlation test will be conducted to see the relationship outcome between the variables. The results of the correlation test between the classroom emotional climate and the biology learning outcomes of students can be seen in the following table 9.

Table 9. Results of the Spearman Rank Correlation Test

No.	Variable	r calculated	r table (5%)	Sig. (2- tailed)	Description
1.	Classroom Emotional Climate and Biology Learning Outcome	0.594*	0.2039	0.000	Positive Correlation

Based on the correlation test results, the calculated r value is 0.594. This indicates that the correlation coefficient shows a relationship between the classroom emotional climate and biology learning outcomes of 0.594. This indicates a sufficient relationship between variable X and variable Y , as it falls within the range of 0.400 - 0.599. Additionally, the significance level obtained from this calculation shows that between the classroom emotional climate (X) and biology learning outcomes (Y), the significance value is $0.000 < 0.05$, indicating a significant relationship between the two variables.

In table 9 asterisk (*) indicates that there is a significant correlation between the classroom emotional climate (X) and biology learning outcomes (Y). To determine the extent of the influence of the classroom emotional climate (X) on biology learning outcomes (Y) in percentage terms, the coefficient of determination (KD) is calculated as $0.594^2 \times 100\% = 35.28\%$. This indicates that the classroom emotional climate influences 35.28% of the biology learning outcomes of students.

Analysis of the significance of the correlation between classroom emotional climate (X) and biology learning outcomes (Y) was further examined using a t -test. This hypothesis test serves to compare the calculated t value with the critical t value from the distribution table. Based on the output results, the calculated t value is was found to be 6.753.

Table 10. Result of t_{table}

No.	Variable	$t_{calculated}$	$t_{table}(5\%)$
1.	Classroom Emotional Climate and Biology Learning Outcome	6.753	1.985

Based on table 10, the result shows that t calculated $>$ t table or $6.753 > 1.985$. This calculation indicates a significant relationship between the classroom emotional climate (X) and biology learning outcomes of students at SMAN Kota Tangerang Selatan. Thus, it can be concluded that the hypothesis stating "there is a positive and significant relationship between the classroom emotional climate and biology learning outcomes of students at SMAN Kota Tangerang Selatan" is accepted, indicating a significant relationship between the classroom emotional climate (X) and biology learning outcomes.

The research results indicate that the level of classroom emotional climate among students at SMAN Kota Tangerang Selatan is mostly in the medium category with a percentage of 73.57%, as well as the biology learning outcomes of students, which are also in the medium category with a percentage of 71.49%. Thus, both variables, namely classroom emotional climate and biology learning outcomes, are at the medium level. The scores obtained for the dimensions of the classroom emotional climate test revealed that the highest average score of 4.19 was associated with the dimension of "Control." Meanwhile, the lowest average score was indicated by the dimension of "Attitude," with an average score of 3.39.

Interpretation of the highest average score in the "Control" dimension indicates that most students at SMAN Kota Tangerang Selatan are capable of controlling themselves in interactions with teachers and peers during classroom learning. Meanwhile, the lowest average score in the "Attitude" dimension indicates that most students are less aware that learning should be driven by desire rather than obligation, and they lack confidence when working on projects in class and struggle to enjoy the learning process. This aligns with research (Rahmawati et al., 2021) indicating that the control dimension reflects how well teachers can create an environment that supports students' concentration on tasks. Meanwhile, the attitude dimension explains students' tendencies to respond in a certain way to something during learning.

The control dimension that achieved the highest score is related to the learning outcomes obtained. Based on the definition explained previously, the value of student interaction with teachers and friends is considered good. This good interaction certainly influences their learning process as research by (Ruus et al., 2007) states that good learning outcomes are determined by the teacher-student relationship that is manifested in daily classroom communication. In addition, research (Košir et al., 2007) states that the relationship between adolescent students and their peers is an important factor in achieving their learning outcomes.

Interpretation for the lowest score in the attitude dimension relates to students' ability to engage in group project work. Student involvement in learning certainly affects their learning outcomes. The emotional support provided by teachers influences student engagement, as research by (Skinner & Belmont, 1993) indicates that teachers who provide support tailored to students' needs and directed assistance typically show higher success and perseverance. Another possible reason may be the poor relationships students have with their peers, which can reduce their engagement in learning. This is consistent with research (Furrer & Skinner, 2003)

that reveals that students with poor peer relationships, even if they have strong relationships with parents and teachers, can still impact their emotional experiences during learning.

During the research, the biology learning outcomes of students at SMAN Kota Tangerang Selatan in the 2024/2025 academic year are also included in the moderate category with a percentage of 71.49%. The difference in percentage in biology learning outcomes is influenced by several factors. As stated by (Parwati et al., 2018) that the factors that influence learning outcomes are internal factors and external factors.

In order to understand the analysis of the relationship between classroom emotional climate and biology learning outcomes yielded a calculated r value of 0.594 and a significance value of $0.000 < \text{the significance level of } 5\% (0.05)$. This indicates a significant positive relationship between the classroom emotional climate and learning outcomes in biology for class XI students at SMAN Kota Tangerang Selatan.

The positive correlation coefficient indicates that the higher the classroom emotional climate, the higher the biology learning outcomes of students, and vice versa. This aligns with research (Wang & Eccles, 2012) indicating that the extent to which teachers provide social support predicts various indicators of behavior, emotions, and cognitive engagement among students, positively correlating with students' enjoyment of school and improving their academic performance. Due to the research findings show that both variables, classroom emotional climate and biology learning outcomes, are in the same category, namely the medium category, suggesting a positive relationship. If the independent variable (classroom emotional climate) is medium, then the biology learning outcomes of students will also be medium. This is because changes in the independent variable will affect the dependent variable.

Furthermore, the correlation coefficient value of 0.594 falls into the medium category (see table 3), indicating a moderate relationship between the classroom emotional climate and biology learning outcomes of students at SMAN Kota Tangerang Selatan. To determine the contribution of the classroom emotional climate variable to the biology learning outcomes variable expressed as a percentage, it is calculated as $0.594^2 \times 100\% = 35.28\%$. This indicates that the classroom emotional climate contributes 35.28% to students' learning outcomes, while 64.72% is influenced by other factors not examined.

Relationship between classroom emotional climate and biology learning outcomes is due to the social and emotional atmosphere in which learning occurs, which can influence students' motivation to engage in learning. This is consistent with research (P. A. Jennings & Greenberg, 2009) indicating that positive relationships with teachers can enhance students' sense of security and connection, providing the social support needed for social, emotional, and academic development. Teachers who are attentive, supportive, and meet students' emotional needs will foster emotional attachment among students, leading to meaningful experiences at school.

This aligns with research (G. Jennings, 2003) indicating that students who have social-emotional experiences through meaningful participation in school tend to achieve higher grades than those who do not find meaning in their school experiences.

The classroom emotional climate not only reflects teacher-student emotional interactions but also the interactions among students that contribute to each other's emotional well-being. Therefore, the social roles of students with their peers are also important in learning to achieve high academic results. This is consistent with research (Thapa et al., 2013) indicating that students' emotional experiences in class depend on the performance of teachers and peers. This is also in accordance with research presented by (Urdu & Schoenfelder, 2006) that students who collaborate with friends become highly motivated and achieve at a high level.

Correlation results from this study align with findings by (Reyes et al., 2012), who concluded that the quality of classroom emotional climate—reflected in positive social and emotional interactions between students, peers, and teachers—has a significant impact on learning outcomes. Supportive evidence is also provided by (Rahmawati et al., 2021) emphasizing that classrooms with a positive emotional climate promote more effective student learning. (Allen et al., 2013) further highlight that emotional support within the classroom plays a critical role in fostering students' academic motivation. A positive emotional climate, therefore, represents a key factor that should be integrated into classroom practices to enhance learning outcomes, particularly in biology education.

From these calculations, it can be stated that the classroom emotional climate has a significant relationship with biology learning outcomes. The higher the level of classroom emotional climate, the higher the biology learning outcomes of students. Conversely, the lower the level of classroom emotional climate, the lower the biology learning outcomes of students. Research findings indicate that fostering a positive emotional climate in the classroom is an effective strategy for enhancing students' learning outcomes. This highlights that emotional factors in the learning environment are not merely supplementary but are essential components of high-quality education. Educators and school administrators are therefore encouraged to give greater attention to elements that shape the emotional atmosphere, such as supportive interactions, open communication, and a psychologically safe classroom environment. These insights hold significant potential for broader application in schools across Indonesia, with the goal improving both educational quality and students' academic performance.

4. Conclusion

Based on the research results and data analysis outlined above, it can be concluded that there is a positive and significant relationship between classroom emotional climate and biology learning outcomes for class XI students at SMAN Kota Tangerang Selatan. The higher the level of classroom emotional climate, the higher the biology learning outcomes of students. Conversely, the lower the level of

classroom emotional climate, the lower the biology learning outcomes of students. Research findings indicate that fostering a positive emotional climate in the classroom is an effective strategy for enhancing students' learning outcomes. This highlights that emotional factors in the learning environment are not merely supplementary but are essential components of high-quality education.

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