



## THE MEDIATING EFFECT OF MOTIVATION ON THE RELATIONSHIP BETWEEN CLASSROOM ENVIRONMENT AND STUDENTS' ATTITUDE TOWARDS SCIENCE

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### **Abstract:**

This study untangled the effect of motivation on the relationship between classroom environment and grade 12 students' attitude towards science. The researcher used quantitative non-experimental type of research and correlational techniques. The study was conducted in seven selected public schools in Davao City where senior high school students are present. There were four hundred (400) grade 12 student participants in total, consisting of two hundred (200) males and two hundred (200) females. The respondents rated on a scale of 1 to 5, with 5 denoting agreement and 1 denoting disagreement from the items that were given to them. Also, ethical procedures were observed. The data that were gathered from the level of classroom environment, motivation, and attitude towards science indicated that the respondents' perceptions of these factors were observed sometimes. Meanwhile, the correlations between Classroom Environment and both the Motivation and Attitude of students toward science had a significant relationship. The same is true with the correlations between the students' Motivation and their Attitude toward Science and on the Mediating Effect of Motivation. Therefore, the physical environment of the classroom is its strongest point, while managing behavior requires attention.

**Keywords:** motivations, attitude toward science, classroom

### **1. Introduction**

In this modern world where everything is technologically and scientifically advanced, education about science and mathematics must thrive for the human race to adapt to these advancements [1], and in order to learn the concepts of science, it must be partnered with a good attitude. A student's attitude toward a science course depends on a variety of factors, such as their perception of themselves, their peers, their parents, and the

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classroom setting. It is a response or a feeling to a certain circumstance or event that could be negative or positive [2]. Similar to this, a student's attitude in learning science can be observed whether he or she shows a positive or negative response to the subject [3]. But most students, especially high school students, lose their interest in science. Students show very little interest in their science-related subjects, and most positive attitudes towards science learning decrease as time goes by [4]. This is why most students on the secondary level have low levels or even no longer have any interests and positive attitudes toward science. This also greatly affects the career path of students, especially at higher grade levels. Students' interests play an important role in their career path decisions and choices [4]. If most of the student population is uninterested in taking any science-related fields, there will be a huge reduction of scientific workers in the upcoming generation.

A study shows that the type of bond and relationship a teacher builds with his or her students plays a vital role in developing the learners to adapt, grow, and learn in accordance with the school context [5]. This helps the students to learn the subject more eagerly. When it comes to attitude, a good social relationship between the students and their science teacher will develop the learners' interest towards the subject [6] and the main ingredient in keeping the students engaged is making them motivated. Motivation, "the heart of learning", is crucial in building a good social relationship inside the classroom [7].

The use of interactive, visual, and auditory technology, such as augmented reality (AR) technology, helps students focus better, stay engaged, and have a positive attitude toward learning [8]. If a science teacher can provide creative visual elements (like diagrams and models of different structures), good communication and interaction with his or her students, it is likely that a teacher can also make his or her students more interested, more motivated, and more inspired to learn science. Another positive attitude that students must develop, aside from being motivated, is their cognition. The cognitive dimension includes exploration, formulation, execution, monitoring, planning and understanding skills [9]. These attitudes are very important for the students to develop positive attitudes when it comes to learning science-related subjects. Teachers are another example of external factors that affect learners' attitudes and motivation towards science.

However, time and instructional management, teacher effectiveness, and their classroom environment or atmosphere are also important external elements that create an impact towards the students' attitude and motivation. The results of the study conducted by [10] have shown that a beneficial impact on the learning and performance of the students was observed only if the teachers properly discussed the topic with their students. Furthermore, [6] stated that classroom talks or discussions between teachers and students affect a student's performance, thus reflecting its importance. This can be achieved by making a good time and instructional plan before the teachers discuss the topic in front of the class. If a teacher follows this strategy and adds on other good teaching techniques, he or she becomes an effective educator.

Nevertheless, there are still things teachers cannot control, such as how the students behave inside the classroom. It is observable that inside a classroom, some students do not connect well with their fellow classmates due to certain differences, and this is why students tend to stay with their friend group or barkadas with similar attitudes, experiences, humor and/or even gender. However, this can also create secret hatred with other subgroups inside the classroom which can affect learning and collaboration regarding certain activities [11].

Creative questions and new innovative ideas must prevail inside the traditional classroom and not deep negative emotions [12]. For this reason, in order to provide an appropriate setting and atmosphere inside the classroom, the teachers in charge must show and teach their students how to connect [10].

A good connection between the teacher and the student will develop good collaboration between the students. The classroom environment is seen as the first step in the process of "building an environment conducive to learning" by "forming an organized setting" and establishing the classroom's physical arrangement is one of them. An organized and clean yet beautiful classroom environment is indeed a place to learn and is an indicator of a good environment that motivates learners to learn any subject. Preparation of areas wherein specific activities are designated, specified purposes for decorating areas, and also organizing materials and areas that are easily accessible, are all things that should be done by the teachers for their students [13]. Aside from a clean environment, the study of [14] described that a good curriculum, sufficient resources, teachers' abilities and many more are the indicators of a good classroom environment.

According to [15], there is a lack of resources, poor professional development, and redundant lessons at the senior high school level, especially in grade 12. Because of this, learning diminishes, mostly at higher grade levels. There are a lot of possible hindrances in learning science. Nevertheless, if a student really wants to learn about science, there will always be a way. A study conducted by [3] presented three (3) indicators of a positive attitude that a student has in learning science. With these indicators, the teachers can identify which students are more inclined or interested in science and those who are not.

First is the level of interest of the students about sciences. Next is if the student has shown a scientific attitude while learning science. Examples of these attitudes are curiosity, cooperation, objectivity, and honesty [16]. Finally, if the student shows an interest in choosing scientific careers in the future. The researcher has not yet discovered a study that incorporates all three variables, let alone one that considers motivation as a mediating factor in the connection between student attitudes and the environment in the classroom. The paucity of literature and research, including the three factors in a single study, would be sufficient to justify continuing the investigation. As a result, the conduct of this study has the potential to contribute to new understanding. As a result, the researcher realized that these factors may be explored from several perspectives.

## 2. Research Objectives

The purpose of this study is to determine the mediating effect of motivation on the relationship between classroom environment and students' attitudes towards science among grade 12 students. Moreover, the study sought to answer the following questions and goals:

- 1) To describe the level of the classroom environment in terms of:
  - 1.1 physical environment;
  - 1.2 time/instructional management;
  - 1.3 behavior management; and
  - 1.4 teacher effectiveness.
- 2) To ascertain the level of motivation.
- 3) To ascertain the level of student attitudes towards science in terms of:
  - 3.1 attitude towards science;
  - 3.2 motivation towards learning science;
  - 3.3 utility of science;
  - 3.4 self-efficacy in science learning;
  - 3.5 normative beliefs about science involvement; and
  - 3.6 intentions to pursue science-related activities.
- 4) To determine the significant relationship between:
  - 4.1 classroom environment and student attitude towards science;
  - 4.2 classroom environment and motivation; and
  - 4.3 motivation and student attitude towards science.
- 5) To determine if motivation significantly mediates the relationship between classroom environment and student attitude towards science.

### 2.1 Hypothesis

The following were the hypotheses of the study.

- 1) There is no significant relationship between classroom environment and student attitude towards science.
- 2) Motivation has no mediating effect on the relationship between classroom environment and student attitude towards science.

## 3. Methodology

This section highlights the methodology utilized in the study, including the research design, geographical area, population and sample, the research instrument utilized, the data collection process, and the statistical tools applied for analysis.

### 3.1 Research Design

This study will employ the non-experimental and quantitative type of research utilizing correlational techniques. It was quantitatively non-experimental since the study

described current existing characteristics pertaining to school climate, work-life balance and career development of teachers. It was quantitatively non-experimental since the study described current existing characteristics pertaining to school climate, work-life balance, and career development of teachers. According to Indu and Vidhukumar (2020), non-experimental research is research where variables are observed and do not interfere with the research participants [17].

It also employed correlational techniques since it examined the relationship between the variables under study. With little to no effort to control unrelated variables, correlational research measures two variables and evaluates the statistical relationship (i.e., the correlation) between them. Moreover, the relationship between the independent and dependent variables is explained by a mediator variable. The full intervention brought about by the mediator variable is known as the complete mediation process. As a result, the outcome variable is no longer influenced by the beginning variable. Partial intervention is the definition of the partial mediation process. A mediation model is created from the mediation brought about by the mediator variable. It is a causal model that emerges as a result of mediation. Put otherwise, this indicates that rather than the other way around, it has been assumed that the mediator variable causes the effect in the result variable.

### **3.2 Geographical Area**

This study was conducted in seven selected public schools cluster 2 in Davao City, Davao region division, specifically from public schools where there were Senior High Students. The capital of Mindanao, the largest city in the country, is also one of the most progressive; it has one of the busiest seaports and international airports for cargo in the country's southern region; it is one of several province-free cities in the Philippines; it serves as the regional hub for Davao Region (Region XI); with 1,363,330 residents as of the 2007 census, it was named the 10th "Asian City of the Future" by Foreign Direct Investment Magazine. The city is home to some of the best mountain resorts and beaches in the nation, and it is close to Mount Apo, the highest peak in the Philippines, and some of the most fascinating diving locations.

### **3.3 Population and Sample**

The respondents of the study were grade 12 learners from the selected schools in the cluster two division in Davao City. The sample consisted of a total of 406 senior high students and were selected by random sample approach, which includes Accountancy, Business and Management (ABM); Humanities and Social Sciences (HUMSS); Science, Technology, Engineering and Mathematics (STEM); and General Academic Strand (GAS) students were the only respondents. Thus, students from other tracks, such as the Technical-Vocational Livelihood Track, Sports Track, Arts and Design Track, were excluded from the study. In determining the number of samples, the researcher utilized the maximum 406 samples at 0.05 level of significance in Slovin's formula. Stratified or arranged random sampling techniques were employed. Selected respondents were only

limited to the senior high students in the public schools in the Cluster 2 division in Davao City.

### 3.4 Distribution of Respondents

**Table 1:** Distribution of Respondents

Cluster	Number of Students	Sample	Percentage
A	63	50	12.3%
B	580	116	28.6%
C	120	51	12.6%
D	153	92	22.7%
E	50	46	11.5%
F	62	50	12.3%
<b>Total</b>	<b>1028</b>	<b>406</b>	<b>100</b>

### 3.5 Research Instrument

The study used adapted questionnaires from various sources. The first part was the adapted survey questionnaire for the first variable, classroom environment (Turano, 2005), having four categories (physical environment, teachers' effectiveness, time, instructional, and behavioural managements) [18]. The motivation variable was adapted from (Garcia & Pintrich, 1996) [19]. The six variables are normative views, self-efficacy, and attitude toward science, motivation to learn science, utility science, and intentions to pursue science (Aydemiz & Kotowski, 2014) [20]. Respondents answered the items using a scale of 1 to 5, with the least number indicating strong disagreement and the greatest number indicating strong agreement. To interpret the status of study habits, refer to the range of means, descriptions, and interpretation presented below.

Range of Means	Descriptive Level	Interpretation
4.20 – 5.00	Very High	This means that the classroom environment for students' learning is always observed.
3.60 – 4.19	High	This means the classroom environment for students' learning is oftentimes observed.
2.40 – 3.59	Medium	This means that the classroom environment is neither observed or not observed.
1.80 – 2.39	Low	This means that the classroom environment for students' learning is rarely observed.
1.00 – 1.79	Very Low	This means that the classroom environment is students' learning never observed.

Range of Means	Descriptive Level	Interpretation
4.20 – 5.00	Very High	This means that the motivation for students' learning is always observed.
3.60 – 4.19	High	This means the motivation for students' learning is frequently observed.
2.40 – 3.59	Medium	This means that the motivation is neither observed or not observed
1.80 – 2.39	Low	This means that the motivation for students' learning is rarely observed.
1.00 – 1.79	Very Low	This means that the motivation is the students' learning never observed.

Range of Means	Descriptive Level	Interpretation
4.20 – 5.00	Very High	This means that the attitude toward science for students' learning is always observed.
3.60 – 4.19	High	This means the attitude toward science for students' learning is oftentimes observed.
2.40 – 3.59	Medium	This means that the attitude toward science is neither observed or not observed
1.80 – 2.39	Low	This means that the attitude toward science for students' learning is rarely observed.
1.00 – 1.79	Very Low	This means that the attitude toward science for students' learning is never observed.

### 3.6 Data Collection

The researcher observed the following procedures during the data-gathering process. The researcher secured approval from the Dean of the Post Graduate School, as noted by the adviser, for the authorization to conduct the study, followed by permission from the schools' division superintendent /s for the identified public for the study's conduction. The same permission was sought from the seven principals where the study was conducted. Upon the approval to do the research, written consent was requested from the science teachers and from the parents or guardians of the minor participants, allowing them to participate in the conduct of the study through the survey. Both the parents or guardians and the participants were requested to sign and confirm the consent form. Once parents' consent was obtained, the survey was administered based on the preferences of the respondents. Retrieval was done right after the filled-out questionnaire was filled up by the respondents.

### 3.7 Statistical Tool

The data analysis and interpretation in this study relied on the following statistical methods and tools:

- **Mean.** Right after the retrieval of the questionnaire, data were tallied and treated with statistical tools using weighted means. The statistical treatment was used to determine the classroom environment, motivation, and student attitude towards science.

- **Pearson r.** This was done in order to ascertain whether the classroom atmosphere, student attitude toward science, and respondents' motivation were significantly correlated.
- **Regression.** This was utilized to identify the coefficient as input in medgraph.
- **A med graph utilizing the Sobel z-test** was then used to prove the mediation and strengthen the obtained results.

## 4. Results

This section shows the data and analysis that have led to the conclusions drawn from the study's acquired data. The following sections are organized as follows for discussions: the level of the classroom environment; the level of attitudes towards science among grade 12 students; the level of motivation among grade 12 students; the correlations between classroom environment and attitudes towards science among grade 12 students; the correlations between classroom environment and motivation among grade 12 students; the correlations between motivation and attitude towards science among grade 12 students; and the on the mediating effect of motivation.

### 4.1 Level of Classroom Environment

Table 1 shows the level of the Classroom Environment. The means of each indicator were closer to one another, and respondents' responses were consistent, as indicated by the overall standard deviation of 0.71, which is less than 1.00. With an overall mean score of 2.93, it was considered moderate. This indicates that the respondents occasionally saw the classroom environment as they perceived it.

**Table 1:** Level of Classroom Environment of Grade 12 Students

Indicators	SD	Mean	Descriptive Level
Physical Environment	0.78	2.98	Moderate
Time/Instructional Management	0.77	2.97	Moderate
Behavior Management	0.73	2.86	Moderate
Teacher Effectiveness	0.77	2.92	Moderate
<b>Overall</b>	<b>0.71</b>	<b>2.93</b>	<b>Moderate</b>

The physical environment had the greatest mean (2.98), and behavior management had the lowest mean (2.86), both representing moderate levels of the classroom environment. This explains that the respondents sometimes observed and perceived physical environment and behavior management. Moreover, the rest of the indicators, which are teacher effectiveness and time/instructional management, have a moderate level, which explains why these were sometimes observed as perceived by the respondents.

### 4.2 Level of Attitudes Towards Science among Grade 12 Students

Table 2 shows the level of attitudes towards science among grade 12 students. The overall standard deviation was 0.60, which is less than 1.00. This explains that the means for each



indicator were closer to each other and there was consistency in the responses among respondents. With a mean score of 2.74 overall, it was considered modest. This indicates that attitudes toward science among pupils in grade 12 did occasionally show up.

**Table 2:** Level of Attitudes towards Science among Grade 12 Students

Indicators	SD	Mean	Descriptive Level
Attitude towards Science	0.73	2.77	Moderate
Motivation towards Learning Science	0.75	2.90	Moderate
Utility of Science	0.82	2.93	Moderate
Self-efficacy in Science Learning	0.68	2.70	Moderate
Normative Beliefs about Science Involvement	0.70	2.57	Low
Intentions to Pursue Science-related Activities	0.66	2.56	Low
<b>Overall</b>	<b>0.60</b>	<b>2.74</b>	<b>Moderate</b>

From the following measures, grade 12 students' attitudes toward science were as follows: the utility of science has the highest mean (2.93), with a moderate level. This means that this was sometimes manifested when intentions to pursue science-related activities had the lowest mean of 2.56, with a low level. This explains that the respondents rarely manifested this. Furthermore, the respondents occasionally displayed the remaining indications, which include self-efficacy in science learning, attitudes toward science, and willingness to learn science. These indicators all have modest levels. On the other hand, normative beliefs about science involvement have a low level, which means that these beliefs were rarely manifested by the respondents.

### 4.3 Level of Motivation among Grade 12 Students

Table 3 shows the level of motivation among grade 12 students. The general mean score was 2.90, known as moderate. The outcome explains that the motivation among grade 12 students was sometimes manifested. Looking at the specific items on motivation among grade 12 students, the item that is crucial for me to understand and learn the course material has the highest mean of 3.10 or moderate, with a standard deviation of 0.95. This means that this item was sometimes manifested among grade 12 students. The standard deviation of this item, which is less than 1.00, implies that the respondents' response to this item was homogenous or consistent. On the other hand, the items I am confident I can understand, the most complex material presented by the instructor in this course and having an uneasy, upset feeling when I take an exam, both have a mean of 2.74, described as moderate. This means that these items were sometimes manifested by grade 12 students. The standard deviation of these items, which were 0.84 and 0.88, respectively, both are less than 1.00 denote that the responses of the respondents on these items were homogenous or consistent.

**Table 3:** Level of Motivation among Grade 12 Students

Items	SD	Mean	Descriptive Level
In a class like this, I prefer course material that really challenges me so I can learn new things.	0.97	2.86	Moderate
If I study in appropriate ways, then I will be able to learn the material in this course.	0.92	2.93	Moderate
When I take a test, I think about how poorly I am doing compared with other students.	0.87	2.86	Moderate
Thinking I will be able to use what I learn in this course in other courses.	0.92	2.96	Moderate
Believing I will receive an excellent grade in this class.	0.90	2.91	Moderate
I am certain I can understand the most difficult material presented in the readings for this course.	0.85	2.76	Moderate
Getting a good grade in this class is the most satisfying thing for me right now.	0.95	3.05	Moderate
When I take a test, I think about items on other parts of the test I cannot answer.	0.91	2.87	Moderate
It is my own fault if I do not learn the material in this course.	0.96	2.92	Moderate
It is important for me to learn the course material in this class.	0.95	3.10	Moderate
The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	0.93	3.06	Moderate
Being confident I can learn the basic concepts taught in this course.	0.91	3.00	Moderate
If I can, I want to get better grades in this class than most of the other students.	0.91	2.75	Moderate
When I take tests, I think of the consequences of failing.	0.91	2.90	Moderate
I'm confident I can understand the most complex material presented by the instructor in this course.	0.84	2.74	Moderate
In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	0.89	2.84	Moderate
Being very interested in the content area of this course.	0.88	2.88	Moderate
If I try hard enough, then I will understand the course material.	0.90	2.99	Moderate
Having an uneasy, upset feeling when I take an exam.	0.88	2.74	Moderate
I'm confident I can do an excellent job on the assignments and tests in this course.	0.85	2.80	Moderate
Expecting to do well in this class.	0.92	2.94	Moderate
The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.	0.95	3.01	Moderate
Thinking the course material in this class is useful for me to learn.	0.95	2.96	Moderate
When I have the opportunity in this class, I choose course assignments that I can learn from, even if they do not guarantee a good grade.	0.91	2.85	Moderate
If I do not understand the course material, it is because I did not try hard enough.	0.93	2.82	Moderate
I like the subject matter of this course.	0.89	2.85	Moderate
Understanding the subject matter of this course is very important to me.	0.91	3.00	Moderate
Feeling my heart beating fast when I take an exam.	0.91	2.88	Moderate
Being certain I can master the skills being taught in this class.	0.88	2.82	Moderate

Wanting to do well in this class because it is important to show my ability to my family, friends, employer, or others.	0.93	2.96	Moderate
Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	0.90	2.90	Moderate
<b>Overall</b>	<b>0.68</b>	<b>2.90</b>	<b>Moderate</b>

Moreover, the levels of the rest of the items were described as moderate, with means ranging from 2.60 to 3.39. This explains further that the items pertaining to the motivation of grade 12 students were all sometimes manifested consistently.

#### 4.4.1 Correlations Between Classroom Environment and Attitudes Towards Science among Grade 12 Students

Table 4.1 shows the results of the analysis of the relationship between classroom environment and attitudes towards science among grade 12 students. The table shows that the classroom environment is positively correlated with attitudes towards science.

**Table 4.1:** Significance on the Relationship between Classroom Environment and Attitude towards Science among Grade 12 Students

Classroom Environment	Attitude towards Science						Overall
	Attitude towards Science	Motivation towards Learning Science	Utility of Science	Self-efficacy in Science Learning	Normative Belief about Science Involvement	Intentions to Pursue Science-related Activities	
Physical Environment	.544** .000	.687** .000	.685** .000	.362** .000	.410** .000	.350** .000	.624** .000
Time Instructional Management	.558** .000	.696** .000	.718** .000	.336** .000	.412** .000	.347** .000	.631** .000
Behavior Management	.532** .000	.640** .000	.666** .000	.403** .000	.425** .000	.378** .000	.623** .000
Teacher Effectiveness	.544** .000	.680** .000	.703** .000	.383** .000	.421** .000	.351** .000	.633** .000
<b>Overall</b>	<b>.586** .000</b>	<b>.727** .000</b>	<b>.746** .000</b>	<b>.399** .000</b>	<b>.448** .000</b>	<b>.383** .000</b>	<b>.675** .000</b>

The result showed an overall r-value of .675 with a p-value of .000, which is <0.05, signifying a notable or significant correlation between the classroom environment and attitudes towards science. Thus, the null hypothesis is rejected. Moreover, looking at the interrelation between indicators of classroom environment and attitudes towards science, evidently with r-value ranges from .336 to .718 and with a p-value of .000, which is less than 0.05 level of significance, there are significant relationships between indicators of classroom engagement and indicators of attitudes towards science. The indicators of time instructional management and utility of science have the highest r-value of .718 with a p-value of .000. While the indicators of time instructional management and self-efficacy in

science learning have the lowest r-value of .336 with a p-value of .000. Both relationships are significant as shown in their p-value which is both less than 0.05 level of significance.

#### 4.4.2 Correlations Between Classroom Environment and Motivation among Grade 12 Students

Reflected in Table 4.2 were the findings of the analysis on the correlation between classroom environment and motivation among grade 12 students. The table shows that the classroom environment is positively correlated with motivation.

**Table 4.2:** Significance on the Relationship between Classroom Environment and Motivation among Grade 12 Students

Classroom Environment	Motivation
Physical Environment	.806** .000
Time Instructional Management	.832** .000
Behavior Management	.808** .000
Teacher Effectiveness	.800** .000
<b>Overall</b>	<b>.873**</b> <b>.000</b>

The result illustrated an overall r-value of .873 with a p-value of .000, which is <0.05, signifying a noticeable relationship between the students' classroom environment and motivation among grade 12 students. Thus, the null hypothesis is rejected.

Moreover, analyzing bit by bit the relationships between indicators of classroom environment and motivation as a mediating variable, evidently with r-value ranges from .800 to .832 and with p-value of .000, which is less than 0.05 level of significance, there are significant relationships between indicators of classroom environment and motivation.

The indicator time instructional management and motivation registered the highest r-value of .832 with a p-value of .000. On the other hand, teacher effectiveness as an indicator and motivation has the lowest r-value of .800 with a p-value of .000. Both have significant relationships.

#### 4.4.3 Correlations Between Motivation and Attitude towards Science among Grade 12 Students

Table 4.3 shows the results of the analysis of the relationship between motivation and attitudes towards science among grade 12 students. The table shows that motivation is positively correlated with attitudes towards science.

**Table 4.3:** Significance on the Relationship between Motivation and Attitude towards Science among Grade 12 Students

Motivation	Attitude towards Science						Overall
	Attitude towards Science	Motivation towards Learning Science	Utility of Science	Self-efficacy in Science Learning	Normative Believe about Science Involvement	Intentions to Pursue Science related Activities	
	.656**	.759**	.759**	.526**	.548**	.502**	<b>.764**</b>
	.000	.000	.000	.000	.000	.000	<b>.000</b>

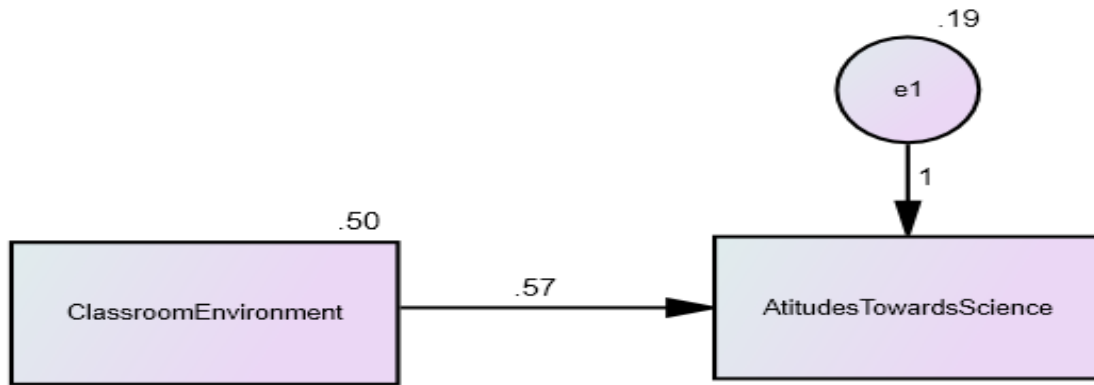
The result showed an overall r-value of .764 with a p-value of .000, which is  $<0.05$ , signifying that a relationship that is notable is present between motivation and attitudes towards science among grade 12 students. Thus, the null hypothesis is rejected.

Moreover, highlighting the relationships between motivation as a mediating variable and the indicators of attitudes towards science, evidently with r-value ranges from .502 to .759 and with a p-value of .000, which is less than 0.05 level of significance, there are significant relationships between motivation and the indicators of attitudes towards science. The indicator motivation towards learning science registered the highest r-value of .759 with a p-value of .000. On the other hand, motivation as a variable and intentions to pursue science-related activities have the lowest r-value of .502 with a p-value of .000. Both relationships are significant as evident in their respective p-values which are less than 0.05 level of significance.

#### 4.5 On the Mediating Effect of Motivation

Table 5 shows the path analysis of the mediating effect of motivation on the relationship between classroom environment and attitude towards science. The data obtained in this table were the results after conducting the SPSS AMOS.

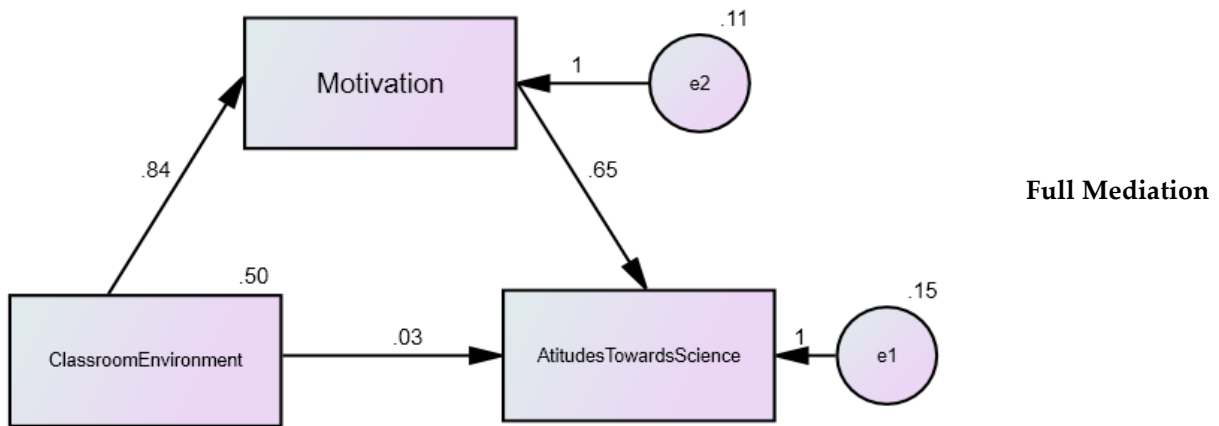
Also, presented in Table 5 are the regression weights on the direct effect of the classroom environment on attitudes towards science. The classroom environment has an estimate of .571, S.E. of .031, C.R. of 18.388 and a probability value of .000, which is less than 0.05 level of significance. This suggests a considerable link between the two variables. A low or small standard error indicates that the estimate has greater precision than a higher standard error.



Regression Weights: (Group number 1 - Default model)

Table 5: Mediation Analysis of the Three Variables

			Estimate	S.E.	C.R.	P	Label
Attitudes Towards Science	<---	Classroom Environment	.571	.031	18.388	***	



Full Mediation

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Motivation	<--	Classroom Environment	.840	.023	35.905	***	
Attitudes Towards Science	<--	Classroom Environment	.029	.056	.521	.602	
Attitudes Towards Science	<--	Motivation	.646	.058	11.182	***	

Figure 2: Path Diagram for the Regression

Moreover, shown in Figure 2 is the mediating effect of motivation on the relationship between classroom environment and attitudes towards science. The result illustrates that motivation has a significant role in the relationship between classroom environment and attitudes towards science of students. Furthermore, motivation as the

mediating variable influences the causal association between classroom environment and learning engagement, for it lowered a significant beta coefficient value from .57 to .03, which makes the relationship between the independent variable and the dependent variable not significant. The mediating effect is full mediation. Thus, the null hypothesis is hereby rejected.

Reflected in the table of Figure 2 and Table 5 are relationships between the variables with their corresponding estimate, standard error, critical ratio and probability value. The relationship between classroom environment and attitudes towards science (Path C) when motivation was being introduced as a mediating variable has an estimate from .571 to .029, which means that as the classroom environment goes up by 1, the attitude towards science goes up by only .029. The regression weights estimate has a standard error (S.E.) of .056 and a critical ratio (C.R.) of .521, which is the result of dividing .029 by .056. The probability (p) value of .602 means that the regression weight for the classroom environment is not different from zero at the .001 level. This implies that the relationship is not significant.

Additionally, the relationship between classroom environment and motivation (Path A) as a mediator has an estimate of .840, which means that as the classroom environment goes up by 1, the motivation goes up by .840. The regression weights estimate has a standard error (S.E.) of .023 and a critical ratio (C.R.) of 35.905, which is the result of dividing .840 by .023. The probability (p) value of .000 means that the regression weight for the classroom environment is different from zero at the .001 level. This implies that the relationship is still significant.

Moreover, the relationship between motivation as a mediator and attitude towards science (Path C) as the dependent variable has an estimate of .646, which means that as motivation goes up by 1, the attitude towards science goes up by .646. The regression weights estimate has a standard error (S.E.) of .058 and a critical ratio (C.R.) of 11.182, which is the result of dividing .646 by .058. The probability (p) value of .000 means that the regression weight for learning engagement is different from zero at the .001 level. This implies that the relationship is still significant.

In Figure 2, steps 1 to 3 are illustrated. In Step 1 (Path C), the classroom environment as the independent variable (IV) does significantly predict attitudes towards science, the dependent variable (DV) and the estimate has decreased. In step 2 (Path A), classroom environment (IV) significantly predicts motivation, the mediator (MV). Finally, in step 3 (Path B), motivation (MV) predicts attitude towards science significantly. The purpose of steps 1 to 3 is to establish relationships among variables in zero-order. If there are significant relationships in steps 1 to 3, one must proceed to step 4. Finally, in step 4, the combined effect of classroom environment and motivation on attitude towards science is insignificant. As illustrated in Figure 2, there is a significant mediation effect of motivation on the relationship between classroom environment and attitude towards science.

## 5. Conclusion

The study reveals that Grade 12 students regarded their classroom environment as moderately effective, with much-needed improvements in terms of the physical environment and student behavior (Barrett et al., 2018). Students' attitude towards science were also moderate, meaning that they are interested in science sometimes or do not have a strong interest and commitment to science-related careers (Makransky et al., 2020). Also, the level of motivation was moderate, meaning that the students' activities while learning science were consistent but not intense (Garcia & Pintrich, 1996). Based on these conclusions, it is possible to state that improving the learning environment and the use of specific motivational interventions are necessary for the development of a more positive attitude and improvement of interest in scientific education (Ibáñez & Delgado-Kloos, 2018).

The findings of correlations between classroom environment, attitudes towards science, and motivation in grade 12 students show an association. Promotively, this study establishes that there is a positive association between the classroom environment and students' attitudes towards science, implying that more supportive and well-managed classrooms may improve students' perception of science. Likewise, the positive and significant relationship between the classroom environment and motivation shows that better conditions in the classroom increase the motivation of the students in science learning (Barrett et al., 2018). Also, motivation has a positive link with the students' perceived positive attitude toward science, showing how motivation affects the attitude of students towards a specific subject (Garcia & Pintrich, 1996). These conclusions indicate that it is essential to improve the physical environment in learning spaces and increase students' interest in science-learning processes to promote more constructive attitudes.

Furthermore, it was established that motivation plays a moderating role between the classroom environment and the students' attitudes towards science. The study further showed that, though positive aspects of classroom climate in the early stages of a course positively influence the positive attitudes towards science, their relationship becomes insignificant in the presence of motivation as the mediating variable (Ibáñez & Delgado-Kloos, 2018). This implies that motivation plays an instrumental role in mediating the effects of classroom environment on science attitudes, in support of the view that increasing students' motivation is a particularly effective way of promoting positive effects of favorable classroom conditions on students' attitudes to science (Garcia & Pintrich, 1996). Hence, efforts directed towards methods that increase students' motivation may yield higher results in enhancing favorable attitudes towards science than attempts to enhance the physical state of the classroom.

Overall, the study indicates that the current classroom environment is moderately effective in enhancing student's attitudes and motivation towards science. The moderate and strong relationships between classroom environment, motivation and attitudes establish the importance of improving the classroom's physical and instructional



conditions to increase motivation. More significantly, motivation stands out as another significant moderator, implying that attempts at enhancing students' motivation may produce a greater impact on better attitudes and enhanced interest in science than a mere enhancement of the classroom environment.

## **6. Recommendation**

Based on the results and conclusion, recommendations are presented. Engaging in the classroom environment is important to motivate senior high school students, thus improving their attitude towards science. Their desire for the subject will likely rise if they have access to classroom resources, feel more capable of completing tasks in the classroom, and recognize the importance of learning. A teacher needs to be a subject-matter specialist, committed to observing the educational processes, and sensitive to the needs of each student. Furthermore, based on the lowest results of Table 1 to 3, behavior management, a student's confidence in understanding complex materials from their instructor, normative beliefs about science involvement, and having an upset feeling when taking an exam showed the lowest mean. Suggesting the improvement of behavior management within the classroom and also more understandable materials from one's instructor in order to grasp the information presented more thoroughly.

Moreover, normative beliefs about science involvement could be improved or handled based on the students' environment since, as previously mentioned in this paper, it is defined as other people's expectations towards an individual. A student's normative beliefs could be influenced by the people around them. Thus, support from their environment is recommended for this low result. On the other hand, having an uneasy feeling during exams is noted to be moderately low in the results of this study. This result could not be seen to be such an unfavorable one, yet a neutral one. Uneasy feelings during tests are normal among every test taker. Therefore, the low recorded mean may signify confidence among the other learners in taking their tests since it is reflected to be almost rare to be manifested by students. Future researchers can utilize qualitative research to deepen the understanding of how motivation drives the classroom environment to improve students' learning attitude towards science.

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The authors declare no conflict of interest.

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Ivy D. Tuballa

THE MEDIATING EFFECT OF SCIENTIFIC EPISTEMOLOGICAL BELIEFS ON THE RELATIONSHIP BETWEEN CLASSROOM SOCIAL ENVIRONMENT AND ADAPTIVE LEARNING ENGAGEMENT OF SCIENCE STUDENTS

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