Science Laboratory Environment and Students Motivation as Predictors on Attitudes Towards Chemistry Lesson

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ABSTRACT

The learning chemistry plays a crucial role in shaping students' attitudes towards science subjects, particularly chemistry. Moreover, students' motivation levels significantly influence their engagement and performance in these lessons. This study investigates the combined impact of the Science Laboratory Environment and student motivation as predictors for students' attitudes towards chemistry lessons. By examining factors such as the quality of the laboratory setting and students' intrinsic drive to learn, this research aims to uncover the intricate relationship between these variables and their influence on students' perceptions and attitudes towards chemistry This research aims to determine the combined significant influence of science laboratory environment and student motivation on students attitudes towards chemistry lesson. This study used a non-exprimental quantitative method using a descriptive, correlational, and predictive approach. Moreover, the respondents of this study were chosen through purposive sampling to 100 junior high school students from private school in Davao City and answered the adopted 3 survey questionnaires. Using Mean and Pearson r, the findings indicated the following; science laboratory environment was high while student motivation and students attitude towards chemistry lesson were high. Furthermore, combining the two predictor variables science laboratory environment and student motivation shows a significant influence on students attitudes towards chemistry lesson.

Key words: students attitudes, students motivation, science laboratory environment

The Problem and Its Scope

In the ever-evolving field of education, it is essential to grasp the complex interaction between the science laboratory environment and students' motivation. This research examines the essential role these elements play in anticipating students' attitudes toward chemistry lessons. The science laboratory, frequently seen as the hub of experiential learning, and students' inherent motivation establish a mutually beneficial connection, shaping their outlook and involvement with the chemistry curriculum. By deciphering these predictive factors, educators and researchers can acquire valuable insights to improve the efficacy of chemistry instruction and cultivate a more favorable and engaging learning environment for students.

Science education faces the challenge of maintaining students' interest, particularly in subjects like chemistry (Musengimana et al., 2020). Additionally, Mahdi (2014) underscores the significance of chemistry, equipping students for diverse careers in chemical engineering, medicine, pharmacy, food science, and environmental studies. Despite its vital role, Nja et al. (2021) note an ongoing decline in students' performance at the foundational level, attributing the high failure rate to issues like teacher motivation, inadequate facilities, student attitudes, and limited professional development opportunities for science educators. This aligns with Akinbobola's (2015) assertion that, despite the acknowledged benefits of science subjects, the laboratory environment lacks the conditions necessary for effective teaching and learning. Consequently, students perceive science as a challenging subject, a sentiment supported by Olubu (2015), who suggests that poor performance in chemistry and related subjects may indicate deficiencies in the school-level laboratory setting. Over the past years, the Philippines has consistently shown a trend of students having limited scientific literacy. This is underscored by the recent PISA results, where Filipino students scored below the average set by the Organization for Economic Co-operation and Development (OECD) in mathematics, reading, and science. The significance of this issue was highlighted by DepEd Secretary Sarah Duterte during the PISA National Forum organized by the Department of Education (DepEd), where discussions on the outcomes of the latest international assessment cycle took place. Secretary Duterte emphasized, "PISA has provided us with valuable insights into the strengths and areas for improvement within our education system." This concerning pattern was evident when the Philippines participated for the first time in the Program for International Student Assessment (PISA) in 2018, revealing that Filipino 15-year-olds ranked near the bottom among 78 countries and territories (Organization for Economic Cooperation and Development [OECD], 2019a, 2019b). Attempts by Philippine studies to comprehend the low science achievement have focused on aspects such as the curriculum (Belmi and Mangali, 2020; Cordon and Polong, 2020) and instructional methods (Sumardani, 2021).

Moreover, studies have identified predictors of Filipino students' learning and achievement in subjects like chemistry, biology, physics, or specific science lessons. These studies can be categorized into two types: (a) those investigating the impact of instructional strategies (Antonio and Prudente, 2021; Francisco and Prudente, 2022; Magwilang, 2016; Morales, 2016, 2017a; Orozco and Yangco, 2016), and (b) those examining student motivations and other non-cognitive variables at the student level as predictors of learning and achievement (Bernardo, 2021; Bernardo et al., 2015; Ganotice and King, 2014; King and Ganotice, 2013, 2014).

Despite the numerous research evidence concerning the science laboratory environment and students' motivation, there is a notable lack of empirical studies in the Philippines exploring how these factors impact students' attitudes. Future researchers need to conduct in-depth investigations, including interviews with students to understand why they may dislike chemistry. Students' negative attitudes toward chemistry in school strongly influence their choices of university courses. If a majority of students harbor negative attitudes toward chemistry, universities and colleges may face challenges in attracting students to chemistry-related courses. This raises concerns about the limited number of individuals who may excel in chemistry in the future, presenting a significant challenge that needs to be addressed (Yunus & Ali, 2018).

The researcher aims to investigate whether specific indicators of the science laboratory environment, including cohesiveness, open-endedness, integration, rule clarity, and material environment (Fraser, 1986), along with attitude indicators such as self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation (Tuan and Chen, 2000), collectively exert a significant influence on students' attitudes towards chemistry. Most existing studies have primarily focused on only two variables within this context. In the researcher's local setting, there is a notable absence of similar comprehensive studies due to a lack of empirical research. Consequently, there is an urgent need to conduct this study to contribute valuable insights to the existing body of knowledge on the subject.

Rationale of the Study

Similar to other physical and natural sciences, chemistry plays a crucial role in everyday life by offering opportunities for learners to comprehend the surrounding environment. Nevertheless, the process of teaching and learning chemistry at various educational levels has encountered numerous challenges. These challenges include students' deficiencies in problem-solving skills, limited spatial visualization abilities, struggles with understanding chemistry vocabulary, and ineffective communication between students and teachers, as indicated in prior research (Byusa et al., 2022). Consequently, researchers from diverse settings have consistently advocated for the establishment of a learning environment capable of effectively addressing these difficulties. This confirms the statement of Sibomana et al. (2021) which states that secondary schools continue to consider chemistry as difficult to learn and students develop a negative attitude towards this subject which leads to low achievement in the subject and it also reduces the student’s interest. The result of this study will be beneficial to the Department of Education Officials, School, Administrators, Chemistry Teachers, Students, and Future Researcher.

Department of Education Officials. The result of the study may help the officials of the Department of Education as they are part of the developing policies, guidelines, and curriculum assessments for the students.

School Administrators. This research will also help the school administrators to allow their faculty members to professionally grow by attending training and seminars that are related to science teaching.

Chemistry Teachers. This study will help chemistry teachers assess and improve their teaching and learning, improve students' motivation, and engage in a positive attitude toward chemistry lessons.

Students. This study will help the students to be more active, and motivated and participate in their chemistry classes.

Future Researchers. The result of the study will help future researchers to utilize some other factors that will enhance students' attitudes in chemistry lessons by using other variables.

Statement of the Problem

This research aimed to determine the combined significant influence of Science Laboratory Environment and Students' Motivation as Predictors of Students Attitude in a private school during the school year 2023-2024. Specifically, the study seeks to answer the following:

1. What is the level of the science laboratory environment as perceived by students in terms of:
   - 1.1 student cohesiveness;
   - 1.2 open-endedness;
   - 1.3 integration;
   - 1.4 rule clarity; and
   - 1.5 material environment?
2. What is the level of science motivation as perceived by the students in terms of:
   - 2.1 self- Efficacy;
   - 2.2 active Learning Strategies;
   - 2.3 science Learning Value;
   - 2.4 performance Goal;
   - 2.5 achievement Goal; and
   - 2.6 learning Environment Stimulation?
3. What is the level of student attitude towards chemistry lessons in terms of:
   - 3.1 enjoyment of chemistry lesson;
   - 3.2 social implications of chemistry;
   - 3.3 attitudes towards scientific inquiry;
   - 3.4 attitudes towards chemists/normality of chemist;
   - 3.5 career interest in chemist; and
   - 3.6 leisure interest in chemist?
4. Is there a significant relationship between science laboratory environment and students' attitude towards chemistry lesson?
5. Is there a significant relationship between students' motivation and students' attitude towards chemistry lessons?
6. Is there a combined significant influence of the science laboratory environment and science motivation on students' attitudes on chemistry?

Hypothesis

The hypothesis was tested at a 0.05 level of significance:

Ho1: There is no significant relationship between the science laboratory environment and students' attitude towards chemistry.

Ho2: There is no significant relationship between science motivation and students' attitudes towards chemistry.

Ho3: There is no combined significant influence of the science laboratory environment and students' motivation on students' attitudes towards chemistry.

REVIEW OF RELATED LITERATURE

The study "Science Laboratory Environment and Students' Motivation as Predictors on Attitudes Towards Chemistry Lesson" investigates the effect of laboratory settings and student motivation on attitudes toward chemistry education. The goal is to understand the relationship between laboratory quality, student motivation, and overall attitudes about chemistry lesson. This study is significant in understanding the various systems that impact students' perceptions and engagement in chemistry instruction.

This portion of the study presents the related literature, studies, and theories of the science laboratory environment, students' motivation, and attitudes toward chemistry lessons. The first variable was the science laboratory environment which comprises 5 domains namely, student cohesiveness, open- endedness, integration, rule clarity, and material environment adopted by Fraser (1986). The second variable was the students' motivation which comprises of 6 domains namely, self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation adopted from Tuan & Chen (2000). Lastly, student attitude towards chemistry lessons comprises 6 domains namely: enjoyment of chemistry lessons, social implications of chemistry, attitudes towards scientific inquiry, attitudes towards chemists/normality of chemists, career Interest in chemist; and leisure interest in chemist adopted from Denila (2010).

Eliseo (2023) claims that science laboratory instruction has garnered praise for its ability to foster within students a positive mindset toward science. Additionally, Bates (2014) clarified that a varied physical setting, context, and culture constitute a learning environment for students. Allanas (2021) provides support for this, noting that the laboratory's distinct setting for learning renders it an essential component of science instruction. Moreover, Berger (2015) found that in the laboratory, students had the opportunity to link their observations to concepts learned in class and to actively connect theory to experiment.

On the other hand, Hatano et al. (2017) emphasized the significance of a conducive learning environment for students. This implies that students require an encouraging and enriching atmosphere that enables them to flourish and prosper. Competent teachers play a crucial role in crafting such an environment by establishing and communicating clear expectations for behavior, monitoring students' conduct, and ensuring their focus on tasks. The study by Kolil et al. (2020), asserts that laboratory exercises serve as a method of instruction to enhance the academic achievement and conceptual understanding of undergraduate students. Additionally, these exercises contribute to fostering positive attitudes and promoting cognitive development.

Moreover, there are three factors interact to shape students' attitudes toward school subjects: the learning environment, student characteristics, and instructor qualities. Consequently, the qualities of the learning environment impact students' interests and attitudes since teachers can incorporate many activities in scientific classrooms, given their level of expertise and the suitability of the surroundings. Various activities implemented in the learning environment positively impact students' interests and attitudes toward the class (Kalyon, 2020) since chemistry is a science based on experimentation, thus, performing experiments within the laboratory becomes essential to the teaching and learning process (Olubu, 2015). She asserts that effective chemistry teaching and learning can only take place when theoretical explanations are substantiated by actual laboratory practices. She emphasizes that the teaching laboratory serves as the standard method for training students in the skills and values essential to scientific investigation. Furthermore, she contends that it plays a crucial role in fostering a positive attitude toward chemistry.

Student Cohesiveness. Indicates that students know, help, and are supportive of one another (Allanas, 2021). According to, Hu et al (2023), peer interaction is essential for group creative thinking. The formation of appropriate peer interaction may enable peers to exchange high-level thinking and learning outcomes while also encouraging the development of student's critical thinking skills. Also, collaborative activities between fellow students can affect their learning performance, the more positive their interactions, the better their learning performance (Perry & Miller, 2019).

Moreover, when asked about Student Cohesiveness, teachers asserted that students should typically cultivate positive relationships with one another. They expressed the belief that there were no significant obstacles to students getting acquainted in class, emphasizing how the substantial time spent together in school facilitated this familiarity (Kwok, 2015).

Open-Endedness. Is the degree to which experiments emphasize a flexible, different approach to exploration (Eliseo, 2023). It was clarified that this dimension pertains to whether students are granted the autonomy to design their experiments. This circumstance arises from the prevailing laboratory learning system, which adheres to the cookbook model. In this model, students conduct investigations following instructions outlined in the practicum book, thereby hindering the execution of open experiments due to students' limited foundational skills and knowledge in laboratory work (Allanas, 2021).

Likewise, the use of the laboratory activities by the teacher was affected by their epistemological belief and if the teachers view science as a body of factual knowledge and students as receivers of such knowledge from teachers, it was likely that the purposes of the laboratory work were to demonstrate and verify scientific principles (Kwok, 2015).

Integration. This is the extent to which the laboratory activities are integrated with non-laboratory and theory classes (Eliseo, 2023). Furthermore, it is considered as an indicator that assesses the way concepts acquired in the classroom integrate with laboratory activities. (Allanas, 2021).

Rule Clarity. Is the amount to which laboratory conduct is governed by formal rules (Eliseo, 2023). Similarly, this dimension assesses the level of regulations in place during laboratory activities. Regulations are essential to oversee the operation of tools and instruments because the laboratory, being a site for experiments, is also susceptible to accidents. In a chemical laboratory, especially, there exist hazardous and flammable materials (Allanas, 2021).

On the other hand, there is a correlation between the open-ended dimension and the clarity rule, if open-endedness is applied, the clarity rule becomes looser allowing students to apply the freedom of the method in their practicum. In this case, it is quite risky because the lack of rules can increase the risk of accidents, therefore teachers generally tend to be rather strict in enforcing safety regulations to anticipate laboratory accidents (Kwok, 2015).

Moreover, it also considers the degree to which the rules of conduct are clearly understood and the degree to which the teacher consistently deals with rule violations (Kuzle & Gracin, 2021).

Students' Motivation

The enthusiasm, perspectives, and drive of students toward learning science tend to diminish over time, particularly throughout the middle school years (Naor et al., 2014). Furthermore, cultivating student motivation is a challenging yet essential element of teaching that instructors must take into account. Some may have experienced leading classes where students are actively involved, motivated, and enthusiastic about learning. Conversely, there might be instances where students appear distracted, uninterested, and hesitant to engage. In all likelihood, instructors have led classes that encompass a combination of these dynamics Yarborough & Fedesco (2020). In addition, motivated students are far more likely to reach their full potential and achieve success. It is a necessary component of effective teaching and learning. It not only results in more positive behavior in students, but it also contributes to a sense of well-being (Hawthorne, 2021).

Research on motivation aims to clarify the factors influencing students' efforts to achieve specific goals, encompassing the intensity and duration of their exertion, as well as the emotions and sentiments characterizing the teaching-learning process. Students' motivation is closely linked to their subjective experiences, particularly those associated with the will and rationale for engaging in academic activities and the social relationships cultivated in the classroom setting. Therefore, motivation to learn is not solely the responsibility of the students; it also arises from the quality of teaching they receive. This complexity is accurately expressed by the assertion that "students are not unmotivated because they do not learn; rather, they do not learn because they are not motivated"(Cicuto & Torres, 2016).

Self-Efficacy. Is one's confidence in carrying out specific academic pursuits. Because students are more involved in tasks where they feel competent and secure, and less engaged when this does not occur, efficacy perception influences compromise. It also predicts how much time and effort students put into a task; the greater their sense of efficacy, the greater their effort and persistence (Cicuto & Torres, 2016). Furthermore, self-efficacy constitutes a significant theory impacting not just the involvement of cognitive mediators linking behavior to key determinants of human behavior but also influencing social dynamics and emotions (Myeong, 2018).

Moreover, research highlights the crucial role of self-efficacy beliefs in performance, warning against overconfidence that may harm later outcomes. It indicates that self-efficacy influences adaptive behaviors, fosters resilience in complex tasks, and uniquely contributes to transfer performance beyond acquired knowledge and skills (Lishinski et al., 2016).

Active Learning Strategy. The active learning approach focuses all learning activities on students, enabling them to directly engage in the teaching and learning process (Eustaqio et al., 2022). Furthermore, students who actively participate in a variety of learning modalities and who can manage their learning are believed to be more motivated and perform better. When individuals study in an active learning environment, they are prompted to take responsibility (Cicuto & Torres 2016).

Scientific Learning Value. Students become actively involved in scientific learning when they realize the task's value (Cicuto & Torres, 2016). In addition, the significance of the task for the individual, the pleasure derived from engaging in the task, the task's utility, and the adverse costs associated with it work in tandem to shape the task's value for the individual (Tas & Cakir, 2014). The authors suggested that people who value learning science are more likely to use active learning strategies.

Learning Environment. Commonly refers to the social, psychological, or psycho-social environment where learning or, in some instances, teaching occurs (Cleveland & Fisher, 2014). An active learning environment can lead to students achieving high goals, possessing strong self-belief, utilizing active learning strategies, and embracing scientific values (Cicuto & Torres, 2016). It is the most important factor of learning, which affects both motivation for learning and learning achievements (Radovan & Makovec (2015).

Performance Goal. Student achievement is influenced by both extrinsic and intrinsic motivation. Extrinsic motivation, driven by performance goals, peer competition, and seeking teacher approval, relies on reward systems with short or long-term outcomes (Cicuto & Torres, 2016). Despite its effectiveness, extrinsic motivation has limitations, as learning is constrained by socially defined desires. This is supported by (Radovan & Makovec (2015), the authors said that the adverse effects of extrinsic goals are primarily evident in the adoption of shallow learning strategies, heightened stress perception, and the practice of self-handicapping.

Achievement Goal. Achievement goal orientation is a psychological concept that outlines students' preferences for different goals, outcomes, and rewards (Hakulinen & Auvinen, 2014). In addition, intrinsic motivation arises when students aim for achievement, and find joy in learning. Furthermore, these students participate in academic activities driven by interest in the subject and necessary skills (Cicuto & Torres, 2016). The authors emphasized that intrinsically motivated students see tasks as valuable in themselves, not just as a means to an end, leading them to work diligently for the sake of learning rather than merely pursuing high grades. Nevertheless, certain research indicates that the adoption of achievement goals by students is influenced by the classroom environment. One aspect of this environment is characterized by the classroom goal structure, which refers to how students interpret their classroom experiences and the motivational orientation they embrace, known as their classroom goal orientation (Chophy, 2018).

Attitudes towards Chemistry Lesson

Assessment within the chemistry curriculum goes beyond the cognitive domain, including the psychomotor and affective domains. Among the affective domains, attitude holds significant importance comparable to academic achievement. Thus, fostering positive attitudes toward chemistry becomes imperative. Unfortunately, studies indicate that chemistry is generally less appealing to students across various age groups (Arniezca & Ikhsan, 2021). The authors elaborate that in the classroom setting, teachers can assess students' attitudes by observing their behavior. Students who consistently complete tasks and actively engage by asking questions during chemistry lessons typically exhibit a positive attitude toward the subject.

Furthermore, a robust correlation exists between students' attitudes and their academic achievements. Once the students' attitudes are identified, suitable instructional methods can be devised to align with their interests. However, despite the acknowledged significance of Chemistry in our daily lives, it is disheartening to observe that the performance of students in secondary schools, along with their attitudes toward these subjects, falls short of expectations (Omwirhiren & Anderson, 2016). The authors emphasize that a student's perception of chemistry significantly influences their attitudes towards the subject, and this attitude, in turn, determines their academic performance. Consequently, fostering a positive attitude towards science as a school subject stands as a crucial responsibility for every science teacher.

The contextual teaching of chemistry renders the subject matter more relevant to students' lives by establishing connections between everyday activities and chemistry concepts. This is achieved by linking the microscopic level in terms of the general content of the course, thereby enhancing students' appreciation of the contribution of chemistry to their lives (Magwilang, 2016). Additionally, he indicated that students' perceptions of chemistry as being too abstract and difficult are gradually transformed into increased interest, excitement, and attention toward the lessons. This transformation motivates and encourages students to develop positive attitudes toward chemistry.

In addition, the majority of students report a sense of accomplishment and satisfaction when they succeed in their chemistry endeavors—essentially, they feel good when their efforts to excel in chemistry yield positive outcomes (Woldeamanuel & Selassie, 2019). The authors elaborate that nearly all students express enjoyment in studying chemistry when they perceive its utility in solving everyday problems. Additionally, the study reveals that regardless of gender, students tend to have a low attitude toward learning chemistry. The causes for this inclination may stem from the challenging nature of the material, a limited awareness of the importance of chemistry in daily life, a lack of exposure and field trips, unappealing and inadequately equipped laboratories, and insufficient teacher motivation.

Enjoyment of Science/Chemistry Lesson. The convenience and comfort that students experience in learning science can influence their motivation for future engagement with science and the frequency of science learning activities in class. It is crucial to understand how comfortable students feel in the learning process (Najid et al., 2021). Additionally, the enjoyment of science affects students' willingness to invest time and effort in science-related activities, their choice of electives, their self-image, and the types of careers they aspire to and choose to pursue (OECD, 2016).

Social Implications of Science/Chemistry. In this dimension, it indicates students' perspectives on science, its impact on their lives, and its influence on the social fabric of the state. It also reveals that students believe science has social implications (Najid et al., 2021). The study emphasizes that students are inclined to discuss these social effects, which can enhance the positive impacts on students, influencing their academic achievements. The social implications manifest in the interactions between students and teachers, as well as among students themselves (Maison et al., 2019).

Attitudes Towards Scientific Inquiry. This phrase refers to combining fundamental science process skills with the established science content to promote creativity and critical thinking, facilitating the development of scientific knowledge (Najid et al., 2021). Moreover, students often encounter questions embedded in the articles they receive. In the science problem-solving process, students typically observe, analyze, and measure, ultimately drawing conclusions to arrive at answers, necessitating their involvement in both scientific and critical thinking (Maison et al., 2019).

Attitudes Towards Science/Chemists/Normality of Chemists/Science. Many students displayed hesitance in this dimension, viewing a scientist as someone inherently gifted and proficient in all scientific domains (Najid et al., 2021). This viewpoint resonates with the idea presented by (Maison et al., 2019), asserting that misconceptions about scientific knowledge influence the conventional perception of a scientist. According to this perspective, an accurate portrayal of a scientist entails possessing a scientific mindset, the ability to solve scientific problems, and the capacity to discover new things.

Career Interest in Science/Chemist. Many countries report a decline in student interest in science and in recruiting students to study science, therefore, identifying the source of the decline and finding solutions is an important aspect of addressing the issue at a high school level. (Najid et al., 2021).

Leisure interest in Science/chemistry. This dimension highlights students' enthusiasm for science, encompassing various aspects of their lives, including discussions about science both within and beyond the school environment, engagement in science-related activities, and conversations about scientific topics (Najid et al., 2021). The concept further elaborates on the interest in extending science learning time for students to enhance their mastery of the subject. This involves revisiting class materials independently at home, and practicing questions individually and in groups. One of the challenges encountered pertains to students' attitudes and perspectives on natural science, which are often negative due to the perception that science subjects are difficult and require a comprehensive understanding of concepts to achieve academic success (Maison et al., 2010).

Synthesis

The literature review examines three main variables: the science laboratory environment, student motivation, and attitudes toward chemistry lessons. The science laboratory environment is detailed across five domains, while student motivation encompasses six domains, and attitudes toward chemistry lessons involve six domains. Science laboratory instruction is recognized for positively influencing students' attitudes toward science, emphasizing the importance of a conducive learning environment, particularly in laboratories, for academic achievement, positive attitudes, and cognitive development.

The synthesis further explores students' motivation, highlighting the role of self-efficacy beliefs and the active learning approach. Motivated students are deemed more likely to succeed, and their engagement in the learning process is crucial. Finally, the review addresses attitudes toward chemistry lessons, emphasizing the significance of fostering positive attitudes for enhanced academic achievements. The interconnectedness of these factors is underscored, emphasizing the need for a positive learning environment, motivation, and favorable attitudes to promote effective science education.

Theoretical/Conceptual Framework

This study is based on Eliseo's (2023) idea that the science laboratory learning environment has been acknowledged for over a decade for its positive impact on student attitudes toward science and the cultivation of interest in science subjects. Allowing students to combine practical activities with theoretical learning in the science laboratory class helps develop a favorable attitude toward chemistry lessons, encouraging them to pursue careers in science.

In the same way, the Progressivism theory, highlighted by Dewey (1950) and discussed by Diehl (2005), underscores the importance of students actively experimenting with ideas in education. This approach is rooted in learners' questions that arise from real-world experiences. This idea is consistent with Tippett and Lee's (2019) statement that progressivism theory revolves around the child, emphasizing the importance of educating the

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whole child. It involves incorporating tasks suitable for the child's development that extend beyond memorization, departing from the traditional approach in primary and secondary education during that era.

Bandura's Social Learning Theory, developed in 1977, emphasizes that people acquire social actions and attitudes by observing or imitating others. This theory, a crucial component of the learning process, highlights the importance of symbolic interaction (Hsu & Huang, 2018). It suggests that interpersonal connections and communication play a direct role in behavioral learning, and the exploration of attitudes and values goes beyond just behaviors. Moreover, it provides a useful framework for understanding how students learn through observation and modeling. According to Bandura's theory, learning takes place in a social context through observation, involving a cognitive process where learners internalize and understand what they observe to reproduce the behavior themselves (Horsburgh & Ippolito, 2018).

The Self-Determination Theory (SDT), developed by Edward Deci and Richard Ryan, is a significant educational theory closely linked to students' motivation. SDT identifies three crucial psychological needs: autonomy (control over actions), competence (feeling effective), and relatedness (meaningful connections). When these needs are satisfied, individuals are more likely to be intrinsically motivated, leading to increased engagement and overall well-being. In an educational context, SDT suggests that fostering autonomy through choices, providing opportunities for skill development, and nurturing positive relationships can enhance intrinsic motivation. Teachers play a pivotal role in creating supportive environments that promote competence and relatedness, ultimately contributing to a deeper understanding and enhancement of students' motivation within the learning process.

Furthermore, the conceptual framework of this study is shown in Figure 1. The top left box shows the science laboratory environment and the bottom left box is the students' motivation. The line below shows their connection indicating a possible relation between the two variables. The students' motivation and science laboratory environment are further connected to the left-right box which is the students' attitude towards chemistry lessons. This connection may also indicate the possible relation of each variable to the student's attitude toward chemistry.

Figure 1 simplifies the study's conceptual framework. The upper-left box is the science lab environment, and the lower-left box is students' motivation, with a line indicating a potential connection. These two, along with students' attitudes toward chemistry in the left-right box, suggest a possible link between each variable and students' attitudes toward chemistry.

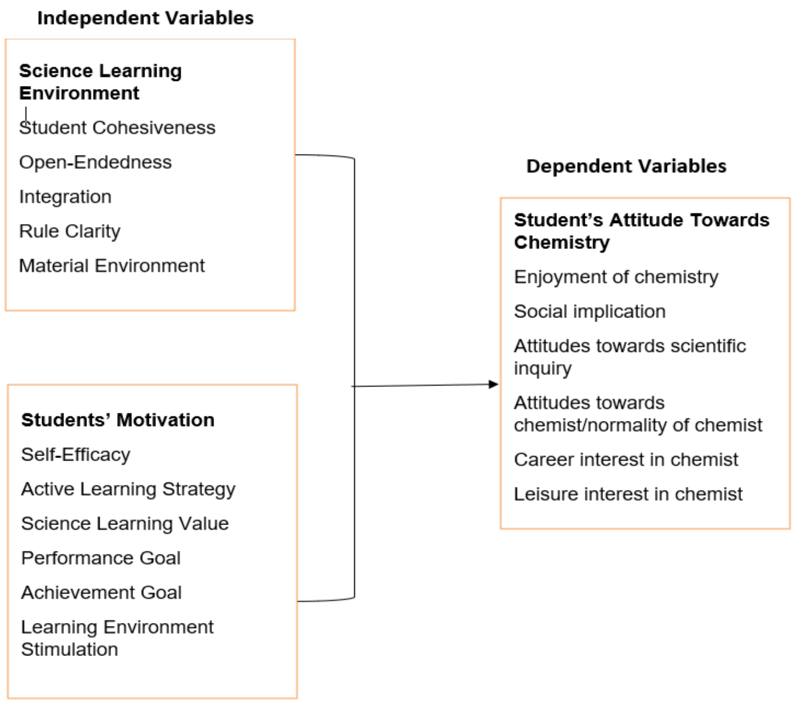

Figure 1. Conceptual Framework of the Study

METHODS

This chapter describes the research design, research locale, research respondents, research instruments, ethical considerations, data-gathering procedures, and data analysis.

Research Design

This study used a descriptive and predictive non-experimental-quantitative design. This supports the theory put forth by Racke and Racke (2014), according to which non-experimental research summarizes findings and makes observations on the relationships between factors rather than relying on manipulating variables. It was also used for this study because it aims to investigate the important combined effects of motivation and the science laboratory environment on the science attitude in chemistry. The design further optimizes the usage of data and statistical tools like mean and Pearson r. Thus, a quantitative approach was taken in this investigation.

Moreover, in the same spirit, this is consistent with the claim made by Chiang et al. (2020), who noted that correlational research methods do not require the manipulation of an independent variable; rather, they include the measurement of two variables and the evaluation of their relationship. This method is chosen because it clarifies the relationship between two or more variables, such as the setting of the scientific lab and the motivation and attitudes of the students toward the chemical lecture. As a result, the study can be conducted using this approach.

Research Locale

The study was conducted in Davao City, Philippines. The schools chosen in this study are private educational institutions particularly the junior high school of the basic education department around cluster 3.

Research Respondents

The respondents were 100 junior high school students from private schools in Davao City, Philippines during the school year 2023-2024. To promote fairness in the data collection the data gathered in the study was purposive or judgement sampling. The idea behind the sampling technique is to focus on people with specific characteristics who will better be able to assist with the relevant research (Etikan et al), in the process of identifying and selecting individuals who are knowledgeable and skilled with phenomena of interest.

Research Instruments

This study adopted 3 questionnaires. The first part of the questionnaire was the Science Laboratory Environment Inventory (SLEI) (Fraser, 1986). The second questionnaire was the Students' Motivation Towards Science Learning (SMTSL) (Tuan and Chen, 2000). The third questionnaire used was the Attitude Towards Science Scale (ATSS) Developed by Ato and Wilkinson (1979 used by Denila (2010).

The SLEI scale comprises 33 items on a five-point Likert scale comprised of five indicators with 33 items namely student cohesiveness, open-endedness, integration, rule clarity, and material environment. The respondents rate using the 5-point Likert scale- 5 -strongly agree to 1-strongly disagree. The following range of interpretations is used to interpret the mean score obtained for the Science Laboratory Environment:

Range of Means	Descriptive Level	Interpretation
4.20 - 5.0	Very High	This means that the items in the science learning environment are always observed.
3.40 -4.19	High	This means that the items in the science learning environment are sometimes observed.
2.60 - 3.39	Moderate	This means that the items in the science learning environment are seldom observed

1.80 - 2.59	Low	This means that the items in the science learning environment are seldom observed.
1.0 - 1.79	Very Low	This means that the items in the science learning environment are seldom observed.

On the other hand, the second part of the questionnaire was the students' motivation. The SMTSL scale comprises of 35 items on a five-point Likert scale comprises of 6 indicators namely, self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation. The following range of interpretations is used to interpret the mean score obtained for the Science Laboratory Environment:

Range of Means	Descriptive Level	Interpretation
4.20 - 5.0	Very High	This means that the items in the science learning environment is always observed.
3.40 -4.19	High	This means that the items in the science learning environment is sometimes observed.
2.60 - 3.39	Moderate	This means that the items in the science learning environment is seldom observed
1.80 - 2.59	Low	This means that the items in the science learning environment is seldom observed.
1.0 - 1.79	Very Low	This means that the items in the science learning environment almost never observed.

Moreover, the third part of the questionnaire was the Attitude Towards Science Scale (ATSS) which consisted of 43 items on a five-point Likert scale encompassing six factors namely Enjoyment of Chemistry Lesson, Social Implications of Chemistry, Attitude Towards Chemists, Career Interest in Chemists, Leisure Interest in Chemists. The following range of interpretations is used to interpret the mean score obtained for Student's Attitude in Chemistry Lesson:

Range of Means	Descriptive Level	Interpretation
4.20 - 5.0	Very High	This means that the items in the science learning environment is always observed.
3.40 -4.19	High	This means that the items in the science learning environment is sometimes observed.
2.60 - 3.39	Moderate	This means that the items in the science learning environment is seldom observed
1.80 - 2.59	Low	This means that the items in the science learning environment is seldom observed.
1.0 - 1.79	Very Low	This means that the items in the science learning environment are seldom observed.

In summary, the research instrument comprises a total of 111 items. Part 1, about the first independent variable, consists of 33 items, while Part 2, associated with the second independent variable, includes 35 items. Part 3, focusing on the dependent variable, encompasses an additional 43 items. Before administration, the research instrument underwent validation by research experts. The validation process assessed various aspects, including the clarity of directions and items, presentation and organization, suitability of the items, adequacy, achievement of purpose, and objectivity of the instrument in this study.

Ethical Consideration

Ethics is considered vital in the study's context since the respondents will express their preferences and opinions concerning their levels of political efficacy and participation. Politics is a sensitive topic to the society. Hence, it is important to consider some ethical considerations that will protect the respondents from all forms of harm that they might experience as they disclose their views about the topic concerned. Every study must include ethical considerations as a necessary component. Therefore, in this study, the researcher will be observing and adhering to the following protocol assessment indicators: social value, informed consent/assent, risks, benefits, and safety, privacy and confidentiality of information, justice, transparency, qualification of researcher, adequacy of facilities, and community involvement.

Social Value. The study holds significance for various stakeholders. Firstly, it is relevant to DepEd officials who play a crucial role in the development of policies, guidelines, and curriculum assessments for students. Secondly, school administrators can benefit by facilitating opportunities for their faculty members to attend training and seminars related to science teaching. Lastly, chemistry teachers stand to gain insights that can aid them in assessing and enhancing their teaching and learning practices.

Informed Consent/Assent. The purpose of the Informed Consent Form and Assent Forms is to ensure the voluntary participation of respondents and their parents/guardians, granting them the right to withdraw at any point. To address internet connectivity, a portable WiFi Router/Pocket WiFi was provided to parents and respondents for their involvement in the study. The survey questionnaire was administered to grade 9 and grade 10 students, all below 18 years old, where obtaining informed consent served as a prerequisite to securing assent. The research instrument was conducted online through Google Forms and delivered to respondents via email.

Furthermore, the information was conveyed to parents/guardians using a language they could comprehend. The researcher ensured that informed consent was signed before directing respondents to the online questionnaire link through Google Forms. Respondents were acquainted with the informed consent's content prior to participating, and printed documents were provided upon request. Any queries were addressed to their satisfaction, and they voluntarily consented to their child or children being part of the study.

Risk, Benefits, and Safety. The potential risks, benefits, and safety concerns for the study's respondents were thoroughly addressed in advance. One identified risk pertained to the security of personal information collected during the survey. To mitigate this, the researcher provided internet connectivity for parents and respondents, ensuring their secure participation. The anticipated benefits of the study include enhancing the teaching skills of chemistry teachers. The researcher's foremost responsibility is ensuring the security and well-being of the respondents.

Privacy and Confidentiality of Information. The Data Privacy Act of 2012 is a robust legislation designed to safeguard the fundamental human right to privacy of communication, simultaneously facilitating the free flow of information to encourage innovation and growth. The researcher adhered strictly to privacy regulations, preserving all personally identifiable information in a confidential manner without disclosure to any third party. Personal data were securely stored in an anonymous manner, with digital files password-protected and accessible only to the researcher. Following the completion of the study, all digital files were permanently deleted, and printed documents were responsibly disposed of using a shredder.

Justice. The study employed purposive or judgment sampling to ensure fairness to the respondents, and the researcher took on any necessary compensation costs as part of their responsibility. To facilitate internet connectivity for parents and respondents, a Portable WiFi Router/Pocket WiFi was provided by the researcher. Additionally, due acknowledgment was given to all respondents who participated in the study in the complete manuscript.

Transparency. The researcher took precautions to prevent any conflicts of interest in this study and addressed them appropriately if they arose. Honesty was encouraged from all participants. Before the final reporting of the study, the respondents were informed of the findings, ensuring they were fully aware of the implications of their participation. There is an intention to present the research findings orally and/or in written form at research congresses and for publication if the opportunity arises.

Qualification of the Researcher. The researcher is currently pursuing a Master of Arts in Education with a major in teaching General Sciences as part of the Educ 203 Research Method course. With 13 years of teaching experience in a private institution, the researcher possesses the necessary qualifications to conduct the study.

Adequacy of Facility. Prior to initiating the study, the researcher ensured that all communication channels were well-established for the distribution and collection of data. Respondents utilized their cellphones, iPads, and laptops to complete the survey. The entire data gathering process occurred online, with the survey being conducted through Google Forms, a platform familiar to the respondents.

Community Involvement. The researcher prioritized adherence to and respect for local culture, tradition, and religion to prevent biases, particularly in formulating the research instrument. Additionally, the researcher honored the consent of the respondents and, upon completion of the study, disseminated the results to aid more Chemistry teachers in conducting research involving different variables. The researcher also respected and acknowledged the community involvement of the participants.

Data Gathering Procedures

The following steps were taken by the researcher in conducting the research procedure.

Asking for Permission to Conduct the Study. The researcher personally obtained the certificate for Initial Approval from the Research Ethics Committee, along with written permission signed by both the researcher and the adviser. This documentation was then submitted to the Dean of the Graduate School to seek approval for conducting the study on the science laboratory environment and students' motivation as predictors of students' attitudes towards chemistry lessons. This study was conducted in a selected school with respondents in Davao City. After obtaining the necessary permissions, the researcher sent a letter to the school president outlining the study's conditions and rules. Furthermore, the researcher obtained informed consent from both the parents and the respondents whose parents provided consent.

Administration and Retrieval of Questionnaires. The researcher personally administered the adopted questionnaire with the assistance of the school principal. Respondents were requested to complete the questionnaires carefully and not leave any items unanswered. The study was administered to a total of 300 Junior High School students. To ensure the complete and orderly distribution as well as the retrieval of the instrument, the researcher was present to answer any questions from the respondents regarding the adopted questionnaire.

Gathering and Tabulation of Data. The researcher, assisted by data analysis experts, collected data from the respondents. The data, gathered through Google Forms on the internet, underwent analysis using mean and Pearson r. Subsequently, the results were tabulated and interpreted using appropriate statistical tools. The entire study adhered to strict ethical considerations throughout its conduct.

Data Analysis

The gathered data was examined using the following statistical tools:

Mean. This was used to describe the level of the science laboratory environment, attitude of chemistry lessons, and science identity,

Pearson r. This was utilized to determine the significant relationship between the science laboratory environment and students’ attitudes toward chemistry lessons, and the significant relationship between students’ motivation and attitudes to chemistry lessons.

Multiple Linear Regression. This was used to determine the singular and combined significant influence of the science laboratory environment and students’ motivation towards chemistry lessons on science identity.

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RESULTS AND DISCUSSION

The analyses and interpretations of the data that the researcher collected are presented in this chapter. Discussions are organized into categories based on how the problem was stated in the first chapter.

Summary of the Level of Science Laboratory Environment as Perceived by the Students

The first objective of this study was to determine the level of science laboratory environment as perceived by the students. Table 1 provides the answer to this objective. The attributes of the science laboratory environment in this study comprises five indicators namely: student cohesiveness, open-endedness, integration, rule clarity, and material environment.

Table 1. Summary of the Level of Science Laboratory Environment as Perceived by the Students.

Indicators	Mean	Descriptive Level
Student Cohesiveness	4.30	Very High
Open-Endedness	4.05	High
Integration	4.27	Very High
Rule Clarity	4.34	Very High
Material Environment	4.19	High
Overall	**4.23**	**Very High**

As shown in Table 1, the level of science laboratory environment as perceived by the students gets an overall mean of 4.23 or *very high* which means it was always observed. This confirms the statement of Nicol et al. (2022) that the science laboratory contains a space for conducting experiments to demonstrate the applications of theoretical ideas, as well as a space for learners to put scientific theory. This is supported by Olubu (2015) who suggested that the laboratory environment plays a significant role in chemistry education, potentially exerting a considerable influence on students' learning outcomes and positively contributing to the improvement of teaching and learning in chemistry.

Among the five indicators in the science learning environment, respondents perceived that *rule clarity* has the highest mean score 4.34, which means that it was always observed. This further implies science laboratory environment respondents agreed that there are certain rules, precautionary measure and guide to follow before the laboratory experiment commence, recognized way to do things safely, a tighter standards compare to other class, and experience informal atmosphere with minimal imposition of rules. The result also affirms the proposition of Allanas (2021) that the clarity of rules are essential for overseeing the operation of tools and instruments, given that the laboratory, being a site for experiments, is susceptible to accidents. Similarly, the findings are in parallel with the statements of Akinbobola (2015), that the form of rule clarity that the students preferred is the type that students' safety and proper handling and care of the equipment is ensured. He emphasized that the teachers should prepare the rules and regulations guiding laboratory activities an make them familiar to the students.

The second highest indicator of the science laboratory environment is *student cohesiveness* with a mean score of 4.30 or *very high which* means that was always observed. This further suggests that participants in the science laboratory environment acknowledged effective collaboration within the class, receiving support and building trust with fellow students. They also reported getting acquainted with others and forming strong relationships. These findings align with Bulgaru's (2014) assertion that group cohesion stems from members feeling connected to the group, desiring to remain part of it, and valuing its significance.

These results are corroborated by Hakama et al. (2018), who assert that the existence of cohesion within the class leads to various positive outcomes for group members, such as active participation in group meetings, enhanced preparedness for tasks, and a proactive adherence to group norms. Similarly, Yang and Lin (2022) emphasize that cohesive team members develop emotional connections, engaging in activities together, sharing meals, and discussing personal matters. When encountering challenges, cohesive teams collaborate to find solutions, offer mutual encouragement, and demonstrate resilience, rarely giving up.

The lowest indicator, is open-endedness with a mean score of 4.05 or high which means it was sometime observed. The respondents agreed that in the laboratory class the teacher decides the best way to carry out experiment, required to design experiments to solve problem, other students collect different data for the same problem, choose the best action in a given activity, allow to do different laboratory exercises. Akinbobola & Ikitde (2001), as cited by Akinbobola (2015) reiterated that effective laboratory courses prioritize students' active engagement in constructing scientific knowledge through questioning, evidence provision, and claim determination rather than mere verification.

The Level of Science Laboratory Environment as Perceived by the Students in terms of Student Cohesiveness

Table 1.1 displays students' perceptions of the science laboratory environment regarding student cohesiveness through six statements with corresponding mean ratings. The statement "we help each other during chemistry class" stands out with the highest mean of 4.39, indicating a very high level of cohesiveness among students, suggesting they are well-acquainted, cooperative, and supportive of each other.

Table 1.1 Level of Science Laboratory Environment in terms of Student Cohesiveness

Items *During chemistry class we…*	**Mean**	**Descriptive Level**
1. get along well with the students in this laboratory.	4.31	Very High
2. have a chance to get to know other students in this laboratory class.	4.27	Very High
3. help each other during laboratory class.	4.39	Very High
4. get to know the students very well.	4.18	High
5. can rely on the the assistance of other students.	4.30	Very High
6. work cooperatively in laboratory sessions.	4.33	Very High
Overall	**4.30**	**Very High**

Indeed, Rosen & Kelly (2022) assert that students share common goals and often require opportunities to engage with classmates facing similar situations and challenges. Furthermore, Kwok's (2015) study in Hong Kong revealed that students remain together for an entire academic year in various subjects, follow a fixed seating arrangement both in classrooms and laboratories, and are grouped consistently in labs. As a result of these practices, students develop strong familiarity with each other, facilitating the cultivation of close bonds within the class structure. This finding aligns with Elesio's (2023) statement that student cohesiveness is measured by the extent to which students know, assist, and support one another.

On the other hand, the lowest mean for the science laboratory environment as perceived by the students in terms of cohesiveness is 4.18 with a description of *high* belongs to the statement "during chemistry laboratory classes we get to know the students really well. This implies the need to employ a more collaborative activities that will encourage interaction among the students.

Slavin (2006), as cited by Anwar (2016) asserts that members of the group consists of a variety of learners who have a diversity of skills to work together to achieve the learning objectives. Therefore, in cooperative learning, learners are given some skills that can help them maximize the cooperation of members to succeed in the task group that is the ability to listen actively, the ability to be a good speaker, the ability to always avoid demeaning other members, and the ability to always accept others as new members. Furthermore, Poupore (2016,) stated that there was a notable correlation discovered between "group work dynamics," which extends beyond mere group closeness to encompass a sense of achievement and purpose, and both task motivation and language output.

The Level of Science Laboratory Environment as Perceived by the Students in terms of Open-Endedness

As depicted in Table 1.2, students' perceptions of the science laboratory environment regarding open-endedness are presented through seven indicators. The table reveals that the statement "In my laboratory class*, I am required to design my experiments to solve a given problem*" achieved the highest mean score of 4.26, indicating a *very high* level of open-endedness. This suggests that students are provided with opportunities to devise their own experiments and address problems within the laboratory setting.

Table 1.2 Level of Science Laboratory Environment in terms of Open-Endedness

Items *In my laboratory class…*	**Mean**	**Descriptive Level**
1. I have the opportunity to pursue my scientific interests.	4.21	Very High
2. I am required to design my experiments to solve a given problem.	4.26	Very High
3. other students collect different data than I do for the same problem.	4.08	High
4. I am allowed to go beyond the regular laboratory exercise and do some experimenting of my own.	3.86	High
5. I do different experiments than the other students.	3.69	High
6. the teacher/instructor decides the best way for me to carry out the laboratory experiments.	4.23	Very High
7. I determine the best course of action in a given laboratory experiments,	4.05	High
Overall	**4.05**	**High**

As stated by Olubu (2015), when a learning environment enables students to actively engage in the learning process, it empowers them to take charge of their own learning, consequently resulting in enhanced learning outcomes for the students. Moreover, as stated by Hidayah et al. (2021) that if students are given opportunity to engage in the learning environment with different scientific activities it will provides insight into how scientists conduct their work, which may subsequently influence students' attitudes towards scientific pursuits.

On the other hand, the indicator with the lowest mean of 3.69 with a description of *high* is "*I do different experiments than the other students.*" This implies that some students feel the freedom to develop their own experiment. In contrary, as stated by Allanas (2021) it is also not possible to conduct open experiments because students do not have basic skills and knowledge of laboratory work. Furthermore, due to the potential for accidents in the laboratory, students are restricted from conducting experiments beyond predetermined parameters.

The Level of Science Laboratory Environment as Perceived by the Students in terms of Integration

Table 1.3 displays students' perceptions of the science laboratory environment regarding integration, comprising seven indicators with corresponding mean scores and descriptions. The statement with the highest mean, "*the laboratory work is related to the topics that I am studying in science classes*," scored 4.37, indicating a very high level of integration. This suggests that students relate observations made in the laboratory to what had been taught in the classroom lessons.

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Table 1.3 Level of Science Laboratory Environment in terms of Integration

Items *In my chemistry class…*	**Mean**	**Descriptive Level**
1. what I do in our regular science class is related to my laboratory work.	4.27	Very High
2. the laboratory work is related to the topics that I am studying in science classes.	4.37	Very High
3. my regular science class work is integrated with laboratory activities.	4.27	Very High
4. I used some theories I've learned from the regular science classes during the laboratory activities.	4.19	High
5. the topics covered in regular science class work are the same as the topics with which I deal in laboratory Sessions.	4.23	Very High
6. what I do in laboratory sessions helps me to understand the theory covered in regular science classes.	4.30	Very High
7. my laboratory work and regular science class work are related.	4.29	Very High
Overall	**4.27**	**Very High**

The findings align with Gupta et al.'s (2015) research, which emphasizes the importance of enhanced integration between classroom instruction and practical laboratory work for students. On the other hand, the indicator with the lowest mean of 4.19 or *high* is "*I used some theories I've learned from the regular science classes during the laboratory activities*." This implies that the theories learned in the classroom will be applicable during laboratory activities.

Additionally, Olubu (2015) found that chemistry students perceived a higher level of integration between theoretical knowledge and practical application. Similarly, the findings from Chua & Karpudewan's (2017) study validate the notion that the environment facilitates the integration of theoretical concepts with practical lessons. Furthermore, Elesio (2023) defines integration as the degree to which laboratory activities are harmonized with non-laboratory and theoretical classes.

The Level of Science Laboratory Environment as Perceived by the Students in terms of Rule Clarity

As shown in the level of science laboratory environment as perceived by the student in terms of rule clarity with seven indicators a mean and a description. It can be seen from the table that the highest mean belongs to the statement *"has rules that guide my activities" and "I am required to follow- certain rules in the laboratory"* with a mean of 4.52 and a description of *very high*. This further implies the extent to which rules serve as guide in conducting the laboratory.

Table 1.4 Level of Science Laboratory Environment in terms of Rule Clarity

Items *My chemistry laboratory class…*	**Mean**	**Descriptive Level**
1. has rules that guide my activities.	4.52	Very High
2. I experience an informal atmosphere with minimal imposition of rules.	4.06	High
3. I am required to follow certain rules in the laboratory.	4.52	Very High
4. there is a recognized way for me to do things safely.	4.48	Very High

5. the teacher/instructor outlines safety precautions to me before my laboratory sessions commence.	4.41	Very High
6. there is a tighter standards than the rest of my classes.	4.08	High
Overall	**4.34**	**Very High**

In the study conducted by Olubu (2015) who states that experiments in chemistry laboratory lessons are normally organized with clear procedures that the students follow in carrying out laboratory activities. Myers and Fouts (1992), as referenced by Olubu (2015), proposed that it is primarily the responsibility of science educators to cultivate a conducive atmosphere that fosters favorable attitudes towards science. This is supported by Kwok (2015) who states that maintaining a well disciplined learning environment with an atmosphere that was neither too strict nor too much personal freedom requires teachers to have a good classroom management skills and the cooperation of self-disciplined students, since this is particularly important for adopting the inquiry learning approach in the laboratory. The author also further argued that if the student were often required to follow the rules for safety concerns, they perceived the laboratory as a very strict environment.

On the other hand, the indicator with the lowest mean of 4. 6 with a description of *high, is "I experience an informal atmosphere with minimal imposition of rule*s". This implies that sometimes student observed an informal atmosphere with minimal imposition of rules in the laboratory. According to Hofstein et al., 2001; Lazarowitz, 1991, as cited by Ayoubi, et al (2018), which stated that due to its less formal ambiance in contrast to the classroom, the laboratory environment encourages increased interaction among students and between students and teachers. This inherent characteristic has the capacity to facilitate positive social interactions, thereby fostering a constructive and favorable learning atmosphere.

The Level of Science Laboratory Environment as Perceived by the Students in terms of Material Environment

As shown in table 1.5 the indicator with the highest mean of 4.39 with a description of *very high* is "*the laboratory equipment which I used is in good working condition*". This further implies that there are enough and functional materials to go round all the students during laboratory activities.

Table 1.5 Level of Science Laboratory Environment in terms of Material Environment

Items *When I'm conducting experiments…*	**Mean**	**Descriptive Level**
1. I notice the laboratory is crowded.	3.67	High
2. the equipment and materials that I need for laboratory activities are readily available.	4.20	Ver High
3. I am happy with the appearance of the laboratory.	4.33	Very High
4. the laboratory equipment which I use is in good working order.	4.39	Very High
5. I find the experience highly appealing.	4.31	Very High
6. I find ample space in the laboratory for both individual and group work.	4.24	Very High
Overall	**4.19**	**High**

The result of the study is supported by, Olubu (2015) stated that chemistry lab offers students a lot of special equipment. Using it well needs students to be very prepared. So, teachers need to use the newest teaching methods to help students do better and stay interested in the subject. Furthermore, Akinbobola (2015) emphasized that a good laboratory environment enhances hands-on activities and enables the students to acquire basic science process skills in order to solve problems.

On the other hand, the indicator with the lowest mean of 3. 67 with a description of *high* is "*I noticed that the laboratory is crowded.*" This further implies that it is crucial for the students' safety as well as the efficacy of the teaching laboratory.

According to Gupta et al. (2015), understanding students' views helps teachers create a conducive learning environment. Hamidu et al. (2014) emphasize the importance of laboratories in science education, stating that success in science courses relies on adequate laboratory resources. Additionally, Elesio (2023) highlights the significance of having sufficient laboratory equipment and materials, defining it as the material environment.

Summary of the Level of Student Motivation towards Chemistry Lesson

The second objective of the study was to determine the level of student motivation towards chemistry lesson. Table 2 provides the summary.

Table 2. Summary of the Level of Student Motivation Towards Science Learning

Indicators	**Mean**	**Descriptive Level**
Self- Efficacy	4.09	High
Active Learning Strategies	4.24	Very High
Science Learning Values	4.30	High
Performance Goal	3.75	High
Achievement Goal	4.33	Very High
Learning Environment Stimulation	4.06	High
Overall	**4.13**	**High**

The level of student motivation towards chemistry lessons in terms of self-efficacy, active learning strategies, science learning values, performance goal, achievement goal, learning environment stimulation is shown in Table 2. Among the six indicators, respondents perceived the *achievement goal* with the mean score of 4.33 with a description of *very high which means it was always observed. This suggest* that students exhibit a very high level of motivation towards achieving specific goals and are driven by clear objectives, and are highly committed to attaining success in their science learning endeavors. A high mean score in this category suggests that students are driven by clear objectives and are highly committed to attaining success in their science education.

This finding substantiate the idea of Bandura (1997) as cited by Baddareen et al. (2014), suggested that individuals' behaviors are influenced by their beliefs regarding their capability to perform a task successfully. It's not just about possessing the necessary skills and knowledge; individuals also require a certain level of confidence in their ability to succeed. The goals people set affect how they act, react, and stay motivated to learn.

The second second highest indicator " Science Learning Values" with the mean of 4.30 and a description of very high. This means that students really value what they learn in science class. They probably understand how important science is for their lives and future, and they enjoy learning about science topics and doing science activities.

According to Llbao et al., referencing Lavigne, Vallerand & Miquelon (2007) and Bautista (2012), science education in the 21st century faces the challenge of aligning with the needs and expectations of society regarding science and technology. To meet these demands, science education plays a crucial role in shaping students' cognitive abilities, enhancing academic performance, and acquiring both subject-specific and transferable scientific skills. Moreover, as stated by to Schulze, referencing Schunk & Zimmerman (2007), students are driven to engage in activities that they find interesting, practical, and relevant to their everyday experiences. Even if students doubt their abilities (lack self-efficacy), they are still willing to try to complete tasks if they see value in the activities.

The third highest indicator is the "*active learning strategies*" with a mean of 4.24 and a description of *very high*. This suggests that when students are involved in their learning process, participating actively rather than passively, their motivation towards science learning tends to be significantly higher, since active learning encourages students to take control of their learning, explore concepts actively, and apply what they learn, which in turn boosts their motivation.

Sicuto et al. stated that in active learning, the focus shifts from the teacher to the student, with teaching centered around the student. Students aren't always reliant on the teacher since they enjoy working with their peers. They work together to solve problems, while the teacher offers guidance rather than immediate answers for their activities. As a result, active learning grants students greater independence and drive compared to passive learning, stemming from increased involvement in the teaching and learning process.

The fourth indicator with the highest mean of 4.09 is *"Self-Efficacy"* with the description of *high which means that this is oftentimes manifested. This* indicate that students generally have a high level of confidence in their capacity to perform well in science-related tasks and activities. This suggests that they feel capable and competent in their ability to learn and excel in science.

In reference to (Jackson, 2002; Lane & Lane, 2001; Pajares, 2003), as mentioned by Baddereen, individuals' beliefs about their own abilities influence what they do in various ways. These beliefs affect their decision-making process, how much effort they put in, their perseverance in the face of challenges, and their thoughts and emotions. Those who have high confidence in their abilities (high self-efficacy) typically perform better than those who doubt themselves. Additionally, a person's self-efficacy can influence the goals they choose to pursue in their learning journey.

The fifth indicator with the highest mean of 4.06 with a description of high is "*learning environment stimulation"* it suggests that students perceive their science learning environment as sufficiently stimulating and conducive to their motivation. This implies that elements within the learning environment, such as teaching methods, resources, and classroom atmosphere, contribute positively to students' motivation to learn science students to stay engaged, curious, and motivated in their science studies.

(Kaplan & Maehr, 2007) cited by Schulze et al, the school atmosphere, known as the learning environment, influences the mastery goals students establish. For instance, students' motivation levels seem linked to how much their teachers show interest in and value them, as well as how they maintain discipline. Furthermore, a more democratic school culture tends to inspire students to set internal goals and appreciate the learning process (Vedder-Weiss & Fortus, 2011, 2012). In addition, the learning environment or 'school culture' plays a role in the mastery goals that students set (Kaplan & Maehr, 2007). The authors further cited, that the degree to which students are motivated appears to be related to teachers' interest in and respect for their students, along with how the teachers enforce discipline. The more democratic the school culture, the more students are motivated by internal goals and the process of learning (Vedder-Weiss & Fortus, 2011, 2012).

The indicator with the lowest mean of 3.75 is "Performance Goal" with a description of high. This lower mean score implies that while performance goals are still relevant, they may not be the primary driver of student motivation in science learning.

In line with the result (Andrée, 2012) as cited by Schulze et al. 2014, activities should have transparent objectives to encourage student participation. In addition, Elliot and McGregor, 2001, and Elliot and Church, 1997; Middleton and Midgley, 1997 as cited by Steinmayr et al. (2019) Performance goals, also known as "ego involvement," center around showcasing one's greater competence and concealing any incompetence compared to others. Later, performance goals were divided into performance-approach (aiming to demonstrate competence) and performance-avoidance goals (aiming to evade appearing incompetent, for example,).

On the other hand, as stated by Ciampa (2024) students with performance orientation have performance goal, they aim to receive praise for their work, while those with a mastery mindset strive to improve their skills. Research strongly indicates that prioritizing mastery can improve children's academic performance over time.

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Level of Student Motivation towards Chemistry Lesson in terms of Self- Efficacy

Table 2.1 shows the level of student motivation towards chemistry lesson in terms of self -efficacy, with seven indicators a mean and a description. It can be seen from the table that the highest mean belongs to the statement " I persevere through challenging science activities and address them with determination" with a mean of 4.19 and a description of high. This further suggests that students feel confident in their ability to persist and overcome challenges in science activities, and a high level of motivation to succeed in science learning.

Table 2.1 Level of Student Motivation Towards Science Learning in terms of Self-Efficacy

Items *In my chemistry laboratory class…*	**Mean**	**Descriptive Level**
1. whether the science content is difficult or easy, I am sure that I can understand it.	4.07	High
2. I am confident in my ability to understand difficult science concepts	4.00	High
3. I am sure that I can do well in science tests.	3.98	High
4. with persistent effort, I can learn science effectively.	4.14	High
5. I persevere through challenging science activities and address them with determination.	4.19	High
6. I enjoy independently thinking through science activities rather than relying on others for answers.	4.12	High
7. when I encounter challenging science content, I actively seek ways to understand and learn it.	4.14	High
Overall	**4.09**	**High**

As what Juan et al. (2018) mentioned that having a good attitude towards science is valuable. Not only does it have its own benefits, but it also leads to behaviors related to science both in and out of school. They also pointed out that students' dedication and interest in learning science can be affected by how much they enjoy the subject, see its value for themselves and society, and feel confident in their ability to do science-related tasks.

In addition, Middleton et al. (2015), stated that when striving for a goal, a person may expect challenges and hurdles from the beginning. These expected obstacles become part of the learner's strategy for achieving the goal, but they may not foresee every difficulty. When the learner decides to change the plan to keep working towards the goal, we describe this as perseverance. In this situation, the individual keeps aiming for the goal but chooses to adjust and change strategies and approaches.

On the other hand, the indicator with the lowest mean of 3.98 is " I am sure that I can do well in science tests" with a description of high. This suggests that although students generally feel motivated about learning science and believe in their abilities (self-efficacy), they might have less confidence when it comes to performing well on science tests. This indicates a need for focused help or actions to boost students' confidence and performance during tests.

In a study conducted by Juan et al. (2018) stated that the strength of self-efficacy significantly influences behavior changes. Individuals with higher self-efficacy tend to persist more in achieving success, regardless of the difficulty level, viewing tasks as challenges to conquer. Conversely, individuals with low self-efficacy perceive tasks as harder than they actually are, leading to stress and anxiety when confronted with challenges. Low self-efficacy beliefs negatively affect academic performance and can eventually lead to self-fulfilling prophecies of failure and learned helplessness, profoundly impacting psychological well-being.

Level of Student Motivation towards Chemistry Lesson in terms of Active Learning Strategies

Table 2.2 shows the level of students motivation towards chemistry lesson in terms of active learning strategies. It has eight indicators with mean and description. Among the eight indicators the statement " when I make a mistake, I try to find out why, with a mean of 4.31 and a description of very high. This implies that students are highly motivated to engage in active learning strategies, particularly in understanding their mistakes and seeking explanations for them.

Table 2.2 Level of Student Motivation Towards Science Learning in terms of Active Learning Strategies

Items *In my chemistry laboratory class…*	**Mean**	**Descriptive Level**
1. when learning new science concepts, I attempt to understand them.	4.20	Very High
2. when learning new science concepts, I connect them to my previous experiences.	4.20	Very High
3. when I do not understand a scientific concept, I find relevant resources that will help me.	4.25	Very High
4. when I do not understand a science concept, I would discuss with the teacher or other students to clarify my understanding.	4.17	High
5. during the learning process, I attempt to make connections between the concepts that I learn.	4.27	High
6. when I make a mistake, I try to find out why.	4.31	Very High
7. when I meet science concepts that I do not understand, I still try to learn them.	4.23	Very High
8. when new science concepts that I have learned conflict with my previous understanding, I try to understand why	4.28	Very High
Overall	**4.24**	**Very High**

According to the study of Kafer et al. (2019), approaching student mistakes with support and constructive feedback has demonstrated positive effects on individual motivation and learning outcomes. In classroom dynamics, mistakes transcend personal experience to become social occurrences. Furthermore, the authors emphasized that, addressing mistakes should be recognized as both an individual and collective aspect within the classroom environment. In relation, according to Siegler et al. (2016) a driven student frequently persists when encountering difficult problems, concentrates deeply on the current task, and frequently considers ways to improve without being diverted by other activities.

On the other hand the indicator with the lowest mean of 4.17 and with a description of high is "*when I do not understand a science concept, I would discuss with the teacher or other students to clarify my understanding." This implies that e*ducators can enhance student engagement by encouraging more discussions, addressing communication barriers, and providing targeted feedback to reinforce collaborative learning in the classroom. In the study conducted by Daniels et al. 2018 were they used Teachers Accountability Scale, resulted that despite acknowledging low student motivation as a significant teaching issue, teachers seem to have surprisingly little personal accountability for it. According to Schuitema, Peetsma, & Oort, 2016; Theobald, 2006; Thoonen, Sleegers, Peetsma, & Oort, 2011, as cited by Johnson (2017), students' learning isn't solely reliant on their own motivation, and that teachers play a crucial role in enhancing students' learning by providing motivational support. Teachers can boost students' motivation by fostering autonomy, relevance, relatedness, competence, showing interest in the subject, and promoting self-efficacy (Ferlazzo, 2015; Schiefele & Schaffner, 2015;

Schuitema et al., 2016; Zhang, and Solmon). Whether motivation stems from within or is influenced externally, it's crucial for teachers to cultivate an environment that nurtures students' motivation to learn.

Level of Student Motivation towards Chemistry Lesson in terms of Learning Values

Table 2.3 shows the level of motivation in terms of learning values, it has five indicators with mean and a description. It can be seen that the two indicators having the same mean of 4.34 and a description of very high are "*I think that it is important because it stimulates my thinking*" and *"It is important to have the opportunity to satisfy my curiosity when learning science." This* indicate a strong endorsement of problem-solving skills and curiosity satisfaction as intrinsic values, reflecting high motivation levels among students.

Table 2.3 Level of Student Motivation Towards Science Learning in terms of Science Learning Values

Items *In my chemistry laboratory class…*	**Mean**	**Descriptive Level**
1. I think that learning science is important because I can use it in my daily life.	4.33	Very High
2. I think that learning science is important because it stimulates my thinking.	4.27	Very High
3. I think that it is important to learn to solve problems.	4.34	Very High
4. I think it is important to participate in inquiry activities.	4.25	Very High
5. it is important to have the opportunity to satisfy my curiosity when learning science.	4.34	Very High
Overall	**4.30**	**High**

Science education captures students' interest by providing them with valuable and meaningful learning opportunities, igniting a curiosity that drives their involvement in scientific activities. In this regard, it is vital to reformulate students' cognitive processes to foster academic achievement and cultivate essential skills through science teaching (Dogomeo & Aliazas, 2022). Rana et al. (2015) emphasize that motivation for learning science is pivotal in enhancing the effectiveness of science education for students at the school level.

Walden University (2022) proposed that contemporary science education aims to equip individuals with the skills needed to address evolving scientific challenges, emphasizing problem-solving, inquiry response, and evidence gathering. These skills are instrumental in shaping young minds and contributing to advancements in science and technology. However, even with outstanding teachers and curriculum, enhancing academic performance becomes challenging, if not unattainable, when students lack motivation. As noted in the syllabus from Carnegie Mellon University (2022), students who lack interest or motivation fail to recognize the value of the course content, regardless of its quality.

On the other hand the indicator with the lowest mean of 4.25 with a description of high is *"I think it is important to participate in inquiry*" This could imply that, relative to the other values listed, students may perceive inquiry activities as slightly less crucial or motivating in their science learning experiences. However, it's important to note that even though it has the lowest mean, it is still categorized as "Very High," indicating a significant level of importance attributed to inquiry activities by the students surveyed.

Level of Student Motivation towards Chemistry Lesson in terms of Performance Goal

Table 2.4 shows student motivation in terms of performance goal, it has four indicators with a mean and description. The indicator with the highest mean of 4.31 and a description of very high is "*I participate in science courses to get a good grade.*" This suggests that obtaining high marks or academic achievement is a significant motivator for students in their science learning endeavors.

Table 2.4 Level of Student Motivation Towards Science Learning in terms of Performance Goal

Items *In my chemistry laboratory class…*	**Mean**	**Descriptive Level**
1. I participate in science courses to get a good grade.	4.31	Very High
2. I participate in science courses to perform better than other students.	3.74	High
3. I participate in science courses so that other students think that I am smart.	3.49	High
4. I participate in science courses so that the teacher pays attention to me.	3.46	High
Overall	**3.75**	**High**

Capunitan et al. (2023) suggested that students' academic achievements are consistently linked with their motivation, indicating their eagerness and interest in their academic endeavors. They emphasize that motivation plays a vital role in learning, as it greatly influences academic performance and is considered a critical aspect of academic success. Moreover, motivational behaviors are essential in determining how students perceive, value, exert effort, and demonstrate interest in their studies (Gbollie, 2017). Furthermore, according to Dogan (2015), as cited by Tinto (1993), students who dedicate themselves to their academic tasks, invest time in studying, and strive to enhance their skills and behaviors are likely to achieve success.

The indicator scoring the lowest mean, 3.46, falls under the "high" category and relates to wanting the teacher's attention in science courses. This indicates that seeking the teacher's attention is not a common reason for students to engage in science classes. Although it still reflects a significant level of motivation, it's not as strong as the desire for good grades or to outperform peers.

Rana discussed how a teacher's supportive teaching style affects students' motivation and learning in science, drawing from insights by Straits. Additionally, Faircloth and Hamm's research explored how belonging influences students' motivation, particularly in how they perceive the value of their school work. Among high school students, their study highlighted the crucial role of belonging in linking student motivation to academic success.

Level of Student Motivation towards Chemistry Lesson in terms of Achievement Goal

Table 2.5 table shows students motivation towards science in terms of achievement goal. It has five indicators with mean and a description. The indicator with the highest mean of 4.40 and a description of very high is "*I feel most fulfilled when I can solve a difficult problem.*" This implies that among the listed achievements related to science learning, students feel most fulfilled when they are able to solve challenging problems. It indicates a strong inclination towards intellectual engagement and mastery of difficult concepts.

Table 2.5 Level of Student Motivation Towards Science Learning in terms of Achievement Goal

Items *In my chemistry laboratory class…*	**Mean**	**Descriptive Level**
1. I feel most fulfilled when I attain a good score in a test.	4.37	Very High
2. I feel most fulfilled when I feel confident about the content of a science course.	4.24	Very High

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3. I feel most fulfilled when I can solve a difficult problem.	4.40	Very High
4. I feel most fulfilled when the teacher accepts my ideas.	4.30	Very High
5. I feel most fulfilled when other students accept my ideas.	4.33	Very High
Overall	**4.33**	**Very High**

Luftenegger et al. (2016) underscore that achievement goals and emotions, as noted by Hulleman et al. (2010) and Goetz and Hall (2013), significantly influence students' learning processes and academic outcomes. Filgona et al. (2016) emphasize the importance of motivation in encouraging students to engage in academic tasks and shaping their learning experiences. Motivated learners tend to employ higher cognitive processes, enhancing their learning outcomes. Additionally, Filgona (2016), citing Sanfeliz and Stalzer, indicates that motivated students find enjoyment in learning science, believe in their learning abilities, and take responsibility for their learning journey.

On the other hand the indicator with the lowest mean of 4.24 is "*I feel most fulfilled when I feel confident about the content of a science course."* Despite being the lowest mean, it still falls under the category of "Very High" motivation. This implies that among the listed achievements related to science learning, feeling confident about the course content is slightly less fulfilling for students compared to other achievements listed. Bathgate et al. (2017), citing Hidi & Renninger (2006), explain that when learners develop a stable interest in a subject, they are more likely to persist in and enjoy activities related to that topic in the future. For instance, if a learner finds science material engaging and it ignites her interest, she is inclined to seek out and have positive experiences with future science-related activities. On the flip side, when a learner receives additional support, they may have positive and successful experiences. This can lead to a greater sense of competence, which in turn helps them develop a lasting interest in science and broaden their understanding and enthusiasm for the subject.

Level of Student Motivation towards Chemistry Lesson in terms of Learning Environment Stimulation

Table 2.6 shows student motivation in terms of learning environment with six indicators. The indicator with the highest mean of 4.14 with a description of high is "*I am willing to participate in this science course because the teacher uses a variety of teaching methods.*" This indicates that among the factors related to the learning environment in science courses, students value the use of a variety of teaching methods by the teacher. It suggests that students are more willing to engage in science courses when they perceive that the teacher employs diverse instructional approaches. This variety likely keeps the learning experience dynamic and interesting for them.

Items *In chemistry laboratory activity…*	**Mean**	**Descriptive Level**
1. I am willing to participate in this science course because the content is exciting and challenging.	4.13	High
2. I am willing to participate in this science course because the teacher uses a variety of teaching methods.	4.14	High
3. I am willing to participate in this science course because the teacher does not put a lot of pressure on me.	4.11	High
4. I am willing to participate in this science course because the teacher pays attention to me.	3.93	High
5. I am willing to participate in this science course because it is challenging.	3.98	High
6. I am willing to participate in this science course because the students are involved in discussion.	4.07	High

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Overall	**4.06**	**High**

Table 2.6 Level of Student Motivation Towards Science Learning in terms of Learning Environment Stimulation

Buckley et al. (2016) highlighted the educator's goal of captivating students' attention and interest to sustain their enthusiasm and encourage ongoing participation. Supporting this notion, Keller (2017) emphasized the pivotal role of teachers' pedagogical content knowledge in predicting students' academic success. Furthermore, referencing Walshaw & Anthony (2008) as cited by Kiemer (2015), traditional classroom practices often involve teachers leading discussions and controlling interactions through questioning. However, actively involving students in classroom discourse can lead to deeper and longer-lasting learning experiences. Therefore, it's vital to transform students' classroom experiences by adjusting the typical patterns of classroom interactions and discussions. Promoting productive classroom discourse is crucial for creating engaging learning environments. Furthermore the same authors stated that it's vital to transform students' classroom experiences into meaningful ones by changing the prevalent routines of classroom interactions and discussions. Productive classroom discourse plays a crucial role in fostering students' interest in the subject.

On the other hand, the indicator with the lowest mean of 3.93 is "I am willing to participate in this science course because the teacher pays attention to me." This suggests that among the factors shaping the learning environment in science courses, students' willingness to participate is somewhat less influenced by the teacher's attention compared to other listed factors. However, it's worth noting that even the lowest mean still falls within the category of "High" stimulation in the learning environment. Despite being the lowest mean, it still indicates a high level of stimulation overall in the learning environment.

Azhar and Abdullah, as cited by Rana et al. (2015), explored students' motivation for learning science in Malaysia and identified several key factors for successful science learning, including students' motivation, language skills, and positive attitude toward science education. Furthermore, Straits, also cited by Rana et al. (2015), emphasized the influence of a teacher's caring instructional styles on students' motivation and learning in science. Building on this, Filgona et al. (2020) underscored the crucial role of teachers in motivating students to engage in learning activities at school. When teachers display enthusiasm for a particular subject, it can ignite positive emotions and eagerness to learn among students.

Summary of the Level of Student Attitude Towards Chemistry Lesson

The third objective of this study was to determine the level of student attitude towards chemistry lessons. Table 3 provides the answer to this objective.

Table 3. Level of Student Attitude Towards Chemistry

Indicators	Mean	Descriptive Level
Enjoyment of Chemistry Lesson	4.22	Very High
Social Implication of Chemistry	4.29	Very High
Attitude Toward Scientific Inquiry	4.04	High
Attitude Towards Chemist/Normality of Chemists	4.05	High
Career Interest in Chemist	3.79	High
Leisure Interest in Chemist	3.97	High
Overall	**4.06**	**High**

The level of students attitude towards chemistry lessons in terms of enjoyment of chemistry lesson, social implications of chemistry, attitudes towards scientific inquiry, attitudes towards chemist/normality of chemists, career interest in chemists, and leisure interest in the chemist is shown in Table 3.

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Among the six indicators in the students attitudes, respondents perceived that *social implication of chemistry* has the highest mean score of 4.29 with a description of *very high*, which means that it was always observed. This suggests that students understand the importance of chemistry in making the word a better place in the future.

This idea substantiates the idea of of Ware (2001), and O'dwyr (2012) as cited by Singh et al. (2016), stated that chemistry provides students with insights into the workings of the world around them, helping them grasp its significance in enhancing life on Earth. In consideration of the crucial role of chemistry in shaping a nation's social and economic landscape, it is imperative to deliver instruction that cultivates students' profound comprehension and passion for the subject. Nevertheless, empirical evidence suggests that chemistry poses inherent difficulties for students across various educational levels.

The second highest indicator is the *enjoyment of chemistry lessons* with the mean 4.22 and a description of *very high*, which means it was *always observed*. This suggests that students take their chemistry class seriously and are devoted to showing up and participating in class activities.

This discovery aligns with Naiker et al.'s (2020) notion that students who find science lessons enjoyable are more likely to develop an interest in science for both leisure and career pursuits. Similarly, Najid et al. (2020) emphasized that emotionally engaged students tend to improve their attitudes towards enjoyment, happiness, and interest in learning.

The least favorable indicator, scoring an average of 3.79, signifies a high level of interest in pursuing a career as a chemist. This suggests that this interest is frequently expressed. It indicates that while some students may find chemistry challenging and difficult, there is still a recognition of the preference for science-related careers among students with a positive attitude.

This aligns with Babaylo's (2020) study, which noted that a significant portion of scientists developed their interest and fascination with science and the natural world during childhood. Specifically, 12 percent attributed this curiosity to exposure from family members who introduced them to scientists, science labs, nature, or science and technology museums. Similarly, Tai et al. (2022) observed a correlation between early interest in science careers during K-12 education and subsequent engagement in such careers. They emphasized the strong association between a desire to pursue STEM careers or coursework and attitudes towards science.

The Level of Students Attitude towards Chemistry Lesson in terms of Enjoyment of Chemistry Lesson

As shown in Table 3.1 is the level of student attitude towards chemistry lessons in terms of enjoyment of chemistry lessons it has statements with mean and description. It can be seen from the table that the highest mean belongs to the statement "*I find the topic important*" with a mean of 4.22 and a description of *very high*. This further implies that students view science, whether they find it exciting and interesting.

Table 3.1 Level of Student Attitude Towards Chemistry in terms of Enjoyment of Chemistry Lesson

Items *In my chemistry lesson…*	**Mean**	**Descriptive Level**
1. I find the topics covered to be interesting.	4.24	Very High
2. I find it to be captivating and engaging	4.14	High
3. the material covered in the lessons is interesting.	4.20	Very High
4. I find it interesting, and not boring.	4.10	High
5. I find the the topic important.	4.32	Very High
6. I look forward to attend the class.	4.30	Very High
Overall	**4.22**	**Very High**

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Huang et al. (2019) characterized students' enjoyment of science as intrinsic motivation, defined as engaging in an activity because it is inherently interesting or pleasurable. This suggests that individuals derive pleasure or satisfaction when participating in something they are naturally passionate about. Najid et al. (2021) highlighted culturally relevant teaching as a pedagogical approach that fosters students' intellectual, social, emotional, and political empowerment by utilizing cultural references to convey knowledge, skills, and attitudes. They also emphasized that emotional engagement in learning can positively influence students' attitudes towards enjoyment, happiness, and interest.

On the other hand, the indicator with the lowest mean is " I find it interesting, and not boring." This further implies that students enjoy their chemistry learning experience. According to the research carried out by Mambiela et al. (2023), the enjoyment of studying science has shown a positive correlation with science achievements across different countries. They suggest that the personal value attributed to science is a significant predictor of students' enjoyment of the subject, emphasizing that a combination of knowledge and personal value influences student enjoyment. This conclusion aligns with the findings of Susilawati et al. (2022), who advocate for teachers to exert more effort in fostering students' enjoyment of science classes, particularly as they progress to higher school levels. It is hoped that this initiative will cultivate a strong sense of enthusiasm among students for attending science courses.

Level of Students Attitude towards Chemistry Lesson in terms of Social Implications of Chemistry.

Table 3.2 displays the student attitudes regarding the social implications of chemistry, encompassing eight indicators. The indicator with the highest mean of 4. 53 is "*I believe that science can make a better place in the future.*" This suggests that, in the students' perspective, this scale assesses whether science is perceived as desirable or easy to grasp. These findings align with Emendu's (2014) assertion in Anambra State, Nigeria, emphasizing the fundamental role of teaching and learning chemistry in fostering the development of chemical industries. With robust industries in place, the economy is expected to thrive, businesses will flourish, and the employment opportunities provided by these industries will positively impact the local community.

Table 3.2 Level of Student Attitude Towards Chemistry in terms of Social Implication of Chemistry

Items *As a student I believe that…*	**Mean**	**Descriptive Level**
1. chemists are very useful in the society	4.45	Very High
2. science can help make a better place in the future	4.53	Very High
3. chemistry can help man to live more comfortably	4.45	Very High
4. most of the problems of our society will be solved through Chemistry	4.20	Very High
5. mankind will last long because Chemistry keeps inventing new ways to support man.	4.33	Very High
6. connecting and agreeing with others is more important than conducting my own experiment to find out.	4.15	High
7. chemistry has done better than harm.	4.21	Very High
8. it is preferable to be taught chemistry facts rather than learn them through experience.	4.03	High
Overall	**4.29**	**Very High**

This corresponds with the assertion made by Eilks et al. (2017), who emphasized the indispensable role of chemistry in the economies of both developed and developing nations. They argued that chemistry is essential for advancing global prosperity and well-being, serving as the foundation for modern agriculture, pharmaceuticals, and providing the fundamental materials for various manufacturing industries. Similarly, these findings align with the conclusions drawn by Wassalwa et al. (2022), who asserted that the social implications of science stem from individuals' social instincts, which are triggered when students engage directly with science. They defined it as the influence of science education on social aspects of life.

On the other hand, the indicator with the lowest mean is " It is preferable to be taught chemistry facts rather than learn them through experience" with a mean of 4.03 and a description of high. This means that students prefer listening to facts given rather than learning them through experience.

The synthesis of Potvin and Hasni (2014) as cited by Kahveci (2015) confirms that interest, motivation, and attitudes decline with school years, especially from elementary to middle school. This trend raises issues about how science and technology is taught in schools, suggesting that there may be a gap between what a school focuses on and what students prefer. However, as stated by Andresen et al., all learning involves experience may it be prior and/or current whether past or present. However, modern teaching methods often overlook this fundamental principle. Experiential-Based Learning (EBL) has emerged in response to traditional didactic approaches that prioritize teacher control and limit knowledge transmission within disciplinary boundaries. EBL advocates for a learner-centric model that encourages active participation, fosters meaningful interactions, and empowers learners to construct their own understanding.

Level of Students Attitude towards Chemistry Lesson in terms of Scientific Inquiry

Table 3.3 shows the level of student attitude towards chemistry lessons in terms of attitude towards scientific inquiry. The indicator with the highest mean belongs to "*I like to go to places to see old things about science"* with a mean of 4.20 and a description of *very high*. This means the conceptualization, which is the basis of the process side of science, primarily relies on the finding-out inquiry part through experimentation.

Table 3.3 Level of Student Attitude Towards Chemistry in terms of Attitude Toward Scientific Inquiry

Items *As a student…*	**Mean**	**Descriptive Level**
1. I would rather solve the problem by doing an experiment than being told the answer.	4.02	High
2. I would prefer to do experiments to find out for myself instead of just agreeing with other people.	4.09	High
3. it is better to do experiments, to find out for yourself than to depend on experts	3.92	High
4. I prefer to do experiments than to read them only.	4.17	High
5. I like a job in a chemistry laboratory.	3.93	High
6. I like to go to places to see old things about science	4.20	Very High
7. scientific research is not entirely focused on human needs.	4.09	High
8. it is preferable to read about experiments rather than conduct them.	3.88	High
Overall	**4.04**	**High**

According to Waasalwa et al. (2022), embracing a scientific inquiry mindset fosters independence and utilizes understanding and experience to seek knowledge and discover scientific concepts. They suggest that a strong investigative attitude is fueled by curiosity, which can enhance students' abilities and attitudes towards scientific activities. Similarly, Najid et al. (2021) found that culturally responsive transformative teaching, which integrates traditional scientific content with chemistry and critical thinking processes, can cultivate students' scientific inquiry attitudes. Their research revealed that a significant number of students exhibited positive attitudes towards learning through scientific inquiry.

On the other hand, the indicator with lowest mean of 3.88, is the statement "*it is preferable to read about experiments rather*

Conversely, the statement "it is preferable to read about experiments rather than conduct them" has the lowest mean score of 3.88, indicating a high level of agreement. This suggests that there may be a lack of seriousness among students regarding the importance of hands-on experimentation.

Similarly, research conducted by Maison et al. (2019) explores students' attitudes toward scientific inquiry, which reflects their approach to solving scientific problems. The findings suggest that students generally exhibit positive attitudes towards scientific investigations. It was observed that students tend to engage deeply in scientific inquiries, focusing on uncovering solutions or answers to given problems. This sentiment was echoed by Tanti et al. (2020), who found that students enjoy conducting experiments, indicating a propensity for critical thinking and discovering new phenomena in physics through their investigations. Moreover, students who demonstrate persistence in seeking solutions during investigations exhibit confidence in their abilities. Additionally, the researchers note that students' inclination to ask questions following their attempts to find solutions indicates a strong curiosity towards the conducted investigations.

Level of Students Attitude towards Chemistry Lesson in terms of Social Implications of Chemistry

Table 3.4 shows the level of students attitude towards chemistry in terms of students attitude. The indicators with the highest mean value are "working with chemistry researchers will be interesting" and "chemists live a normal life. This implies that indicate that students generally hold a positive view of chemists' professional lives, finding the work they do in research settings particularly intriguing.

Table 3.4 Level of Student Attitude Towards Chemistry in terms of Attitude Towards Chemist/Normality of Chemists

Items *As a student I believe that…*	**Mean**	**Descriptive Level**
1. a normal family life is possible by being a chemist.	4.05	High
2. I would like to work with people who make discoveries in chemistry when I graduate.	3.95	High
3. chemists are as fit and healthy as other people.	4.03	High
4. working with chemistry researchers will be interesting.	4.17	High
5. if you meet a chemist, he will most likely look like anyone else you have met.	3.99	High
6. chemists have social concerns.	4.05	High
7. chemists live a normal life.	4.17	High
8. chemists are more friendly than other people.	3.96	High
Overall	**4.05**	**High**

In the study conducted by Surya et al. *(2012), stated that s*tudents' interests and levels of engagement in science significantly impact their academic pursuits and that attitude refers to a person's overall inclination towards specific subjects. When students deepen their understanding and show a stronger desire to take more science courses and read more about science, it indicates their dedication to the field. Furthermore the authors implies, that the interest is crucial in science education. Modern education aims to renew students' interest in subjects like chemistry by addressing factors that reduce their enthusiasm. The 2013 curriculum helps increase students' attention, active learning, comprehension, and interest in the subject. If students lack interest in chemistry, they are less likely to make an effort to understand the concepts taught to them. This highlights that students' interest in the subject is the main factor influencing their decision to study chemistry.

On the other hand, the indicator with the lowest mean is "*I would like to work with people who make discoveries when I graduated"* with a description of high. This suggests that students may not perceive making groundbreaking discoveries as the most important aspect of being a chemist. Instead, they may value other aspects of the profession, such as the daily work environment or the societal impact of chemistry, as more significant.

The insufficient comprehension of chemistry's importance in the future (Kubiatko, 2015), combined with the intricate nature of chemistry concepts (Sausan et al., 2018), led to the majority of middle school students having a diminished perception of chemistry. Moreover, most students do not really like chemistry, although learning chemistry helps them to understand the way the world works (Hofstein et al., 2011).

The Level of Students Attitudes towards Chemistry Lesson in terms of Career Interest in Chemistry

Table 3.5 displays the level of student attitudes towards chemistry lessons concerning their interest in pursuing a career in chemistry. The indicator " working in a chemistry laboratory is an interesting way to learn" and "chemists live a normal life" scored the highest mean of 4.12, indicating a strong positive sentiment. This suggests an assessment of whether students harbor favorable attitudes towards chemistry to the extent that they envision a future career in the field. This finding aligns with Ribes' (2021) assertion that careers in the chemical industry are highly rewarding, as they offer solutions to global challenges such as ensuring access to clean water, providing nutritious food, enhancing healthcare, promoting wellness, facilitating affordable housing, and developing sustainable infrastructure.

Table 3.5 Level of Student Attitude Towards Chemistry in terms of Career Interest in Chemist

Items *As a student I believe that…*	**Mean**	**Descriptive Level**
1. a career as a chemist would be exciting.	3.95	High
2. working in a chemistry laboratory is an interesting way to learn	4.12	High
3. money spent on chemistry is well worth spending.	3.90	High
4. A job as a chemist would be interesting.	3.94	High
5. I like to be a scientist when I graduate	3.34	High
6. money used in chemistry is worth it.	3.89	High
7. I like to be a chemist after I graduate.	3.41	High
Overall	**3.79**	**High**

Furthermore, career interest refers to the desire to pursue a scientific profession with the aim of achieving future professional success, as highlighted by Membiela et al. (2023). Obtaining a university degree is not solely driven by its necessity in today's job market, but also by its potential for enhancing future professional prospects. The significance of science in prospective careers affects students' motivation, and intentions toward scientific careers are shaped by their interest in science, which in turn influences their confidence in learning science.

Conversely, the indicator "I like to be a scientist when I graduate" has the lowest mean among students' attitudes towards chemistry lessons, yet it is still rated as high. This suggests that despite its lower score, students are still

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drawn to pursuing science-related courses after graduation, viewing a career as a scientist as an appealing prospect.

Furthermore, interest in a career in science is not only a form of readiness or aspiration for future life but also reflects a level of maturity and decision-making skills. According to Wassalwa et al. (2022), this interest can be discerned through students' positive responses to science, their desire to pursue a career in the field, and their perception that science aligns with present and future needs. They emphasize the significance of noting career interest as it profoundly impacts students' professional achievements and personal lives. It is crucial to cultivate this interest early on, allowing students time to explore and reconsider their futures based on their talents and passions. This notion is supported by Ong et al. (2019), who found that interest plays a pivotal role in both academic and career success, surpassing cognitive ability and personality. Students who are genuinely interested in their chosen field tend to exhibit superior performance and retention.

The Level of Students Attitudes towards Chemistry Lesson in terms of Leisure Interest in Chemist

Table 3.6 presents students' attitudes towards chemistry lessons regarding their leisure interest in chemistry. The table includes six indicators along with their mean scores and descriptions. Notably, the statement "I would enjoy visiting a science display" holds the highest mean of 4.39, indicating a very high level of agreement. This suggests that students who exhibit a positive attitude towards chemistry often engage in chemistry-related activities during their leisure time, such as visiting science exhibitions or displays.

Table 3.6 Level of Student Attitude Towards Chemistry in terms of Leisure Interest in Chemist

Items *As a student…*	**Mean**	**Descriptive Level**
1. I would enjoy visiting a science display	4.39	Very High
2. it is interesting to attend public lectures about chemistry.	4.05	High
3. I like to belong to a Chemistry/Science Club.	3.70	High
4. I advocate for the encouragement of scientific hobbies.	3.98	High
5. I like spending my free time doing chemistry work.	3.51	High
6. I like to go to places to see old things about science/ chemistry	4.17	High
Overall	**3.97**	**High**

Compared to the findings, Susilawati et al. (2021) inferred that leisure interest in science exhibits a greater inclination among female students compared to males. They noted that female students demonstrate interest in exploring science through activities such as watching television programs like those featured on the Discovery Channel, science fiction shows, and documentaries about animal life. Moreover, many female students exhibit enthusiasm when discussing science with their friends. Additionally, students' interest in science correlates with their recruitment into science-related fields, as evidenced by the responses in the TORSA dimension of Career Interest in Science, which closely parallels the level of interest observed in the Leisure Interest in Science dimension (Najid et al., 2021).

Conversely, the indicator "I like spending my free time doing chemistry work" has the lowest mean of 3.51, yet it is still rated as high. This indicates that students participate in Science Club because they derive enjoyment from engaging in science-related activities and projects.

This supports Wassalwa et al.'s (2022) notion that leisure interest in science reflects a sense of joy or fascination with learning science, motivating students to dedicate their free time to further exploration. This exploration often involves seeking information from diverse sources such as books, articles, journals, and newspapers.

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Similarly, this aligns with Maison et al.'s (2019) argument that the appeal of extending science learning time indicates students' interest in increasing their engagement with science beyond regular class hours.

Significance on the Relationship between Science Laboratory Environment and Student Attitude

Table 4 exhibits the r values with descriptions indicating the significance of the relationship between science laboratory environment and students attitudes.

Table 4. Significance on the Relationship between Science Laboratory Environment and Student Attitude Towards Chemistry

	Student Attitude Towards Chemistry			
Science Laboratory Environment	**r**	**p-value**	**Decision on H_o**	**Interpretation**
	.778	.000	Reject	**There is a significant high correlation.**

Table 4 highlights a significant correlation between the Science Laboratory Environment and Student Attitudes, confirming their relationship in the findings. The overall p-value of 0.000 indicates significance at the 0.05 level, leading to the rejection of the null hypothesis. This suggests a noteworthy high correlation between the two variables.

Examining the correlation coefficient of r = 0.778 reveals that each alteration in the independent variable corresponds to a proportionate moderate change in the dependent variable. Therefore, the overall findings indicate a high correlation, as indicated by the value of r = 0.778. This implies that improvements in the Science Laboratory Environment are associated with reasonable improvement in Student Attitudes.

The result was supported by Cheung (2011), as cited by Elesio (2023) the development of positive attitudes toward science lessons is crucial for two main reasons. First, these attitudes are linked to academic success, and second, they predict future behavior (Glasman & Albarracin, 2006). Therefore, having a positive attitude plays a key role in determining students' performance in chemistry (Chin & Lim, 2016; Xu, 2014). Moreover, a student's attitude toward chemistry is significant in their decision to pursue a career related to chemistry (Xu, 2014). u & Uzuntiryaki, 2006).

In addition, the significance of the laboratory environment in enhancing learning effectiveness stems from students' perception that a preferred laboratory setting positively impacts their attitudes and cognitive learning outcomes (Kwok, 2015). This idea is reinforced by Olubu's (2015) study, which found a correlation between a positive attitude toward science and the classroom environment. Olubu further noted that positive attitudes were observed in science classrooms characterized by high levels of student involvement, teacher support, student collaboration, orderliness, clarity of rules, and the use of innovative teaching methods by teachers.Laboratories are crucial for fostering interest, curiosity, and a positive attitude toward chemistry, as well as enhancing creativity and problem-solving skills in science. They also play a key role in improving students' comprehension of science concepts and the scientific process (Azizoglu & Uzuntiryaki, 2006).

Furthermore, according to Marchut and Gormally (2019), students felt akin to scientists when engaged in designing and conducting their own experiments. Specifically, they highlighted the empowerment derived from collaborating with peers to troubleshoot experiments independently of the instructor's guidance. They expressed feeling like scientists during these moments.

Significance on the Relationship between Student Motivation and Student Attitude toward Chemistry Lessons

Table 5 exhibits the r value with descriptions indicating the Significance on the Relationship between Student Motivation and Student Attitude towards Chemistry Lessons.

Table 5. Significance on the Relationship between Student Motivation Towards Science Learning and Student Attitude Towards Chemistry

	Student Attitude Towards Chemistry			
	r	**p-value**	**Decision on H_o**	**Interpretation**
Student Motivation Towards Science Learning	.900	.000	Reject	**There is a significantly high correlation**

Table 5 reflects the significant relationship between the Students Motivation towards Chemistry Lesson and Students Attitudes and exhibited the existence of their relationship in the results. With the p-value of 0.000, the correlation is significant at a 0.05 level of significance. Thus, rejecting the null hypothesis. It shows that there is a a positively strong correlation between the two variables.

The correlation coefficient of r = 0.900 explains that for every change in the independent variable, there is an equivalent high changes in the dependent variable. Thus, the overall results have shown a strong correlation as reflected in the value of r = 0.900. It explains that for every changes in the Students Motivation toward the Chemistry Lesson, there is also a reasonable improvement in the Students Attitude. According to Aghekyan (2015), when researchers aim to understand what motivates students to learn science, they typically investigate their reasons for learning science and the beliefs and feelings that impact this learning. It is believed that comprehending the factors contributing to students' motivation in science learning will assist science education researchers and educators in enhancing science education. The author further explains that understanding students' sentiments about the environment helps environmental educators enhance their environmental knowledge. Additionally, attitudes towards science and personal interests play a significant role for science students, influencing various aspects of their personality and life choices (Surya & Arty, 2021).

Furthermore, the factors impacting the attitudes of secondary school students towards studying science and mathematics include the attitudes of their parents and friends, as well as the quality of teaching (Tomperi et al., 2020). Similarly, students generally held positive attitudes towards the study of chemistry, aligning with the positive trend observed among first-year undergraduate chemistry students in New Zealand and Australia (Naiker et al., 2021).

Mubeen (2014) explains that motivation serves as an inner force that drives us forward and impacts our thoughts, feelings, and actions. It involves two main parts: having a clear goal and persistently working towards it. Motivated individuals are determined and continue striving until they achieve their goals. Moreover, Richard et al. (2011), cited by Mubeen, indicate that teachers can easily spot highly motivated learners by their commitment and enthusiasm. Conversely, students lacking motivation may feel dissatisfied in the classroom. However, if classroom activities cater to their needs, even seemingly unmotivated students can actively participate in learning. Essentially, effective learning demands both attention and interest, making motivation essential (Bhatia, 1997), as mentioned again by Mubeen (2014).

Table 6. Regression Analysis on the Significant Combined Influence of Science Laboratory Environment and Student Motivation Towards Science Learning on Student Attitude Towards Chemistry

	Student Attitude Towards Chemistry						
		Unstandardized Coefficients		Standardized Coefficients			
Independent Variables	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**Decision on H_0**	**Interpretation**

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(Constant)	.237	.184		1.292	.199		
Science Laboratory Environment	.028	.083	.025	.342	.733	Failed to Reject	Not Significant
Student Motivation Towards Science Learning	.896	.076	.878	11.775	.000	Reject	Significant

R = .900; R^2 = .810; F-value = 275.015; p-value = 0.000

Presented in table 6 is the regression model showing the combines influence of predictor variables Science Laboratory Environment and Students Motivation on Students Attitude towards Chemistry Lesson.

The variable Science Laboratory Environment having a standardized coefficient beta of 0.025 and a p - value of .733, indicate not a significant influence on student attitude.

While the Student Motivation towards Chemistry with the beta of .878 and a p -value of 0.000 is significant variable to influence the dependent variable. It implies that putting the two (2) predictor variables altogether, only one becomes significant predictors of student attitude towards chemistry.

The t- value of 11.775 for the predictor variable of Student Motivation towards Chemistry has the highest value, and the Science Laboratory Environment with the t- value of .342. That means that there is a significant evidence against the null hypothesis.

However, combining the two predictor variables Science Laboratory Environment and Student Motivation it shows a significant influence on Student Attitudes towards Chemistry. The R^2 value of .810 or 81% of the variance, explained by the combined predictors variables Science Laboratory Environment and Students Motivation, contributed to Students Attitudes towards Chemistry Lesson. Furthermore, as reflected by the F-value of 275. 015 with the corresponding p-value of 0.000, the regression analysis is significant.

Chua and Karpudewan (2017) found that having good science labs is important for teaching science in Malaysia. They showed that when students have a positive experience in the lab, they are more likely to enjoy learning science. This backs up Asabe's (2013) idea that a good lab environment leads to better attitudes towards science learning. Additionally, Çıbık and Aka (2021) conducted a study in Turkey and found that having access to labs is crucial for students to develop positive attitudes toward them. They discovered that using labs in chemistry, which involves complex concepts, helps students grasp the scientific method, improve problem-solving skills, and apply their learning to real-life situations. This aligns with the findings of Newell et al. (2015), who emphasized that focusing on attitudes that influence students’ science knowledge gains can help educators assess the effectiveness of interventions in boosting enrollment in advanced science courses and encouraging pursuit of science careers.

According to Eccles and Wigfield's, as cited by Shin (2018) expectancy value theory suggests that students' motivation stems from their needs and the importance they place on the goals set in their environment (Eccles et al., 1983). It highlights that students' actions are influenced not only by how much they value a goal but also by their belief in their ability to achieve it. As further cited by the Shin, motivation is what drives someone to act. It prompts behaviors, provides a sense of purpose, and keeps them going (Kim, 2004). In essence, it's the force behind starting, guiding, and sustaining actions. Students' self-efficacy boosts their confidence, enabling them to make informed choices and succeed in learning activities. Moreover, previous research (Kim & Jung, 2012; Lee & Choi, 2015) has demonstrated a strong link between learning motivation and self-efficacy: when motivation to learn is high, so is self-efficacy.

In the study of Oyedeji (2017), figured out that numerous research studies have explored how students' motivation correlates with their attitudes toward learning mathematics. For instance, a study titled "Attitudes towards Mathematics: Effects of Individual, Motivational, and Social Support Factors" concluded that variables related to motivation are key predictors of attitudes toward mathematics. Additionally, when reviewing literature on attitudes and their development, researchers have consistently identified motivation as a significant factor influencing students' attitudes toward mathematics. Moreover, Siti and Effandi, in their study titled "The Learning Environment, Teacher Factors, and Students' Attitudes Among Engineering Technology Students," as again cited by Odejedi (2017) discovered that there is a moderate but significant relationship between the learning environment and students' attitudes toward mathematics. They concluded that institutions should pay attention to both the learning environment and teacher factors to foster positive attitudes toward mathematics among students.

According to Meece, Wigfield, & Eccles (1990), as referenced by Ivaniushinan (2016), their research underscores the crucial role of motivation in predicting academic success. While cognitive abilities are undeniably important, other student attributes also matter. In higher education, particularly in selective universities, the selection process minimizes disparities in intellectual abilities among students [Furnham, Chamorro-Premuzic, McDougall 2002]. This emphasizes the significance of personal qualities like character traits, individual learning methods, and motivation in determining different levels of academic

CONCLUSION AND RECOMMENDATIONS

This chapter provides a summary of the study's findings, drawing conclusions from the gathered data, and offering recommendations based on these findings. The study aimed to ascertain the combined significant influence of the Science Laboratory Environment and Student Motivation as Predictors on Students' Attitudes Towards Chemistry Lessons during the school year 2023-2024. This study investigates into various aspects, beginning with an examination of the science laboratory environment as perceived by students. It evaluates factors such as student cohesiveness, open-endedness, integration, rule clarity, and material environment. Additionally, the study explores students' motivation, encompassing self-efficacy, active learning strategy, science learning value, performance, and achievement goal. Furthermore, it assesses students' attitudes towards chemistry lessons, considering factors like enjoyment of the lessons, social implications of chemistry, attitudes towards scientific inquiry, attitudes towards chemists/normality of chemists, career interest, and leisure interest in chemistry. The primary goal of this study is to identify the significant relationships between the science laboratory environment and students' attitudes towards chemistry lessons, as well as between students' motivation and their attitudes towards chemistry. Moreover, it aims to understand the combined significant influence of the science laboratory environment and motivation on students' attitudes towards chemistry.

This study employs a non-experimental quantitative design, utilizing a descriptive-correlational and predictive approach. Additionally, it collected responses from 100 junior high school students in Davao City during the 2023-2024 school year. The respondents were selected through purposive random sampling, ensuring ethical considerations regarding the confidentiality of the participants.

This study adopted 3 survey questionnaire validated by an expert; the Science Laboratory Environment Inventory (SLEI) which comprises 33 items on a five-point Likert scale comprises five indicators with 33 items namely student cohesiveness, open-endedness, integration, rule clarity, and material environment, for the five SLEI scales, the students' motivation which comprises of 35 items on a five-point Liket scale which comprise of 6 indicaties namely, self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation adopted from Tuan & Chen (2000), and the Attitude Towards Science Scale (ATSS) which consisted of 43 items on a five point Likert scale encompassing six factors namely enjoyment of chemistry lesson, social implications of chemistry, attitude towards scientific inquiry, attitudes towards chemists/normality of chemists, career interest in chemist, leisure interest in chemist.

The findings of the study are as follows:

The level of science laboratory environment as perceived by students was very high. The indicators student cohesiveness, integration, rule clarity were very high while open-endedness and material environment were high. Rule clarity acquired the highest mean while material environment was the lowest.

The level of students motivation was high. The indicators active learning strategy, science learning values and achievement goal were very high, while self-efficacy, learning environment stimulation, and performance goal were high. The indicator science learning values acquired the highest mean, while performance goal was the lowest.

The level of students attitude towards chemistry lesson was high. The indicators social implication of chemistry and enjoyment of chemistry lesson were the highest while attitude towards chemist/normality of chemists, attitude toward, leisure interest in chemist, and career interest in chemist were high. The indicator social implication of chemistry acquired the highest mean while career interest in chemist was the lowest.

Conclusions

Based on the findings of the study, the conclusions are herewith presented:

The regression analysis examined the combined influence of the science laboratory environment and student motivation towards science learning on students' attitudes towards chemistry. The results revealed that student motivation towards science learning had a significant positive impact on students' attitudes towards chemistry, indicating that as students' motivation towards science learning increased, their attitudes towards chemistry also improved.

However, the science laboratory environment did not have a significant influence on students' attitudes towards chemistry. This suggests that variations in the science laboratory environment did not strongly correlate with changes in students' attitudes towards chemistry.

Overall, the regression model demonstrated a strong relationship between the independent variables (student motivation towards science learning and the science laboratory environment) and students' attitudes towards chemistry, as indicated by the high R-value. The F-value of 275.015 with a p-value of 0.000 further supports the significance of the overall model.

Recommendations

Based on the conclusions of the study, the recommendations are herewith encouraged:

With the result of the study the learners already have an interest in chemistry, they are motivated to learn and they develop a positive attitude. The Department of Education should introduce interactive and inquiry-based learning programs that highlight the practical applications of chemistry in everyday life. Additionally, they should facilitate partnerships with industries and research institutions to offer students exposure to real-world applications of chemistry and career opportunities in the field.

Moreover, the school administrators should prioritize enhancing the science laboratory environment by ensuring it is engaging, well-equipped, and conducive to exploration. Additionally, they should implement strategies to foster student motivation by providing opportunities for hands-on learning, emphasizing the real-world relevance of chemistry, and offering supportive and encouraging learning environments.

Chemistry teachers should incorporate hands-on experiments, demonstrations, and interactive activities to make chemistry lessons engaging and relevant to students' lives. They should also provide opportunities for students to explore their own questions and interests within the subject, fostering a sense of ownership and curiosity. Teachers should also guide the learners in doing chemistry experiments and help them have a clear vision of why they need to conduct such experiments, have a focus and coherent rules and goals, because this will help the students develop a positive attitude towards chemistry lessons.

Students are encouraged to develop an understanding of the factors influencing their attitude towards chemistry lesson, with this study revealing a significant contribution from student motivation. Providing opportunities for students to explore their chemistry interests through hands-on experimentation can further enhance and foster positive attitudes towards chemistry lessons. Moreover, recognition and support from chemistry teachers, peers, and family members can guide students towards improved performance and cultivate positive attitudes, leading to success in chemistry.

Lastly, future researchers of this related study should focus a study on how to develop, enhance, and use the scientific ability and skills of the learners not just in chemistry but in different science disciplines using other variables.

REFERENCES

1. Aghekyan, R. (2019). Measuring high school students' science identities, expectations of success in science, values of science and environmental attitudes: development and validation of the SIEVEA survey. Science Education International, 30(4), 342-353. https://files.eric.ed.gov/fulltext/EJ1236363.pdf
2. Ahmad, C. N. C., Osman, K., Halim, L., & Noh, N. M. (2014). Predictive relationship between physical and psychosocial aspects of science laboratory learning environment among secondary school students in Malaysia. Procedia-Social and Behavioral Sciences, 116, 158-162.162. https://www.sciencedirect.com/science/article/pii/S1877042814001864
3. Akinbobola, A. O. (2015). Evaluating science laboratory classroom learning environment in Osun State of Nigeria for national development. Journal of Resources Development and Management, 9(7). https://core.ac.uk/download/pdf/234696087.pdf
4. Allanas, E. (2021, April). Analysis of student perceptions in the learning environment chemical laboratory. In Journal of Physics: Conference Series (Vol. 1876, No. 1, p. 012066). IOP Publishing. https://iopscience.iop.org/article/10.1088/1742-6596/1876/1/012066/meta
5. Alhadabi, A. (2021). Science interest, utility, self-efficacy, identity, and science achievement among high school students: An application of SEM tree. Frontiers in Psychology, 12, 634120. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2021.634 120/full
6. Altaf, M., Akhter M., & Rana, R., (2014). Chemistry Laboratory Teaching-Learning Environment-Developinf an Inventory for Survey. Retrieve on April 03, 2023. https://www.noveltyjournals.com/upload/paper/Chemistry%20Laboratory%achingearning%20Environment-77.pdf
7. Antonio RP, Prudente MS (2021) Metacognitive argument-driven inquiry in teaching antimicrobial resistance: Effects on students' conceptual understanding and argumentation skills. J Turk Sci Ed 18(2):192–217. https://doi.org/10.36681/tused.2021.60
8. Anwar, K. (2016). Working with Group-Tasks and Group Cohesiveness. International Education Studies, 9(8), 105-111.
9. Apu, G. (2020). Factors Affecting Students Academic Achievement in Chemistry: A Case of Obudu Local Government Area. Available at SSRN 3554319. https://papers.ssrn.com/ sol3/papers. cfm? Abstract id=3554319
10. Aquino, J. E., & Bautista, R. G. (2022). CHEMIKA and Students' Academic Achievement in Chemistry. American Journal of Educational Research, 10(8), 501-507. http://surl.li/qxnto
11. Arniezca, E. Y., & Ikhsan, J. (2021, March). Students' attitudes towards chemistry: on the gender and grades perspective. In 6th International Seminar on Science Education (ISSE 2020) (pp. 309-314). Atlantis Press. https://www.atlantis-press.com/proceedings/isse-20/125954759
12. Arnous, H., & Ayoubi, Z., (2018). Student Perceptions of The Chemistry Laboratory Learning Environemnts and Student - Instructor Interactions in the Undergraduate Chemistry Laboratory Courses in Lebanon. Retrieve on April 06, 2023. http://surl.li/qxnxg
13. Asabe, M. B. (2013). A study of students' attitude towards the three categories of questions in WAEC Practical Chemistry Examination in Zaria Inspectorate Division of Kaduna State, Nigeria. IOSR Journal of Applied Chemistry, 5(3), 1-4.,
14. Astalini, A., Kurniawan, D. A., Kurniawan, N., & Anggraini, L. (2019). Evaluation of student's attitude toward science in Indonesia. Open Journal for Educational Research, 3(1). from https://files.eric. ed. gov/full text/EJ1225942.pdf
15. Aydoğdu, B., Buldur, S., & Kartal, S. (2013). The effect of open-ended science experiments based on scenarios on the science process skills of the pre-service teachers. Procedia-Social and Behavioral Sciences, 93, 1162-1168, from https://www. sciencedirect. com/science/ article/pii/ S1877042813034538

16. Babaylo, P., (2020). Science-Related Attitudes and Academic Acievements of Students with Varied Learning Styles. Retrieved on April 4, 2023, from https:nosteonline.org/wp-content/uploads/2020/10/01-Babaylo-For-Final-Ghaleb,
17. Bandura, A., (1960). The Social Cognitive Theory. Retrieved on September 17, 2022, from http:// surl. li/qxtnm
18. Baran, M., & Medine, B. (2023). A Picture of Chemistry: A Case Study from High Schools (Hakkari Sample). https://doi.org/10.5539/jel.v12n2p11
19. Bathgate, M., & Schunn, C. (2017). The psychological characteristics of experiences that influence science motivation and content knowledge. International Journal of Science Education, 39(17), 2402-2432.
20. Belmi RM, Mangali GR (2020) PISA 2018 science framework vis-a-vis the Philippine Kto12 science curriculum. In: Balagtas MU, Montealegre MC (eds) Challenges of PISA: the PNU report 100. Philippine Normal University & Rex Institute for Student Excellence, Manila, pp. 101–141
21. Bhargava, S. (2016). Role of Chemistry in Everyday Life. Journal of Chemistry and Chemical Sciences, 6(2), 192-198.
22. Berger, S. G. (2015). Investigating Student Perceptions of the Chemistry Laboratory and Their Approaches to Learning in the Laboratory. University of California, Berkeley. From https://escholarship.org/content/qt7sj3518r/qt7sj3518r.pdf
23. Binwal, H., (2020). Attitude towards science: a study of 9th grade adolescent students. Retrieved on April 8, 2023, from http://surl.li/qxt
24. Bodnar, K., Hofkens, T., Wang, M., Schunn, C., (2020). Science Identity Predicts Science Career Aspiration Across Gender and Race, but Especially for White Boys. Retrieved on April 06, 2023, from https://www.lrdc.pitt.edu/Schunn/papers/BodnarIdentity2020.pdf
25. Boucaud, A., (2017). A Correlational Study Examining the Relationship Between Restorative Practices and School Climate in Selected Elementary Schools in a Large Mid-Atlantic Urban School District. Retrieved on September 23, 2022 from https://core.ac.uk/download/pdf/327228538.pdf
26. Brown, S., White, S., Sharma, B., Wakeling, L., Naiker M., Chandra, S., Gopalan, R., & Bilimoria, V., (2015). Attitude to the study of chemistry and its relationship with achievement in an introductory undergraduate course. Retrieved on April 04, 2023, from https://www.researchgate.net/ publication/ 277645489 Attitude to the study of chemistry and its relationship with achievement in an introductory under graduate course
27. Bulgaru, I., (2014). Cohesion-performance Relationship to the Educational Group Level. Retrieved on April 21, 2023 from, https://doi.org/10.1016/j.sbspro.2015.02.112103
28. Byusa, E., Kampire, E., & Mwesigye, A. R. (2022). Game-based learning approach on students' motivation and understanding of chemistry concepts: A systematic review of literature. Heliyon. https://www. cell.com/heliyon/pdf/S2405-8440(22)00829-5.pdf
29. Capunitan, K., Lirado, J., & Gregana, C. (2023). Motivational Factors in Science Learning, Learner's Satisfaction and Learning Outcomes of Pre-Service Teachers. International Journal of Scientific and Management Research, 6(5), 72-115.
30. Ciampa, K. (2014). Learning in a mobile age: an investigation of student motivation. Journal of computer assisted learning, 30(1), 82-96.
31. Cicuto, C. A. T., & Torres, B. B. (2016). Implementing an active learning environment to influence students' motivation in biochemistry. Journal of Chemical Education, 93(6), 1020-1026.Chawla J., (2015). Achievement in the chemistry of ix graders in relation to achievement motivation. Retrieved on September 21, 2022, from https://www.academia.edu/21581699/Achievement In Chemistry Of Ix Graders In Relation to Achievement Motivation
32. Chen, S., & Wei, B. (2020). Development and validation of an instrument to measure high school students' science identity in science learning. Research in Science Education, 52(1),111–126. https:// doi.org/10.1007/s11165-020-09932-y
33. Chibuzor, N., (2021). Effect of Problem-Solving Strategy on Chemistry Students' Performance in Secondary Schools in Abia State. Retrieved on October 08, 2022, from https://www.arcjournals.org/pdfs/ijhsse/v8-i7/25.pdf

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

34. Chiang, A., Jhangiani, R., & Price, P.,2020. Research Methods in Psychology - 2nd Canadian Edition. Retrieved on October 04, 2022 from https://opentextbc.ca/ research methods/chapter/ correlational-research/
35. Chophy, V. (2018). Classroom goal structure and students' achievement goal: A study of Intrinsic Motivation of secondary school students in Nagaland. International Journal of Psychological Studies, 10(3), 53-65.
36. Choudhary, F., (2016). Effect of Inquiry Based Instruction on Student's Attitude and Academic Achievement in Physics. Retrieved on April 8, 2023, from http:// www.sciint.com/ pdf/ 13123424641%20a%209194%20Farkhunda%20Rashid%20-Revised-refereed.--Paid.pdf
37. Chua, K. & Karpudewan, M., (2017). The role of motivation and perceptions about science laboratory environment on lower secondary students' attitude towards science. Retrieved on April 03, 2023, from https://www.eduhk.hk/apfslt/download/v18_issue2_files/karpudewan.pdf
38. Çıbık, S. & Aka, I. (2021). Student views on attitudes towards chemistry laboratory skills. Retrieved on April 08, 2023, from https://dergipark.org.tr/en/download/article-file/2054298
39. Diehl, D., (2005). Educational Philosophies Definitions and Comparison Chart. Retrieved on October 04, 2022 from https://web.augsburg.edu/~erickson/edc490/downloads/comparison eduphilo.pdf104
40. Cordon JM, Polong JDB (2020) Behind the science literacy of Filipino students at PISA 2018: a case study in the Philippines' educational system. In Sci Ed J 1(2):70–76.https://doi.org/10.37251/isej.v1i2.59
41. Daniels, L. M., Poth, C., & Goegan, L. D. (2018, October). Enhancing our understanding of teachers' personal responsibility for student motivation: A mixed methods study. In Frontiers in Education (Vol. 3, p. 91). Frontiers Media SA.
42. Dogan, U. (2015). Student engagement, academic self-efficacy, and academic motivation as predictors of academic performance. The Anthropologist, 20(3), 553-561.
43. Dogomeo, J., & Aliazas, J. V. (2022). Dual Coding Cognition in Devising Infographics for an Enhanced Students' Scientific Knowledge. International Journal of Science, Technology, Engineering and Mathematics, 2(4), 1-17.
44. Duban, N., Aydoğdu B., & Yüksel, A., (2019). Classroom Teachers' Opinions on Science Laboratory Practices. Retrieved on October 09, 2022 from https://files.eric.ed.gov/fulltext/EJ1207702.pdf
45. Eilks, I., Sjöström, J., & Zuin, V., (2017). The responsibility of Chemists for a better world: challenges and potentialities beyond the lab. Retrieved on April 29, 2023, from https://www.researchgate.net/publication/324546087 The responsibility of Chemists for a better world challenges and potentialities beyond the lab
46. Elesio, J.M. (2023). Science Laboratory Environment and Attitude Towards Chemistry Lessons of Senior High School Students. Retrieved on April 08, 2023, from https://journal.formosapublisher.org/index.php/eajmr/article/view/3027
47. Elliniadou, E., & Sofianopoulou, C., (2021). Students' Attitudes Towards Science: Where Do We Go From Here. Retrieved on April 8, 2023, from http://endeducationconference.org/wpcontent/uploads/2021/07/2021end108.pdf
48. Emendu, N., (2014). The Role of Chemistry Education in National Development. Retrieved on April 29, 2023, from https://www.theijes.com/papers/v3-i3/Version-3/C0333012017.pdf
49. Filgona, J., Sakiyo, J., Gwany, D. M., & Okoronka, A. U. (2020). Motivation in learning. Asian Journal of Education and social studies, 10(4), 16-37.
50. Fulmer, G., Ma, H., & Liang, L., (2019). Middle school student attitude toward science, and their relationships with instructional practices: a survey of Chinese students preferred versus actual instruction. Retrieved on April 06, 2023, from https://doi.org/10.1186/s41029-019-0037-8
51. Francisco Jr LM, Prudente MS (2022) Improving students' conceptual knowledge in online distance learning through the use of micro-lectures: A photosynthesis example. Innov Technol Manag J 5:1
52. Gautam, A., (2020). Sample Survey VS Complete Enumeration. Retrieved on September 23, 2022, from https://anshulee-gautam.medium.com/sample-survey-vs-complete enumeration- cb7f8157dc7b105
53. Gede, W., (2018). Effect of using portfolio assessment to improve scientific attitude of students learning physics in high school. Retrieved on October 09, 2022 from https://www.shsconferences.org/articles/shsconf/pdf/2018/03/shsconf_gctale2018_00118. pdf

54. Gosling, C., (2017). Identity as a Research Lens in Science and Physics Education. Retrieved on April 05, 2023, from https://bild-lida.ca/journal/volume-1_1-2017/identity-as-a-research-lens-in science-and-physics-education/
55. Gupta, A., Koul, R., & Sharma, M., (2015). Assessing The Science Laboratory Learning Environments at the Senior Secondary Level in An Indian School. Retrieved on April 03, 2023, from https://eduquestjournal.com/files/EQ.pdf
56. Gbollie, C. K. (2017). "Student Academic Performance: The Role of Motivation, Strategies, and Percieved Factors Hindering Liberian Junior and Senior High School Students Learning. Education Research International, 11.
57. Ghaleb, A. B., Ghaith, S., & Akour, M. (2015). Self-efficacy, achievement goals, and metacognition as predicators of academic motivation. Procedia-social and behavioral sciences, 191, 2068-2073.
58. Hakama, A., Ma'mun, A., Kardjono, K. & Bakar, R., (2018). The Effect of Outdoor Education on Students' Cohesiveness and Communication. Retrieved April 21, 2023, from https://www.scitepress.org/PublishedPapers/2017/70663/70663.pdf
59. Hakulinen, L., & Auvinen, T. (2014, April). The effect of gamification on students with different achievement goal orientations. In 2014 international conference on teaching and learning in computing and engineering (pp. 9-16). IEEE.
60. Hamidu, M. Y., & Ibrahim, A., & Mohammed A., (2014). The Use of Laboratory Method in Teaching Secondary School Students: a key to Improving the Quality of Education. Retrieved on October 09, 2022 from https://www.ijser.org/researchpaper/The-Use-of-Laboratory-Method-inTeaching-Secondary School -Students-a-key-to-Improving-the-Quality-of Education.pdf
61. Hannah, R. (2013). The Effect of Classroom Environment on Student Learning. Retrieved on September 20,2022, from https://scholarworks.wmich.edu/cgi/viewcontent.cgi?article=3380&context=honors theses
62. Hasni, A., & Potvin, P., (2015). Student's Interest in Science and technology and its relationship with teaching methods, family context and self-efficacy. Retrieved on April 5, 2023, from https://files.eric.ed.gov/fulltext/EJ1069261.pdf
63. Hatono, Effendi, Susanti R., Riyanto, Ismet & Eijkelh of, H., (2017). Designing a Learning Environment for Science Education Based on PISA Prospective Teacher: Chemistry Content. Retrieved on October 09, 2022 from file:///C:/Users/Caren/Downloads/25893066.pdf The practice of science and engineering requires
64. Haw, L., Sharif, S., & Han, C., (2022). Predictors of Student Engagement in Science Learning: The Role of Science Laboratory Learning Environment and Science Learning Motivation. Retrieved on April 06, 2023, from https://doi.org/10.21315/apjee2022.37.2.11107
65. Hidayah, F. F., Imaduddin, M., Yuliyanto, E., Tantayanon, S., & Djunaidi, M. C. (2021). Environment and Teaching Satisfaction. Ilkogretim Online, 20(1), 1340-1350.
66. Hierrezuelo, J.M., (2019). Attitudes and values in science. Retrieved on April 8, 2023, http://surl.li/qxurb
67. Horsburgh, J., & Ippolito, I., (2018). A skill to be worked at: using social learning theory to explore the process of learning from role models in clinical settings. Retrieved on October 11, 2022, from https://bmcmededuc.biomedcentral.com/articles/10.1186/s12909-018- 1251-x
68. Hosbein, K. N. (2000b). The process of establishing theoretically grounded measures of science and chemistry identity for use in undergraduate chemistry courses. https://doi.org/10.15760/etd.7225
69. Hsu, C., & Huang, W., (2018). An interpretation of students' learning attitude and behavior toward physical education. Retrieved on October 11, 2022, from https://www.kheljournal.com/ archives/ 2018/vol5issue5/Part B/5-5-17- 795.pdf
70. Hosbein, K. N. (2000b). The process of establishing theoretically grounded measures of science and chemistry identity for use in undergraduate chemistry courses. https://doi.org/10.15760/etd.7225
71. Hurst, B., Wallace, R., & Nixon, S. B. (2013). The Impact of Social Interaction on Student Learning. Retrieved on April 03, 2023, from https://scholarworks.wmich.edu/reading_horizons/vol52/iss4/5
72. Ismail, A., & Mahmood. A., (2018). The Influence of Interaction on Students Academic Performance: Case of Saudi Public University. Retrieved on April 03, 2023, from DOI:10.1109/ICCOINS.2018.8510577
73. Ivaniushina, V., Alexandrov, D., & Musabirov, I. (2016). The structure of students' motivation: Expectancies and values in taking data science course. Вопросы образования, (4 (eng)), 229-250.

74. Jidesjö, A. & Danielsson, A., (2016). Student experience and interest in science: Connections and implication for further education. Retrieved on April 5, 2023, from https://www.diva-portal.org/smash/get/diva2:535833/FULLTEXT01.pdf108
75. Juan, A., Hannan, S., & Namome, C. (2018). I believe I can do science: Self-efficacy and science achievement of Grade 9 students in South Africa. South African Journal of Science, 114(7-8), 48-54.
76. Johnson, D. (2017). The Role of Teachers in Motivating Students to Learn. BU Journal of Graduate studies in education, 9(1), 46-49.
77. Käfer, J., Kuger, S., Klieme, E., & Kunter, M. (2019). The significance of dealing with mistakes for student achievement and motivation: results of doubly latent multilevel analyses. European journal of psychology of education, 34, 731-753.
78. Kahveci, A. (2015). Assessing high school students' attitudes toward chemistry with a shortened semantic differential. Chemistry Education Research and Practice, 16(2), 283-292.
79. Kalyon, D., (2020). The science learning environment primary school students imagine. Retrieved on October 09, 2022 from http://www.scientiasocialis.lt/jbse/files/pdf/vol19/605627.SahiKalyon_JBSE Vol. 19_No.4.pdf
80. Karpudewan, M., & Chong Keat, M. (2017). The effects of classroom learning environment and laboratory learning environment on the attitude towards learning Science in the 21st-century Science lessons. Malaysian Journal of Learning and Instruction (MJLI), Special issue on Graduate Students Research on Education, 25-45. Retrieved on April 04, 2023, from http://surl.li/qxvys
81. Keller, M. M., Neumann, K., & Fischer, H. E. (2017). The impact of physics teachers' pedagogical content knowledge and motivation on students' achievement and interest. Journal of Research in Science teaching, 54(5), 586-614.
82. Kibga, E., Gakuba E., Sentongo, J., (2021). Developing Students' Curiosity Through Chemistry Hands-on Activities: A Case of Selected Community Secondary Schools in Dar es Salaam, Tanzania. Retrieved on April 7, 2023, from https://www.ejmste.com/download/developing-students-curiosity-through chemistry-hands-on-activities-a-case-of-selected-community-10856.pdf
83. Khanam, R., (2018). The Importance of Chemistry Education. Retrieved on April 29, 2023, from https://www.imedpub.com/conference-abstracts-files/2472-1123-C5-014- 005.pdf
84. Kolil, V. K., Muthupalani, S., & Achuthan, K. (2020). Virtual experimental platforms in chemistry laboratory education and its impact on experimental self-efficacy. International Journal of Educational Technology in Higher Education, 17(1). https://doi.org/10.1186/s41239-020-00204-3
85. Kurniawan, D. A., Astalini, A., Darmaji, D., and Melsayanti, R. (2019). Students' attitude towards natural sciences. Retrieved on October 04, 2022 from https://www.researchgate.net/publication/341988728 Students' attitude towards natural sciences109
86. Kwok, P.W. (2015). Science laboratory learning environments in junior secondary schools. Retrieved on September 20, 2022, from https://citeseerx.ist.psu.edu/viewdoc/ download? doi=10.1.1.847. 8327&rep=rep1&t ype=pdf
87. Kuzle, A., & Gracin, D., (2021). Drawing out classroom social climate: The use of participant-produced drawings in research on psychosocial classroom learning environment in the context of school mathematics. Retrieved on October 06, 2022 from https://files.eric.ed.gov/fulltext/EJ1327606.pdf
88. Lajium, D., Ismail, Z., & Yunus Z., (2015). Secondary chemistry learning environments and students' attitudes towards chemistry. Retrieved on September 20, 2022, from https://www.researchgate.net/publication/284388568 Chemistry learning environments and students' attitudes towards chemistry
89. Lin-Siegler, X., Ahn, J. N., Chen, J., Fang, F. F. A., & Luna-Lucero, M. (2016). Even Einstein struggled: Effects of learning about great scientists' struggles on high school students' motivation to learn science. Journal of Educational Psychology, 108(3), 314.
90. Lishinski, A., Yadav, A., Good, J., & Enbody, R. (2016, August). Learning to program: Gender differences and interactive effects of students' motivation, goals, and self- efficacy on performance. In Proceedings of the 2016 ACM conference on international computing education research (pp. 211-220).
91. Lüftenegger, M., Klug, J., Harrer, K., Langer, M., Spiel, C., & Schober, B. (2016). Students' achievement goals, learning-related emotions and academic achievement. Frontiers in psychology, 7, 603.

92. Magwilang, E., (2016). Teaching Chemistry in Context: Its Effects on Students' Motivation, Attitudes and Achievement in Chemistry. Retrieved on September 30, 2022, from http://ijlter.org/index.php/ijlter/article/view/670/289
93. Mahdi, G. J. (2014). Student attitudes towards chemistry: An examination of choices and preferences. American Journal of Educational Research, 2(6), 351- 356. http://doi.org/10.12691/education-2-6-3
94. Musengimana, J., Kampire, E., & Ntawiha, P. (2021). Factors Affecting Secondary Schools Students' Attitudes toward Learning Chemistry: A Review of Literature. EURASIA Journal of Mathematics, Science and Technology Education, 17(1).
95. Jannah, N., & Putra D., (2019). Learning In Nature Science: Social Implications, Normality of Scientist, Attitudes Towards Investigation of Natural Science, And Interest Adds to Science Learning Time. Retrieved on October 06, 2022 from https://www.ijstr.org/final-print/dec2019/Learning-In-Nature-ScienceSocial-Implications-Normality-Of-Scientist-Attitudes-TowardsInvestigation-Of-Natural Science-And-Interest-Adds-To-Science-LearningTime.pdf
96. Malina, M., (2020). Attitude and level of performance of students in chemistry. Retrieved on November 07, 2022 from https://www.researchgate.net/publication/346166251 ATTITUDE AND L EVEL OF PERFORMANCE OF STUDENTS IN CHEMISTRY
97. Mambiela, P., Acosta, K., Yebra, M., & Gonzales, A., (2023). Motivation to learn science, emotions in science classes, and engagement towards science studies in Chilean and Spanish compulsory secondary education students. Retrieved on April 04, 2023, from https://doi.org/10.1002/sce.21793110
98. Marchut, A., & Gormally, C., (2019). Successes and Limitations of Inquiry-Based Laboratories on Affective Learning Outcomes for Deaf, Hard-of-Hearing, and Hearing Signing Students. Retrieved on April 06, 2023, from https://files.eric.ed.gov/fulltext/EJ1234121.pdf
99. Matias, L., Donato, L., Roman, P., Torres, F., Jorge, N., Mendoza, S., Washington, A., & Borrero, M., (2019). An exploratory study comparing students' science identity perceptions derived from a hands-on research and non research-based summer learning experience. Retrieved on October 31,2022, from https://iubmb.onlinelibrary.wiley.com/doi/epdf/10.1002/bmb.21314
100. Middleton, J. A., Tallman, M. A., Hatfield, N., & Davis, O. (2015). Taking the severe out of perseverance: Strategies for building mathematical determination. The Collected Papers. Chicago, IL: Spencer Foundation. Article Available Online [http://www. spencer. org/collected-papers-april-2015].
101. McWilliams, C., Nims, B., & Dwyer K., (2020). The Development of Science Identity in Undergraduate STEM Majors: A Case Study of Urban High School Students. Retrieved on October 23, 2022 from https://irl.umsl.edu/cgi/viewcontent.cgi?article=1979&context=dissertation
102. Kim, M. (2017). Understanding children's science identity through classroom interactions. International Journal of Science Education, 40(1), 24–45. https:// doi.org/10.1080/ 09500693.2017.1395925
103. Moeed, A., (2013). Science investigation that best supports student learning: Teachers' understanding of science investigation. Retrieved on October 09, 2022, from https:// files. eric. ed.gov/ fulltext/ EJ1016895.pdf
104. Mubeen, S., & Reid, N. (2014). The measurement of motivation with science student. European Journal of Educational Research, 3(3), 129-144.
105. Muhammed, A. B. (2021). Measuring Students' attitude towards chemistry: The Strengthening Mathematics and Science Education's approach. Unnes Science Education Journal, 10(3), 124–131. https://doi.org/10.15294/usej.v10i3.46507
106. Mujtaba, T., Sheldrake R., & Reiss, M., (2020). Chemistry for All Reducing inequalities in chemistry aspirations and attitudes. Retrieved on April 22, 2023, from https:// www.rsc.org/ global assets/22-new-perspectives/talent/is-chemistry accessible-for-all/rsc-cfa-report.pdf111
107. Murthy, S., & Etkina, E., (2014). Development of Scientific Abilities in a Large Class. Retrieved on October 09, 2022 from https:// www.researchgate.net/ publication/ 237431474 Development of Sc ientific Abilities in a Large Class
108. Musengimana, J., Kampire, E., & Ntawiha, P., (2020). Factors Affecting Secondary Schools Students' Attitudes toward Learning Chemistry: A Review of Literature. Retrieved on October 04, 2022, from https://files.eric.ed.gov/fulltext/EJ1284629.pdf

109. Mutlu, A., & Şeşen, B., (2020). Comparison of inquiry-based instruction in real and virtual laboratory environments: Prospective science teachers' attitudes. Retrieved on April 8, 2023, from https://files.eric.ed.gov/fulltext/EJ1271129.pdf
110. Najid, A., Rahmawati Y., & Yusmaniar (2021). Developing students' attitudes towards chemistry learning through culturally responsive transformative teaching (CRTT). Retrieved on September 21, 2022, from https://aip.scitation.org/doi/pdf/10.1063/5.0041989 DOI:10.17265/2161 623X/ 2015. 12. 005
111. Naiker, M., Sharma, B. N., Wakeling, L., Johnson, J. B., Mani, J. S., Kumar, B., Naidu, A., Khan, M. G., & Brown, S. (2020). Attitudes towards science among senior secondary students in Fiji. Waikato Journal of Education, 25, 57–72. https://doi.org/10.15663/wje.v25i0.704
112. Naiker, M., Wakeling, L. Johnson, J.; and Brown, S., (2021). Attitudes and experiences among first-year regional Australian undergraduate students toward the study of chemistry. Retrieved on April 06, 2023, from https://ro.uow.edu.au/jutlp/vol18/iss4/15
113. Newell, D., Tharp, B., Vogt, G., Moreno, N., &. Zientek, L. (2015). Students' Attitudes Toward Science as Predictors of Gains on Student Content Knowledge: Benefits of an After-School Program. Retrieved on April 8, 2023, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4712926/
114. Nidup, Y., Zangmo, S., Rinzin, Y., Yuden, S., Subba, H. R., & Rai, J. (2021). The Perception of Class X Students of Phuentsholing Higher Secondary School towards Chemistry. Anatolian Journal of Education, 6(1), 51–66. https://doi.org/10.29333/aje.2021.614a
115. OECD (2016). "Student's attitudes towards science and expectations of science relate careers". Retrieved on October 06, 2022 from https://www. oecdilibrary. org/docserver/ 9789264266490en. pdf? expires=1665028357&id=id& accname=guest& checksum=94DC0E 4E1DBED 4952973114 C7 EA EA42E
116. Okam, C.C., & Zakari, I.I. (2017). Impact of Laboratory-Based Teaching Strategy on Students' Attitudes and Mastery of Chemistry in Katsina Metropolis, Katsina State, Nigeria. Retrieved on September 21, 2022, from https://files.eric.ed.gov/fulltext/EJ1272657.pdf
117. Olubu, O., (2015). Influence of Laboratory Learning Environment on Student's Academic Performance in Secondary School Chemistry. Retrieved on November 07, 2022, from https:// www.davidpublisher. com/ Public/uploads/Contribute/568f8199d8eb4 .pdf
118. Olufemi, T., 2012. Theories of Attitudes. Retrieved on October 04, 2022 from https://www.novapublishers.com/wp-content/uploads/2019/09/978-1- 62081-194-8_ch3.pdf
119. Omwirhiren, E., & Anderson, F., (2016). Effect of Class Size and Students' Attitude on Academic Performance in Chemistry at Demonstration Secondary School, Ahmadu Bello University Zaria, Nigeria. Retrieved on September 22, 2022, from https://www. academia.edu/ 30362434/Effect of Class Size and Students Attitude on Academic Performance in Chemistry at Demonstration Secondary School Ong, K., Chou, Y., Yang, D., & Lin, C., (2019). Creative Drama in Science
120. Education: The Effects on Situational Interest, Career Interest, and Science-Related Attitudes of Science Majors and Non-Science Majors. Retrieved on April 04, 2023, from https://www.ejmste.com/ download/creative-drama-in-science-educationthe-effects-on-situational-interest-career-interest-and-7788.pdf
121. ONGOWO, R. O. (2015). Relationship between students' perception of biology learning environment and their achievement, motivation and attitude in co-educational secondary schools, in Siaya county, Kenya (Doctoral dissertation, Maseno University). https://www.eduhk.hk/apfslt/download/v18 issue2 files/karpudewan.pdf
122. Oser, R., (2013) Effectiveness of Virtual Laboratories in Terms of Achievement Attitudes, and Learning Environment among High School Science Students. Retrieved on October 06, 2022 from https://core.ac.uk/download/pdf/195631589.pdf113
123. Oyedeji, S. O. (2017). The Effects of Students' Motivational Factors on Their Attitudes toward Mathematics. International Journal of Evaluation and Research in Education, 6(4), 277-287.
124. Park, M. (2022). Exploration of Relationships between Students' Science Identities and Achievement Emotions in Physics. Education Sciences, 12(5), 290. https://doi.org/10.3390/educsci12050290
125. Perrault, L., (2017) "Exploring Science Identity: The Lived Experiences of Underserved Students in a University Supplemental Science Program". Retrieved on April 5, 2023, from https:// scholar works. uno.edu/td/2428

126. Poupore, G. (2016). Measuring group work dynamics and its relation with L2 learners' task motivation and language production. Language Teaching Research, 20(6), 719-740. https://doi.org/ 10.1177/ 1362168815606162
127. Prachagool, V., & Arsaiboon, C., (2021). Scientific attitudes of young children through literature based and project-based learning organization. Retrieved on October 09, 2022 from https://files.eric.ed.gov/fulltext/EJ1326825.pdf
128. Raacke, M., & Raacke, J., (2014). Nonexperimental Research Methods from Research Methods: Are You Equipped? Retrieved on October 04, 2022 from https://he.kendallhunt.com/sites/ default/files/ uploadedFiles/Kendall_Hunt/Content/Higher_Education/Uploads/Bonds_Raacke_Research_2e_Ch4.pdf
129. Rafanan, R., De Guzman C., & Rogayan, D., (2020). Pursuing STEM Careers: Perspectives of Senior High School Students. Retrieved on October 09, 2022 from https:// dergipark. org.tr/tr/ download/article-file/1193431
130. Rahmawati, Y., & Koul, R., (2013). Attitude and level of performance of students in cchemistry. Retrieved on November 07, 2022 from https://www. researchgate.net/ publication/ 293335350 Students' Perceptio ns For the Chemistry Laboratory Environment Improvement
131. Rana, R. A., Mahmood, N., & Reid, N. (2015). Motivation and science performance: influence on student learning in science. Science Institute (Lahore), 27(2), 1445-1452.
132. Ribes, C., (2021). "Strategies for Success as an Industrial Chemist" Retrieved on April 29, 2023, from https://www.degruyter.com/document/doi/10.1515/ci-2021- 0302/html? lang=en
133. Rodriguez, L., Campbell, T., Volin, J.C., Moss, D. M., Arnold, C., & Cisneros, L. (2021). Assessing STEM identities in intergenerational informal STEM programming. Retrieved on April 05, 2023, from https://citejournal.org/wp-content/uploads/2021/10/v21i4Science1.pdf
134. Roehrig, G., Gonsar, N. Y., & Nowariak, A. H. (2022). STEM Identity Development for Under-represented Students in a Research Experience114 for Undergraduates. ASEE Annual Conference and Exposition, Conference Proceedings. Retrieved on April 05, 2023, from https://experts.umn.edu/en/publications/stem-identity-development-for under- represented-students-in-a-res
135. Rosen, D. J., & Kelly, A. M. (2022). Working together or alone, near, or far: Social connections and communities of practice in in-person and remote physics laboratories. Physical Review, 18(1). https://doi.org/10.1103/physrevphyseducres.18.010105
136. Ruff, C., (2016). Finding Relevance, Competence, and Enjoyment: The Development of Domain Identification and Interest in First-Year Science Majors. Retrieved on April 7, 2023, from https://files.eric.ed.gov/fulltext/EJ1125225.pdf
137. Ruz, P., & Schunn C., (2018). The nature of science identity and its role as the driver of student choices. Retrieved on October 23, 2022 from https://www.researchgate.net/publication/329324850 The nature of science identity and its role as the driver of student choices
138. Sharaabi-Naor, Y., Kesner, M., & Shwartz, Y. (2014). Enhancing students' motivation to learn chemistry.
139. Sharma, B. N., Narayan, S., Khan, M. G., Kumar, B., Havea, R., Johnson, J. B., & Naiker, M. (2021). The attitudes of Tongan senior secondary students toward science. New Zealand Journal of Educational Studies, 56(2), 245–268. https://doi.org/10.1007/s40841-021-00203-6
140. Shashi, P. (2016). Laboratory Experience for perspective Science Teachers: A Meta-analytic Review of Issues and Concerns. Retrieved on April 03, 2023, from https://core.ac.uk/download/pdf/236408342.pdf
141. Sheldrake, R., Mujtaba, T., & Reiss, M., (2017). Science teaching and students' attitudes and aspirations: The importance of conveying the applications and relevance of science. Retrieved on April 8, 2023, from http://surl.li/qxxma
142. Sibomana, A., Karegeya, C., & Sentongo J., (2021). Factors Affecting Secondary School Students' Academic Achievements in Chemistry. Retrieved on September 22, 2022, from https://www. Researchgate.net/publication/357432824 Factors Affecting Secondary School Students' Academic Achievements in Chemistry
143. Singh, I. S., & Chibuye, B. (2016). Effect of Ethnochemistry Practices on Secondary School Students' Attitude towards Chemistry. Journal of Education and Practice, 7(17), 44-56.

144. Suhaini, M., (2020). Factors Influencing Student Achievement: A Systematic Review. Retrieved on October 05, 2022 from https://www.researchgate.net/profile/MazliliSuhaini/publication/340507648 Factors Influencing Student Achievement A Systematic Review/links/5ed5cc75299 bf1c67d327e73/ Factors-Influencing-Student-Achievement-A Systematic-Review.pdf
145. Sumardani D (2021) Philippines: Strength and weakness of science curricula. Sci Educ J 5(2):99–106. https://doi.org/10.21070/sej.v5i2.1507
146. Surya, W., & Arty, I., (2021). Students' attitudes toward chemistry based on their learning experiences. Retrieved on April 06, 2023, from DOI:10.1088/1742-6596/1806/1/012178
147. Susilawati, N., Aznam, N., & Paidi, P. (2022). Attitudes towards Science: A study of gender differences and grade level. European Journal of Educational Research, 11(2), 599–608. https://doi.org/10.12973/eu-jer.11.2.599
148. Surya, W. P., & Arty, I. S. (2021, March). Students' attitudes toward chemistry based on their learning experiences. In Journal of Physics: Conference Series (Vol.1806, No.1, p.012178). IOP Publishing. Sausan, I., Saputro, S., & Indriyanti, N. Y. (2020). A New Chemistry Multimedia: How Can It Help Junior High School Students Create a Good Impression? International Journal of Instruction, 13(4), 457-476.
149. Shin, M. H. (2018). Effects of Project-Based Learning on Students' Motivation and Self-Efficacy. English teaching, 73(1), 95-114.
150. Taherdoost, H., (2016). Sampling Methods in Research Methodology; How to Choose a Sampling Technique for Research. Retrieved on October 03, 2022, from http://surl.li/qxxqe
151. Tanti, Kurniawan, D., Anggraini, L., & Perdana R., (2020). A study analysis of tudent attitude to science lessons. Retrieved on April 04, 2023, from https:// files. eric. ed.gov/ fulltext/ EJ1276476.pdf
152. Tai, R.H., Ryoo, J.H., Skeeles-Worley, A. et al., (2022). (Re-)Designing a measure of student's attitudes toward science: a longitudinal psychometric approach. IJ STEM Ed 9, 12. Retrieved on April 04, 2023, from https://doi.org/10.1186/s40594-022-00332-4
153. Tippett, T., & Lee, J., (2019). Looking Back to Move Forward: Understanding Progressive Education in the 21st Century. Retrieved on April 118, 2023, from https://files.eric.ed.gov/fulltext/EJ1285555.pdf116
154. Toma, R., & Greca. I., (2018). The Effect of Integrative STEM Instruction on Elementary Students' Attitudes toward Science. Retrieved on April 07, 2023, from https://www.ejmste.com/ download/the-effect-of-integrative-stem instruction-on-elementary-students-attitudes-toward-science-5353.pdf
155. Tuan*, H. L., Chin, C. C., & Shieh, S. H. (2005). The development of a questionnaire to measure students' motivation towards science learning. International journal of science education, 27(6), 639-654.
156. Kvivesen M., Manshadi, S., & Uteng, S., (2020). The three-factor model: A study of common features in students' attitudes towards studying and learning science and mathematics in the three countries of the North Calotte region. Retrieved on April 06, 2023, from https://files. eric.ed.gov/ full text/ EJ1272226.pdf
157. Trujillo, G., & Tanner, K., (2014). Considering the Role of Effect in Learning: Monitoring Student's Self-Efficacy, Sense of Belonging, and Science Identity. Retrieved on October 24, 2022, from https://www.researchgate.net/publication/260486288Considering the Role of Affect in Learning Monitoring Students' Self Efficacy Sense of Belonging and Science Identity
158. Velooa, A., Perumal S., & Vikneswarya, R., (2013). Inquiry-based instruction, students' attitudes and teachers' support towards science achievement in rural primary schools. Retrieved on April 8, 2023, from https://core.ac.uk/download/pdf/82164567.pdf
159. Wassalwa, M., Evendi, E., Huda, I., Yusrizal, Y., Halim, A., & Saminan, S. (2022). Students' Attitudes towards Science in Junior High Schools and State
160. Wassalwa, M., Evendi, E., Huda, I., Yusrizal, Y., Halim, A., & Saminan, S. (2022). Sikap Peserta Didik Terhadap Sains di Sekolah Menengah Pertama dan Madrasah Tsanawiyah Negeri Kabupaten Aceh Jaya. Jurnal Penelitian Pendidikan IPA (JPPIPA), 8(2), 709 717. https:// doi.org/ 10.29303/ jppipa. v8i2.1359
161. Woldeamanuel, M., & Selassie, G., (2019). Motivation and Attitude Towards Learning Chemistry. Retrieved on September 17, 2022 from https://www. ajol.info/ index. php/ajce/ article/ view/188876

162. Yadav, B., & Mishra S., (2013). A Study of the Impact of Laboratory Approach on Achievement and Process Skills in Science among Is Standard Students. Retrieved on October 09, 2022, from https://www.ijsrp.org/research-paper-1301/ijsrp-p1382.pdf
163. Yang, H.-H., & Lin, Y.-T. (2022). How Knowledge Sharing and Cohesion Become Keys to a Successful Graduation Project for Students from Design College. Retrieved on April 21, 2023, from117 https://doi.org/10.1177/21582440221121785
164. Yarborough, C. B., & Fedesco, H. N. (2020). Motivating students. Vanderbilt University Center for Teaching. Retrieved [todaysdate] from https://cft.vanderbilt.edu//cft/guides-sub-pages/motivating-students/. https://cft.vanderbilt.edu/guides-sub-pages/motivating-students/
165. Yunus, F., Ali, Z., (2018). Attitude towards Learning Chemistry among Secondary School Students in Malaysia. Retrieved on September 22, 2022, from https://www.researchgate.net/publication/322299979 Attitude towards Learning Chemistry among Secondary School Students in Malaysia