

## The Mediating Effect of Classroom Climate on the Relationship between Teacher Communication Behavior and Science-Related Attitudes of the Students

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**Abstract:** This study determined the mediating effect of classroom climate on the relationship between teacher communication behavior and science related attitudes of the students. The quantitative approach using the correlational technique and mediation analysis were utilized in this study. Simple random sampling technique was used in this study with a sample of 389 students coming from the senior high school department of the four selected private schools in Davao City. Sets of adapted survey questionnaires were used in obtaining data from the respondents which were subjected for content validity and reliability analysis. The data were analysed using the Mean, Pearson-r, Multiple Regression Analysis, and Medgraph using Sobel z-test. The results revealed that the levels of classroom climate, teacher communication behavior and science related attitudes of the students are high or oftentimes evident. In particular, effect of the IV (teacher communication behavior) on DV (science related attitudes of the students) is weakened as shown in the lowered beta value .403 after the controlling MV (classroom climate), hence, showing a still significant relationship which implies a partial mediation. Moreover, a significant partial mediation existed between these variables. A significant partial mediation of the classroom climate on the relationship between teacher communication behavior and science related attitudes of the students was proven in the study.

**Keywords:** Education, classroom climate, teacher communication behavior, science related attitudes, multiple regression, mediation, Philippines

### 1. INTRODUCTION

Students' attitudes in science are relevant elements as it motivates them to bring support in studying science (Kapici&Akçay, 2016). Some countries like Indonesia found that student-centered teaching and learning approaches become efficient to develop students' creativity, academic, and other skill-based activities (Khotimah et al., 2021). However, in the past few years, there have been sudden changes in education structure and context of lower interest in science or engineering in higher education institutions. It aggravated the lack of teacher force that put science in the focus of interest (Chrappan&Bencze, 2017). The inadequacy of teaching strategies, inquiry-based instruction have made science uninteresting and unchallenging. This resulted in a lack of awareness in science and technology when associated with a society that could be mainly rooted in inadequate teacher training and competency (Nadirova& Burger, 2018).

In 2016, K-12 of the Philippines ground the system's preparedness, especially in science and math subjects, upon two added years for basic education. Moreover, most Philippine Science schools are observed to be even left behind in school facilities (Fernando et al., 2019). However, the Philippines' science education by its status is undeveloped (Fajardo et al., 2019). Until an evident was proved that students' performance level in the national standardized test such as TIMSS in 2003 (Orleans, 2011) and TIMSS in 2008 (Ogena et al., 2010) resulted in students' deficiency in science literacy. Moreover, developing science attitudes is relevant, and it is regarded to have a huge contribution in increasing science uptake to produce sufficient scientists.

Viewing this way, the teachers' interpersonal behavior and communication are essential elements in producing a positive classroom climate that will contribute to the students' attitudes in science and motivation to learn. Also, conceptualizing teacher communication in classroom effectiveness has a perceived benefit in a classroom environment. In turn, it motivates student learning. This supported Eupena's (2012) idea that teachers can influence positive science attitudes via a positive classroom climate. Meanwhile, researchers have shown that intensifying positive attitudes elicits an increase of student attention and participation in science activities (Ong et al., 2014). When students have positive attitudes on science-related subjects, this may also affect their active participation and excellent performance as this may also result in interacting with the science teachers, doing school-related homework, and many more (Shah et al., 2013).

In the context of mediating effects, no studies were found across the relationship between classroom climate, teacher communication behavior, and students' science attitudes. This dire need gives importance in uncovering its variable relationships, situating Davao City as the locality. This research interest could uncover the determination and significance of classroom climate as a mediator to teacher communication behavior and science-related attitudes. Its implications and undertaking can update existing literature for each variable involved in the study.

## **2. RESEARCH OBJECTIVE**

The research seeks to determine the mediating effect of classroom climate on the relationship between teacher communication behavior and science-related attitudes of students. It specifically has the following main objectives:

1. To determine the level of teacher communication behavior in terms of:
  - 1.1 Challenging;
  - 1.2 Encouragement and praise;
  - 1.3 Non-verbal support;
  - 1.4 Understanding and friendly; and
  - 1.5 Controlling.
2. To determine the level of science-related attitude of students in terms of:
  - 2.1 Social implication of science;
  - 2.2 Attitude to scientific inquiry;
  - 2.3 Enjoyment of science lessons;
  - 2.4 Leisure interest in science; and
  - 2.5 Career interest in science.
3. To describe the level of classroom climate of the students.
4. To establish the significance of the relationship between:
  - 4.1 Teacher communication behavior and science-related attitude of the students;
  - 4.2 Teacher communication behavior and classroom climate; and
  - 4.3 Classroom climate and science-related attitude of the students.
5. To determine if the classroom climate has a significant mediating effect on the relationship between teacher's communication behavior and the students' science-related attitude.

## **Hypothesis**

The following were the hypotheses of the study:

1. There is no significant relationship between teacher communication behavior and the science-related attitude of the students.

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2. There is no significant relationship between teacher communication behavior and classroom climate.
3. There is no significant relationship between classroom climate and science-related attitudes of the students.
4. Classroom climate has no mediating effect on the relationship between teacher communication behavior and science-related attitude of the students.

### Methodology

In this study, the researcher used a descriptive-correlational research design to illustrate the relationship between the two variables, teacher communication behavior as the students' independent variable and science-related attitudes acting as the dependent variable (Vanderstoep & Johnston, 2009). Additionally, it focuses on establishing the main component of this study procedure manifesting the strength in the association between the two variables, teacher communication behavior as the independent variable and science-related attitudes of the students as the dependent variable through the incorporation of a third variable which is the classroom climate acting as the potential mediating variable. In this study, the respondents were Grade 12 students from the STEM (Science and Technology, Engineering and Mathematics) in the four selected private schools in Davao City. The sample size was determined using Slovin's formula, and 389 students primarily from Grade 12 STEM (Science and Technology, Engineering and Mathematics) with 18 years old and above only. In connection to this study, a simple random sampling technique was used in this study. Mean, Pearson Product Moment Correlational, Medgraph, and Mediation Test were the statistical tools used by the researcher.

### 3. DATA ANALYSIS

This part provides the presentation, analysis, and interpretation of the collected data from the respondents. It focuses on the data related to the mediating effect of the classroom climate on the relationship between teacher communication behavior and science-related attitudes of the students. The discussion is sequenced through the following: a correlation between teacher communication behavior and science-related attitudes of the students, a correlation between teacher communication and classroom climate, correlation between classroom climate and science-related attitudes of the students.

Tables 1, 2, and 3 presented the standard deviation, which has a range of 0.48 up to 0.55, which is less than the typical standard of 1.0 in a five (5) point Likert scale. It implies that the ratings of the collected questionnaires arrived within the desired mean upon consistent answers of the respondents (Baron & Kenny, 1986).

### Hypothesis Testing

**HO1:** There is no significant relationship between teacher communication behavior and the science-related attitude of the students.

**Table1.** Correlation between Teacher Communication Behavior and Science Related Attitudes of Students

Teacher Communication Behavior	Science Related Attitudes					
	Social Implication of Science	Attitude to Scientific Inquiry	Enjoyment of Science Lessons	Leisure Interest in Science	Career Interest in Science	Overall
Challenging	.271** (.000)	.299** (.000)	.291** (.000)	.157** (.004)	.230** (.000)	.325** (.000)
Encourage and Praise	.206** (.000)	.251** (.000)	.245** (.000)	.274** (.000)	.250** (.000)	.331** (.000)
Non-verbal Support	.295** (.000)	.313** (.000)	.264** (.000)	.278** (.000)	.223** (.000)	.361** (.000)
Understanding and Friendly	.255** (.000)	.246** (.000)	.189** (.001)	.127* (.021)	.137* (.013)	.243** (.000)
Controlling	.282** (.000)	.324** (.000)	.250** (.000)	.260** (.000)	.235** (.000)	.355** (.000)
<b>Overall</b>	<b>.338**</b>	<b>.370**</b>	<b>.317**</b>	<b>.293**</b>	<b>.278**</b>	<b>.419**</b>

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	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
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It is depicted in Table 1 results from the test of the relationship between teacher communication behavior and the students' science-related attitude. This relationship was tested at a 0.05 level of significance; in particular, it revealed a positive and significant relationship between all indicators of the students' teacher communication behavior and science-related attitudes. As revealed in the P-value of less than 0.05, an overall computed value of 0.419 is significant at the 0.05 level. The overall result reflects that teacher communication behavior is positively correlated with the students' science-related attitudes since the overall r-value is 0.419 with a p-value of  $<.05$ , hence rejecting the null hypothesis. This shows that the increase in teacher communication behavior would also likely increase the students' science-related attitudes.

**HO2:** There is no significant relationship between teacher communication behavior and classroom climate.

**Table2.** Correlation between between Teacher Communication Behavior and Classroom Climate

Teacher Communication Behavior	Classroom Climate
Challenging	.985** (.000)
Encouragement and Praise	.526** (.000)
Non-verbal Support	.510** (.000)
Understanding and Friendly	.566** (.000)
Controlling	.222** (.000)
<b>Overall</b>	<b>.692**</b> <b>(.000)</b>

Displayed in Table 2 are the results of the relationship between teacher communication behavior and classroom climate. The result shows that the overall values reveal a positive and significant relationship between teacher communication behavior and the students' science-related attitudes. The overall result reflects that teacher communication behavior is positively correlated with classroom climate since the overall r-value is 0.692 with a p-value of  $<.05$ , rejecting the null hypothesis. Thus, there is a positive association between the two variables.

**HO3:** There is no significant relationship between classroom climate and science-related attitudes of the students.

**Table3.** Correlation between Classroom Climate and Science Related Attitudes of the Students

Classroom Climate	Science Related Attitudes					
	Social Implication of Science	Attitude to Scientific Inquiry	Enjoyment of Science Lessons	Leisure Interest in Science	Career Interest in Science	Overall
	.239** <b>.000</b>	.280** <b>.000</b>	.271** <b>.000</b>	.142** <b>.010</b>	.224** <b>.000</b>	.224** <b>.000</b>

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

\*Correlation is significant at the 0.05 level (2-tailed).

Displayed in Table 3 is the test of the relationship between classroom climate and science-related attitudes of the students. The result shows that the overall values reveal a positive and significant relationship between the student's classroom climate and science-related attitudes with an R-value of 0.224 and a p-value of  $<.05$ . More specifically, all indicators of science-related attitudes such as the social implication of science with an R-value of 0.239, attitude to scientific inquiry with an R-value of 0.280, enjoyment of science lessons with an R-value of 0.271, leisure interest in science with an R-

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value of 0.142 and career interest in science with an r-value of 0.224 were positively correlated with classroom climate. Thus, the rejection of the null hypothesis at 0.05 level of significance

**HO4:** Classroom climate has no mediating effect on the relationship between teacher communication behavior and science-related attitude of the students.

**Table4.** Mediation Analysis of the Three Variables

Step	Path	Beta (Unstandardized)	Standard Error	Beta (Standardized)
Step 1	c	.466	.056	.419
Step 2	a	.559	.032	.692
Step 3	b	.033	.096	.024
Step 4	c'	.448	.077	.403

R-square: .439

Data were analyzed with the linear regression method as input to the medgraph. As shown in table 4, the result of regression is displayed; Baron and Kenny (1986) proposed a mediation analysis that presents the mediating effect of the last (third) variable to the main and dependent variables to make the third variable act as a mediator, there are four processes needed to be achieved.

In Table 4, these are categorized as Steps 1 to 4. In Step 1, teacher communication behavior as the independent variable (IV) significantly predicts the students' science-related attitudes, which is the study's dependent variable (DV). In step 2, teacher communication behavior significantly predicts classroom climate, the mediator (M). In step 3, classroom climate significantly predicts science-related attitudes of the students. In step 4, the combined effect of teacher communication behavior and classroom climate on students' science-related attitudes is significant.

As a matter of triangulation, further mediation analysis through medgraph is warranted, including the Sobel Test to evaluate the value of mediation effect. This test has been tested with high-reliability results in mediation (Ozden et al., 2008). Baron and Kenny's (1986) research findings found that if the independent variable's influence is insignificant in the final analysis, full mediation is attained. It implies that the mediator variable mediates the results.

After applying Sobel Z-test, the partial mediation region is described as not sufficiently large. It indicated that the mediating effect of classroom climate has a more conservative impact on the students' science-related attitudes. It is described as conservative, for it fully covers significant aspects towards science-related attitudes of the students. It is evident in the strong presence among the variables of the study. Although, the partial mediation also interprets that in the total effect of almost 60 percent, it has been either directed or mediated by other variables not included in the model.

Baron and Kenny's (1986) steps in the mediation test of teacher communication behavior and science-related attitudes have proven that mediation is significant, and there is partial mediation. In addition, the three paths highlighted in the model are supported by the principles of the Classical Multiple Regression Model, which revealed the level of linear relationship among the three variables. Applying the principle of Multiple Regression is appropriate because the data has passed the preliminary analysis by establishing a high level of correlation of .439. Apart from the assumption of normality of data, a high level of correlation among the variables is a requirement to do away with the spurious model.

The hypothesis was rejected since significant partial mediation occurred after Sobel's z-value of .339 resulted in a p-value less than 0.05. Thus, the connection between teacher communication behavior (IV) and science-related attitudes of the students (DV) has been significantly reduced by the involvement of classroom climate acting as the mediating variable. Thus, the graph shows that .419 is reduced to .403 in the following regression result.

From the graph above, significant mediation occurs when ninety-five (95%) percent is achieved as the confidence interval. It carries a less standard error (se) of 0.0701 as attained by subtracting the lower limit of 0.3402 from the upper limit of 0.4805 and dividing the difference on the constant number of 3.92. The small standard estimates have computed the precision of the coefficient estimate. The rule is formulated this way: the smaller the standard error, the more precise the estimate.



The computed total effect of .419 is described as the raw correlation between teacher communication behavior (IV) and science-related attitude (DV). The direct effect of .403 is the size of the correlation between teacher communication behavior (IV), and science-related attitudes of the students (DV) with the classroom climate (MV) included in the regression. The indirect effect is defined as the equivalent amount based from the results obtained from the original correlation between the independent variable (IV) as the teacher communication behavior and the dependent variable (DV) or the science-related attitudes of the students that now goes through the association of the third variable known as the mediator to the dependent variable ( $a*b$ ) where "a" refers to the path between independent variable (IV) and mediating variable (MV) and "b" refers to the path between the mediating variable (MV) and dependent variable (DV). Then, the ratio index is calculated by dividing the indirect effect to the total effect, and that  $0.108$  divided by  $0.419 = 0.257$  percent. It indicates that there is 25.7 percent of the total effect of the IV to the DV that hits the MV, and 25.7 percent of the total effect of IV to the DV passes through MV, and 74.3 percent of the overall effect is either directed or mediated by other variables which are outside the model.

Furthermore, Baron and Kenny's (1986) procedures in mediation test of classroom climate have confirmed that significant mediation means partial mediation. First regression found that the independent variable (teacher communication behavior) has affected the mediator (classroom climate) at the beta coefficient of .692 with a significant relationship at a p-value equal to 0.05. Second regression indicated that the independent variable (teacher communication behavior) had affected the dependent variable (science related attitudes) at the beta coefficient of .419 with a significant relationship at a p-value equal to 0.05. Third regression showed that for the mediation to hold, the mediator (classroom climate) has affected the dependent variable (science-related attitudes) at beta coefficient value of .249 with a significant relationship at a p-value equal to 0.05

Lastly, the dependent variable (science-related attitudes) is regressed on both the independent (teacher communication behavior) and the mediating variable (classroom climate). Since the teacher communication behavior coefficient has been reduced from .419 to .403, it is still significant. Thus, partial mediation of the classroom climate on the relationship between teacher communication and students' science-related attitudes is achieved.

Sobel Z-test value of 0.339846 has a probability value of 0.000 significance lower than the 0.05 level of significance. As a result, significant mediation has been determined. Thus, hypothesis 1 of this study is rejected. There is a significant mediation of classroom climate on the relationship between teacher communication behavior and science-related attitudes of the students. However, since it is only considered a partial mediation, it is not claimed that classroom climate was the very reason teacher communication behavior can affect students' science-related attitudes.

#### **4. DISCUSSIONS**

The discussion of findings of the study is centered on the major research hypothesis directing the study:

there is no significant relationship between teacher communication behavior and the science-related attitude of the students, there is no significant relationship between teacher communication behavior and classroom climate, there is no significant relationship between classroom climate and science-related attitudes of the students and classroom climate has no mediating effect on the relationship between teacher communication behavior and science-related attitude of the students.

The test of the relationship between teacher communication behavior and science-related attitudes of the students revealed a significant relationship between teacher communication behavior and the students' science-related attitudes. This implies that teacher communication behavior is correlated to the science-related attitudes of the students. In other words, the increase in teacher communication behavior would also likely increase the science-related attitudes of the students. This conforms to the result of Vigna (2018), proving that non-verbal and other body movements can be defined as a form of communication with spoken written language and body expressions to convey messages to the intended audience. Ferguson (2013) confirmed this, claiming that praise is a good technique or approach that leads to positive behavior and a management tool. Han & Tosten (2016) proved that teachers made sure that the students feel belongingness in approaching them through non-verbal

support such as body language, proximity, and giving thumbs-up to transmit good communication and interaction within the classroom climate. Furthermore, this study confirms the contention of She & Fisher (2000), claiming that in a room where learners observe that their educators show utmost aspects in communication in language, written, spoken, and physical activities. This has parallels to the result of (Eupena 2012) as seen to have a goal in conducting the study to which the students have given an opportunity to learn the science lessons and make it more enjoyable and give meaning to what is in reality.

The relationship between teacher communication behavior and classroom climate revealed an interesting connection of all indicators in the classroom climate. It implies that a friendly and healthy communication of teacher and students helps uplift the spirit of the room's physical condition. This is congruent with the study of Sidelinger et al. (2012), claiming that establishing a good relationship starts with the teacher's behavior as he/she sets democratic rules inside the classroom environment. With this, students started to build trust and good interpersonal relationships not only with the other learners but also with the teacher. In lieu, more students were capable of doing their role in active participation inside the classroom instruction. This is further reinforced in the results of Gascoigne (2012) proved that teacher communication behavior has a significant effect on classroom climate. In congruence to Ratzburg (2010) study, an excellent educator increases the students' interest to promote more exemplary scholastic achievements to the students. Moreover, similar results of Torrente (2013), especially during the early years of schooling, when teachers have caregiving functions and students spend the majority of time with the same teacher; attachment bonds are likely to form. This also conforms to Glomo-Narzoles' (2013) findings that strong rapport and positive communication behavior lie in the educators' hands as this was part of their responsibility to promote the best interpersonal relationship to the learners.

The test of the relationship between classroom climate and science-related attitudes of the students shows a positive and significant relationship between classroom climate and science-related attitudes of the students. This means that the classroom climate would also likely increase the science-related attitudes of the students. This is anchored to the study of (Ahnert et al., 2012), claimed that it became clear that students' relationships with teachers begin to connect with each other's interpersonal culture setting inside the learning environment and parallel to the study of Leone (2009) by engaging into actual exposure allowing teacher and students to create an opportunity to know each other for mutual understanding and respect. Similar findings of Ong et al. (2014) affirm that students who have shown an interest in science are more actively participative in science lessons and activities inside the classroom environment.

The mediation analysis reveals that classroom climate partially mediates the relationship between teacher communication behavior and science-related attitudes of the students. The partial mediation can hardly claim that classroom climate is the very reason teacher communication behavior can influence the students' science-related attitudes. This indicates that classroom climate can partly explain how teacher communication behavior may change students' attitudes in science classes and activities. Regarding students' attitude in science classes in connection to Djigic & Stojiljkovic's (2011) findings, the strong bond of the classroom and students in science classes and activities is significantly linked to a favorable and friendly classroom plays on students' learning environment and attitude and this affects their learning progress and interest.

## **5. CONCLUSIONS AND RECOMMENDATION**

The respondents give a high level of classroom climate, high teacher communication behavior, and a high level of science-related attitudes. This study confirmed significant relationships among the three variables: teacher communication behavior and science-related attitudes of the students, teacher communication behavior and classroom climate, and classroom climate and science-related attitudes of the students. In case of the mediation, the study revealed that classroom climate partially mediates the relationship between teacher communication behavior and students' science-related attitudes. In line with this, the singular influence of the two variables on the students' teacher communication behavior and science-related attitudes has been established through regression. Hence, the researcher

recommends the following for the benefit of all engaging stakeholders after a thorough discussion on the study results. It is suggested that students continue their efforts and levels of interest to maintain and improve their study performance because there is a consistently high-level perception among teacher communication behavior, science-related attitudes of the students, and classroom climate.

## **6. RECOMMENDATION FOR FUTURE RESEARCH**

The researcher recommends that future researchers conduct another study exploring the indicators of classroom climate on other variables. Consequently, further studies may be conducted in other places to explore other variables that affect the students' teacher communication behavior and science-related attitudes.

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