# RELATIONSHIP BETWEEN CULTURAL FACTORS AND SECONDARY SCHOOL STUDENTS’ PERFORMANCE IN CHEMISTRY IN SAMBURU COUNTY, KENYA

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**A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy in Curriculum and Instruction of Egerton University**

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## DECLARATION AND RECOMMENDATION

### Declaration

I declare that, this thesis is my original work and has not been presented for any degree or diploma in this or any other university.

Signature……………………………………………Date……20/02/2024……………

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### Recommendation

This Thesis has been submitted for examination with our approval as the University supervisors.

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# DEDICATION

This work of love and affection is dedicated to my wife Margaret Apoo Ekwam, son Lomonyang D., daughters Iruata E., Akiru E., and Ayenae R., and to their patience, understanding, and support during my school years. Furthermore, may the All-Powerful God grant my parents Lomonyang Naluku and Mary Akiru Lomonyang moral support, which motivated me to assume this important responsibility.

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## ABSTRACT

This study examined the relationship between students' performance in chemistry at secondary schools in Samburu County and their cultural factors. A survey with correlations was the study design that was used. The target group consisted of all secondary school chemistry students in Samburu County. The accessible population in 2023 consisted of all Form Three Chemistry students in the County. Using cluster sampling, nine secondary schools public and private were selected as sample units. Using simple and stratified random sampling, 286 students were selected as a sample from the accessible population. The four instruments used to gather the data were the Students' Chemistry Performance Test (SCPT), Students' Cultural Beliefs and Practices Questionnaire (SCBPQ), Students' Religion Questionnaire (SRQ), and Students' Cultural Traditions Interview Schedule (SCTIS). The instruments were validated and pilot tested before being used. The reliability coefficients for SCPT, SCBPQ, and SRQ were 0.80, 0.85, and 0.81, respectively. To analyze the collected data, a mix of descriptive and inferential statistics was employed. To assess the quantitative data from the SCPT, descriptive statistics were used. The frequencies, means, and percentages of the data were used in the analysis. The qualitative data from the SCTIS was evaluated using the Chi-Square Test and a logical approach. To ascertain the relationships between the various variables, the study used Simple Linear Regression and the Chi-Square test. All statistical tests of significance were conducted at a coefficient level of alpha ($\alpha$) equal to 0.05 using the Statistical Package for Social Sciences (SPSS) version 23.0 for Windows. The following were the study's conclusions: Chemistry students' performance was below average (23.64%), with boys' schools outperforming coeducational and girls' schools. The chemistry performance of students was shown to have stronger statistically significant connections with cultural practices ($r = 0.115$, $P < 0.05$), traditions ($r = 8.533$, $P > P$), and religion ($r = 0.031$, $P < 0.05$). There was no significant correlation found between students' performance in chemistry and cultural beliefs ($r = -0.002$, $P > 0.05$). It is recommended that significant educational decisions be made as early in high school as feasible. The main objectives of these actions should be to reduce the impact of cultural factors that are known to worsen students' performance in chemistry and to begin offering in-service training to science teachers. This will provide them with the skills necessary to teach chemistry more effectively. The findings of the study will assist curriculum developers, teacher educators, policy makers, and chemistry instructors in addressing the required interventions to enhance meaningful chemistry learning and, consequently, improve students' performance in the subject in secondary schools across the country.

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## LIST OF ABBREVIATIONS AND ACRONYMS

**ATR** African Traditional Religion
**CK** Cultural Knowledge
**DEO** District Education Officer
**FET** Further Education and Training
**GET** General Education and Training
**GIS** Geographical Information Systems
**JICA** Japan International Corporation Agency
**KCSE** Kenya Certificate of Secondary Education
**KICD** Kenya Institute of Curriculum Development
**KNEC** Kenya National Examinations Council
**MoEST** Ministry of Education, Science and Technology
**NACOSTI** National Commission for Science, Technology and Innovation
**NCHE** National Commission on Higher Education
**NEPAD** New Partnership for Africa's Development
**SCBPQ** Students' Cultural Beliefs and Practices Questionnaire
**SCPT** Students' Chemistry Performance Test
**SDGs** Sustainable Development Goals
**SCTIS** Students' Cultural Traditions Interview Schedule
**SMASSE** Strengthening of Mathematics and Science in Secondary Education
**SPSS** Statistical Package for Social Sciences
**SRQ** Students' Religion Questionnaire
**UNESCOs** United Nations Educational, Scientific and Cultural Organizations
**URT** United Republic of Tanzania

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the Study

Cultural sensitivity has received a lot of attention in science teaching. Culture defines an individual's unique patterns of moral principles, customs, taboos, attitudes, knowledge, skills, behaviours, and technology (Irungu, 2019). Culture is the collectively taught behaviours of a group of people that are generally accepted as their traditions and are transmitted in different ways from one generation to the next (Nnamani, 2016). Cultural differences and characteristics manifest themselves in varying forms and intensities.

The general definition of culture provided by UNESCO states that the art, literature, customs, taboos, values, way of life, and spiritual, material, intellectual, and emotional qualities of a society, community, or group of people are all included in the various forms of culture (Nnamani & Oyibe, 2016). The idea that cultural knowledge is the primary element impacting academic performance and achievement can be dangerous, hurtful, and counterproductive when misunderstood (Palt, 2018).

The various forms that cultural knowledge might take are contingent upon its unique historical and customary context. Values, taboos, rituals, conventions, beliefs, traditions, and cultural practices are a few examples. According to Thomas (2017), the teaching and learning process is impacted by the cultural, economic, technological, religious, and political institutions of today. Cultural components fostered both communal development and technological advancement. The late Mwalimu Julius Nyerere, the former president of Tanzania, provided proof for the aforementioned statements when he described cultural education as an essential component of a person's lifestyle (Kigotho, 2015).

It is often acknowledged that lifestyle choices have an effect on instruction and learning (Almut, 2017). The main cause of poor performance, especially in chemistry, has been linked to students' faulty conceptual understanding when they enter the classroom (Meri, 2021). Studies show that most students' understanding of scientific facts is shaped by their cultural beliefs, norms, and behaviours (Dudovitz, 2017). Consequently, there are increasingly greater disparities between what students learn in the classroom and what they come across on a regular basis in the scientific community. The majority of pupils find it extremely difficult to explain, comprehend, and predict natural events (Tharani, 2020). Science instructors are more conscious of the need to reduce conflicts between students' worldviews and scientific beliefs by explicitly connecting science to their cultural backgrounds. This can be accomplished successfully by carefully considering the cultural perspective in relation to the chemistry performance of the students.

Abulude (2016) pointed out that the formation of new conceptions in the field of science is significantly influenced by preexisting knowledge of concepts held before the new learning. Chemistry is taught in secondary schools as one of the basic sciences. It deals with phenomena that are connected to physics and chemistry and how they impact man's day-to-day life. Cultural factors were likely to have an impact on students' chemistry performance. Chemistry teachers need to support their students in applying their knowledge in ways that draw from their cultural experiences if they want learning to have any real value. Therefore, the goal of this research is to determine the relationship between students' performance in chemistry and their cultural beliefs.

Cultural practices vary throughout the world and are carried out in a sequential manner for specific purposes in certain locations. Different parts of the cosmos are governed by distinct sets of values, beliefs, and customs that preserve their respective cultures. Every religion has associated with its doctrines certain cultural customs. Certain cultural customs, such as fasting, are observed exclusively at designated periods, while others are observed continuously (Ember, 2017). Certain African societies incorporated legends into their practices, explaining their actions by using stories or metaphors to convey essential information about the paranormal. These were employed to aid in the explanation of ideas, viewpoints, and concepts so that the adherents may better comprehend their religion. These rituals may help people find peace of mind, give them hope, help them turn their life around, and modify their opinions, as evidenced by the bulk of African cultural traditions (Marcus, 2016).

Cultural customs are carried out as a sign of integrity and loyalty to the community. Cultural anthropologists contended that a ritual might be divided into four primary kinds, according to Batyra (2017a), a viewpoint on the human condition. These four characteristics were: a ritualized social practice that was repeated and distinct from daily routines; ritualized schema; and mythological encoding. This study is significant because it closes the information gap about the relationship between Kenyan cultural practices and students' performance in chemistry, as there is currently inadequate data on the subject.

Numerous research conducted outside of Kenya have been conducted to identify the variables affecting secondary school students' interest in science courses. According to Oluwatosin and Ogbabe (2017), it was determined that the elements could be divided into two primary categories: internal and external influences. External influences included those from the outside, such as peers, family, the school setting, the media, and societal cultural norms. The internal elements, such as students' attitudes, views, and experiences with science in the classroom, were included in the second category (Freathy, 2019). Rather than linking genetically related domains to the gap, Tharani (2020) linked the difference to social values. Several studies have demonstrated that students' attitudes in scientific classes affected their participation in science in various parts of the world. Therefore, the purpose of this study is to determine the relationship between cultural traditions and students' performance in chemistry.

Globally, every nation's creation of new technologies is greatly aided by a strong cultural heritage in science. For instance, the development of the necessary scientific abilities for invention and creativity allowed America, Britain, Japan, and China to succeed in industrialization (Revelle, 2017). By 2030, Kenya wanted to be a middle-income nation; however, based on secondary school pupils' performance in scientific classes, this goal might not be achievable. This is a result of the disapproval that pupils have for science and mathematics. As a result, students have performed worse on the Kenya Certificate of Secondary Education exams (SMASSE project, 1998). The majority of Kenyan students opt out of science classes when given the chance, and even those who do usually do poorly (Kigotho, 2015). The low performance is shown in Table 1 results, which show students' performance in chemistry and other science subjects from 2020 to 2023.

*Table 1:*

*National Students' Performance in KCSE Chemistry and other Science Subjects in 2020 to 2023*

| Subject | 2020 Entry. | Mean % | 2021 Entry. | Mean % | 2022 Entry. | Mean % | 2023 Entry. | Mean % | Average Mean % |
|---|---|---|---|---|---|---|---|---|---|
| Biology | 509,982 | 29.19 | 545,663 | 23.93 | 593,965 | 25.90 | 629,538 | 27.69 | 26.68 |
| Physics | 149,790 | 39.77 | 160,182 | 35.04 | 173,573 | 39.88 | 183,969 | 40.43 | 38.78 |
| Chemistry | 566,836 | 23.72 | 606,515 | 24.05 | 660,204 | 26.24 | 699745 | 28.57 | 25.65 |

Source: County Education Office, Maralal

According to Table 1, the average mean score for Chemistry was 25.65%, whereas the average mean score for Biology and Physics ranged from 26.68 to 38.78%. Although the negative attitude that students have toward science topics may be the cause of these inequalities in students' performance, in this instance it was more evident in chemistry than in other science disciplines. Enhancing chemistry student performance is a major barrier to Kenya's industrialization as well as the development of scientifically literate citizenry capable of coming up with innovative solutions to science-related issues. In response to the dismal results of students' performance in the sciences and mathematics, the Kenyan government, through the Ministry of Education, Science and Technology (MoEST), with assistance from the Japanese government through the Japan International Corporation Agency (JICA), launched the Program for the Strengthening of Mathematics and Science in Secondary Education (SMASSE) (Nwona, 2015). In Samburu County, the program was implemented, and a notable improvement was observed. Nevertheless, as Table 2 shows, despite this intervention, students' performance in these subjects particularly chemistry among the sciences remained below 50% (KNEC Report, 2023).

*Table 2:*

*Samburu County Students' Performance in 2021 to 2023 KCSE Examinations in Sciences*

| Subject | 2021 | | | | 2022 | | | | 2023 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Female No. Sat. | Mean % | Male No. Sat. | Mean % | Female No. Sat. | Mean % | Male No. Sat. | Mean % | Female No. Sat. | Mean % | Male No. Sat. | Mean % |
| Biology | 401 | 21.56 | 582 | 23.11 | 440 | 27.60 | 718 | 30.50 | 470 | 27.56 | 820 | 30.60 |
| Physics | 63 | 20.06 | 150 | 22.67 | 67 | 22.25 | 170 | 25.50 | 182 | 22.06 | 240 | 29.67 |
| Chemistry | 440 | 15.60 | 710 | 17.56 | 420 | 16.20 | 740 | 19.06 | 490 | 17.11 | 840 | 21.00 |

Source: County Education Office, Maralal

Two conclusions may be drawn from Table 2:

i. Boys' and girls' chemistry performance over the given period was below average (50%).

ii. Despite the fact that both boys' and girls' performance fluctuated, it was clear that there was a gender difference in performance: girls' scores were consistently lower than boys', primarily in the area of chemistry.

Several variables have been suggested as the cause of Chemistry's poor performance. These included the excessive number of students enrolled, the students' disinterest in the subject, the lack of resources, the parents' educational background and socioeconomic standing (Koul, 2017). Through its several branches, Kenya's Ministry of Education has worked hard to lessen the reasons behind students' subpar performance in chemistry. These initiatives included, among other things, setting up in-service training programs for chemistry teachers, providing basic training materials, and, on occasion, revising the secondary school curriculum. Students continue to do poorly in chemistry despite the aforementioned initiatives (KNEC, 2020). This implied that the problem that caused the students to perform poorly in the course had not been fully resolved. Although the previously indicated factors may have contributed to this type of achievement, there may have been other, more significant factors as well. Research has shown that cultural factors affect how well students do in science classes and, in turn, in chemistry classes (Irungu, 2019).

There was a gender gap in the chemistry performance of the students, as Table 2 shows. Numerous academics have determined that attitude-related variables, including low self-esteem, a negative self-concept, fear of failure, cultural impact, and insecurity, affect how well girls perform in math and science (Ludecke, 2018). A system may eventually become more economically efficient if performance in science (and hence in chemistry) is maximized while performance gaps between boys and girls are reduced. Students' scientific performance and chances may improve as a result of this approach (Eren-Sisman, 2018). Thus, psychological and social aspects may be linked to the association between cultural elements and students' success in chemistry. The impact of cultural factors on students' chemistry performance persisted even in the absence of a significant cultural background. This study's justification stemmed from the necessity to find out more about the relationship between cultural traditions and students' chemistry performance in order to suggest possible remedial actions.

Different aspects of the human experience form the basis of both science and religion. Science uses information gleaned from observations of the natural world to explain its theories. A theory must ultimately be changed or abandoned when empirical data from experiments or observations contradicts the hypothesis. Religious faith, on the other hand, is not grounded on empirical evidence, is typically connected to supernatural powers or beings, and does not necessarily change in response to contradicting evidence. Since supernatural beings are not a part of nature, they handled human cognitive functions in other dimensions. Science and religion were pitted against one another in an attempt to generate conflict when none was necessary (Oladejo, 2021). Thus, the purpose of this study is to ascertain whether there is a connection between students' performance in chemistry and their religious beliefs.

Cultural considerations are among the variables that could affect how well students succeed in chemistry. A community's beliefs, moral standards, customs, religion, language, and laws/rules are all considered cultural influences. However, the cultural elements chosen for this study are cultural beliefs, practices, traditions, and religion because they are universal to all communities worldwide, they are encountered by students on a daily basis, they have an impact on chemistry, and most importantly, they are community-based factors. Students in Samburu County do not, however, completely comprehend how these variables relate to one another. Thus, establishing this link was the aim of our investigation.

### 1.2 Statement of the Problem

The national government has made an effort to improve every county's students' academic performance, including Samburu County. The chemistry curriculum will be updated, laboratories will be equipped with the required tools, and free day secondary school grants will provide funds to purchase textbooks at a 1:1 ratio. The administration has attempted to reduce the workload for teachers and students by reviewing and streamlining courses. Even though chemistry performance was falling, the Strengthening of Mathematics and Science in Secondary Education (SMASSE) program gave science teachers on-the-job training to raise subject proficiency levels. Despite efforts to enhance it, the issue of low student performance in chemistry continued. This indicates that further research is required because the true cause of low performance in chemistry has not been found. Because of this disparity, the researcher believed that more thorough research was necessary to determine how cultural factors affect students' performance in chemistry and to provide real improvements.

### 1.3 Objectives

This section's study is guided by both general and particular objectives.

#### 1.3.1 Broad Objective

This study's primary goal was to ascertain the association between cultural variables and Samburu County secondary school students' chemistry performance.

#### 1.3.2 Specific Objectives

The research was directed by the subsequent four distinct objectives:

i. To ascertain the association between Samburu County secondary school students' performance in chemistry and their cultural beliefs.
ii. To determine whether cultural practices and Samburu County secondary school students' chemistry test scores are related in any way.
iii. To ascertain the connection between Samburu County secondary school students' performance in chemistry and cultural traditions.
iv. To investigate the connection between Samburu County secondary school students' performance in chemistry and their religious beliefs.

## 1.4 Hypotheses of the Study

The study examined the following four null hypotheses in an effort to meet its specific objectives.

Ho1**:** There is no statistically significant relationship between cultural beliefs and secondary school students' performance in chemistry in Samburu County.

Ho2**:** There is no statistically significant relationship between cultural practices and secondary school students' performance in chemistry in Samburu County.

Ho3**:** There is no statistically significant relationship between cultural traditions and secondary school students' performance in chemistry in Samburu County.

Ho4**:** There is no statistically significant relationship between religion and secondary school students' performance in chemistry in Samburu County.

## 1.5 Significance of the Study

Ideally, the following would benefit from the study's findings:

**(a) Chemistry Teachers**

The curriculum for classroom chemistry is implemented by teachers. The results of the study would make them more aware of the recommended intervention techniques for raising students' chemistry performance.

**(b) Chemistry students**

The study's findings will help secondary school students identify the precise chemistry topics they find difficult. They will therefore benefit from the guidance offered on improving performance in chemistry.

**(c) Chemistry Teachers Trainers**

The study's findings will be used to make teacher trainers more aware of how a teacher's traits impact their students' chemistry performance and how to mitigate them in order to close the achievement gap between cultural influences and student success in the subject.

**(d) Curriculum Developers**

The results would allow KICD and textbook writers to create materials for chemistry instruction and learning that are free from the prejudice caused by cultural factors.

### 1.6 Assumptions of the Study

All of the participants in the study were believed to be of similar age and academic level. The research sample is typical of Kenya's secondary school student population as a whole. Unless otherwise noted, there were correlations between the study's factors and the chemical performance of the students. It was believed that parents' social, economic, and political standing, the educational environment, the academic credentials of chemistry professors, and security had little bearing on how well their children performed in the subject of chemistry. In their candid answers, those who completed the questionnaires and interview schedule expressed their thoughts and assessments regarding the connection between cultural influences and chemistry students' academic achievement. Additionally, it was presumed that the respondents had the data requested in the questionnaires, interview schedule, and chemistry test items. Every chemistry teacher in the schools that were sampled was skilled, capable, and efficient in what they taught. Finally, it was presumed that a standard chemistry curriculum was followed by all of the sampled secondary schools.

### 1.7 Scope of the Study

Students studying chemistry in Form Three were the main focus of the Samburu County study. Its primary focus was investigating the relationship between cultural factors and students' chemistry performance. The students' chemistry performance test (SCPT) was used to evaluate the Mole Concept, Organic Chemistry I, Nitrogen, and its associated compounds as they are taught in the approved Kenya Institute of Curriculum Development syllabus (KICD, 2002). The principles of chemical engineering and industrial chemistry are covered in these Form 3 chemistry courses. They also address subjects that are thought to be difficult and could lead to misconceptions among students. The public secondary schools in Samburu County that are coeducational for boys and girls hosted the study.

### 1.8 Limitations of the Study

As a result, the study only looked at Samburu County's secondary public and private schools. The relationship between cultural factors and students' chemistry performance was the main focus of the study; other educational aspects were not considered. Furthermore, the instruments used in this study were insufficient to account for every possible aspect that could influence students' performance in chemistry because there are many more. The secondary school students in Kenya's Samburu County were the only recipients of the generalizations. It was not anticipated, however, that limiting the research study's generalizations to the County would jeopardize the development of a thorough understanding of the relationship between cultural factors and students' performance in chemistry, since secondary schools in other parts of Kenya operated under somewhat similar conditions and constraints.

## 1.9 Operational Definition of Terms

The definitions of the terminologies used in this study are provided below.

**Beliefs:** Refers to personal attitudes associated with true or false ideas and concepts about something. In this study, it was taken to mean the connection between cultural beliefs and students' performance in chemistry. The measure was in form of students' scores in SCBPQ.

**Culture:** It refers to the ideas, customs, and social behaviours of particular people or society. In this study, it was taken to mean the connection between selected traditional ideas, customs, social behaviours of particular people or society and students' performance in chemistry. The measure was in form of students' scores in SCBPQ, SRQ and SCTIS.

**Cultural Beliefs:** Refers to traditional attitudes associated with true or false ideas or concepts about something that are held by the society in a given locality. In this study, it was taken to mean the connection between traditional attitudes associated with true or false concepts about chemistry and students' performance in chemistry. The measure was in form of students' scores in SCBPQ.

**Cultural Factors:** Refers to the set of beliefs, moral values/practices, traditions, ethics, religion, language and laws/rules practiced in a community. In this study, it was taken to mean the association between the chosen cultural facts/circumstances and students' performance in chemistry. The measure was in form of students' scores in SCBPQ, SRQ and SCTIS.

**Cultural Practices:** Refers to the manifestations of culture or sub-culture, especially in regard to the traditional and customary activities of a particular ethnic or other cultural group. In this study, it was taken to mean the connection between the traditional activities of a given ethnic group or society and students' performance in chemistry. The measure was in form of students' scores in SCBPQ.

**Cultural Traditions:** Refers to the norms, rituals, customs, precepts, principles and moral codes which regulate the conduct and actions of individuals in the society. In this study, it was taken to mean the connection between cultural traditions and students' performance in chemistry. The measure was in form of students' scores in SCTIS.

**Factors:** It refers to the circumstances, facts, elements or situations that influences the results of something. In this study, it was taken to mean the association between cultural facts or circumstances and students' performance in chemistry. The measure was in form of students' scores in SCBPQ, SRQ and SCTIS.

**Performance:** Refers to accomplishment of a given task measured against preset known standards of accuracy, completeness and speed. In this study, it was taken to mean the connection between cultural factors and students' measure of the level of success or failure attained in doing specific tasks in a subject or an area of study after teaching/learning experience. The measure was in form of scores attained by students in SCPT.

**Relationship:** It refers to the state in which two or more things are being associated to one another. In this study, it was taken to mean the connection between cultural factors or circumstances and students' performance in chemistry. The measure was in form of students' scores in SCPT, SCBPQ, SRQ and SCTIS.

**Religion:** Refers to the process of believing for example in God or gods, nature and activities connected to it. In this study, it was taken to mean the association between the process of believing in God, gods or nature and students' performance in chemistry. The measure was in form of students' scores in SRQ.

**Traditions:** Refers to specific guidelines, ideas and customs passed down from one generation to the next with symbolic meaning or special significance with origins in the society. In this study, it was taken to mean the connection between specific ideas or customs transmitted from one generation to another and students' performance in chemistry. The measure was in form of students' scores in SCTIS.

### 1.10 Chapter Summary

The study's conundrum that is, the possibility that cultural factors have a significant role in students' poor chemistry performance has been conceptualized in this chapter. This study sought to determine the relationship between cultural factors and secondary school students' performance in chemistry. Among the other features of the study are its background, problem description, objectives, significance, assumptions, scope, limitations, and definitions of terms utilized in the investigation. In the chapter, secondary school students were also identified as the main unit of study. These topics are further explored in chapter two with regard to the connection between cultural factors and students' chemistry performance.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

In this chapter, the researcher reviews the literature on previous studies that have been done in connection to the researcher's area of interest. The empirical literature evaluation is based on the secondary school chemistry curriculum as well as cultural beliefs, practices, traditions, and religion. The researcher presents differing viewpoints that are critical of other authors who have put forward different takes on the same issues that are being studied. In conclusion, it provides a synopsis of the assessed literature along with citations to the gaps identified, in addition to providing a theoretical and conceptual framework.

## 2.2 Chemistry in the Secondary School Curriculum

One of the most major fields of study in science, chemistry is a key topic that has a big impact on how people live their daily lives in society. In all science-focused disciplines, including engineering, mining, medical, and many more, it holds a highly delicate place. Students who plan to pursue jobs in science and engineering must have taken chemistry in secondary school, not just be proficient in the subject but also have passed the KCSE. Additionally, chemistry helps students comprehend their surroundings and the events that take place in them. It assists the students in cooperatively resolving basic problems they may face in the future and on a daily basis. Irungu (2019) contends that chemistry is the most relevant subject since it has applications in real-world situations. To make the Earth a decent place to live, chemistry is vital for far too many reasons.

It is depressing to learn that, in spite of its important function, pupils consistently perform poorly on it. This has raised a great deal of anxiety and led experts to investigate the reasons behind the recurrent failures. A few of these have been linked, among other things, to ineffective teaching strategies, a shortage of teachers with formal training, a dearth of facilities for instruction, the absence of appropriate practical equipment, and insufficient money for educational initiatives in educational institutions (Judger, 2016). Educational stakeholders have tried to figure out how to get pupils doing better in chemistry.

A few strategies included determining the best pedagogy for instruction (Hobart, 2016), enhancing instructors' content knowledge, and providing educational resources. Students' performance in chemistry is still below average in spite of all these efforts. Therefore, it was important to take into account additional elements that might be to blame for the poor chemistry performance of pupils (Irungu, 2019). Cultural misunderstandings that students bring to science classes especially chemistry have been found to be a major cause of their subpar performance in the field (Muller, 2019). Research has shown that students' impressions of society and cultural concepts influenced how they interpreted scientific phenomena (Freathy, 2019).

### 2.2.1 Concepts of Teaching and Learning of Chemistry in Secondary Schools

Students who get scientific instruction in the classroom are more likely to develop positive attitudes toward chemistry. The Scientific Literacy notion, which maintained that students' positive science self-concepts had a substantial influence on their attitudes toward chemistry, served as an example of this (Koul, 2016). The affective part of scientific literacy, which consists of both cognitive and affective learning components, includes self-concept (Mair, 2017). It consisted of "attitudes and values that individuals may have towards teaching and learning of chemistry," according to Ruschenpohler (2019). Positive self-concepts in chemistry are a feature of scientific literacy in chemistry education, according to the same metric. Moreover, there is a strong relationship between students' self-concepts and their performance. They are crucial for facilitating chemistry as well as for advancing scientific literacy in the area as a result.

However, there was a lack of information regarding certain aspects of secondary school students' self-concepts. There has been much discussion on secondary school students' self-concepts in general science and chemistry. Research on chemistry education is mostly concerned with how college students view their own chemistry (Nielsen, 2016). Regarding secondary school students, many questions remained unanswered. An overview of the three main components of chemistry education are provided below:

**(i).** Self-perception and chemical learning processes in relation to one another. According to education psychology theory, pupils who have a good self-concept are more likely to exhibit learning goal orientations (Chan, 2020). These results imply that a similar association, such as a positive relationship between cultural influences and students' success in chemistry, can be established for the subject of chemistry. Establishing a relationship of this kind is crucial since it can assist in considering the real-world applications of a chemistry self-concept. Because self-concept studies are difficult to perform, they have remained at the theoretical level in some investigations. The design of interventions carried out during the teaching and learning processes is made more fascinating by the more concrete nature of learning goal orientations.

**(ii).** Learning goal orientations operate as a mediator between students' success in chemistry and cultural influences. It is frequently maintained that learning goal orientations regulate the relationship between cultural factors and students' success in chemistry and other sciences (Smith, 2018). The performance of students in chemistry and cultural elements were favourably correlated with learning goal orientations (Ludecke, 2018). These aim orientations used as interpretive tools for chemistry instruction. Students with learning goals typically see challenges as chances to strengthen their own learning abilities (Eren-Sisman, 2018). It was postulated that acknowledging these chances would subsequently lead to efficient learning practices and improved chemistry performance among students. Many signs of learning goal orientations were present. The incremental hypothesis of intelligence was one such sign. This suggests that learners who have a learning goal orientation see themselves as malleable and reachable in terms of their talents (Dudovitz, 2017).

Students thought that if they put in enough work on their own, they might improve their competences. Additionally, when faced with a demanding assignment, students who have a learning goal orientation are more likely to persevere (Batyra, 2017b). Because they had faith in their capacity to learn and comprehend, students did not instantly retreat back into themselves. Thus, persistence served as an additional marker of learning goal orientations. According to Broman (2015), the requirement for cognition was the third facet of goal orientations. As stated by Bathyra (2017a), students who are oriented toward learning goals generally "engage in and enjoy thinking." The satisfaction of intellectual pursuits and the achievement of intended educational objectives are closely related (Oladejo, 2021).

**(iii).** The effect of social environment on the performance of chemistry students. Research has demonstrated that students' sense of self-development is significantly influenced by their sociocultural environment. Self-concepts were influenced by both the larger cultural background and the social interactions in the classroom when learning chemistry. According to Dudovitz (2017), the foundation of academic self-concepts appears to be the student-teacher interaction. Instructors' perceptions of gender disparities in science achievement appeared to be linked to students' self-perceptions and goal-achieving (Thomas, 2017); also, cooperative learning strategies were used by the instructors to teach chemistry (Raufelder, 2015). The majority of these conclusions about the function of the social setting were general in nature. Therefore, the effect of the social milieu in chemistry class on the correlation between cultural characteristics and students' chemistry performance was unknown. It is anticipated that cultural variables and students' chemistry performance will be shown to have a similar beneficial association, as reported in the research on education psychology.

However, it is widely agreed that language was essential to chemistry education (Markic & Childs, 2016). This held true in social situations as well. Social support was necessary for chemistry to form (Harris, 2021). Peer collaboration that is cooperative and encouraging can help students do better in chemistry and other sciences while also reducing anxiety (Eren-Sisman, 2018). Additionally, students' performance in chemistry appears to be significantly impacted by their positive connection with the instructor. This was particularly true, according to students from disadvantaged families (Wentzel, 2017). The previously listed factors indicate that there appears to be a disparity between students' chemistry performance and cultural influences. This study aimed to determine the relationship between cultural factors and students' performance in chemistry in order to close the stated gap.

### 2.2.2 Approaches to Teaching and Learning of Chemistry in Secondary Schools

Because of its unique language, chemistry is the foundation of all science topics worldwide. However, in order to make chemistry approachable, entertaining, significant, engaging, and useful, one must devise methods that make the aforementioned criteria evident (Ajayi, 2016). The key strategies for increasing the results orienteers of chemistry education and learning are particulate matter methodologies and instructional strategies. Changing the chemistry curriculum presents both opportunities and challenges as outdated teaching methods are compared to more modern learning objectives. Since it provided for the most thorough covering of the material and was the mode that most of them were familiar with, many chemistry instructors in the past opted for the traditional lecture style (Muller, 2019). Some active teaching techniques for teaching chemistry include the following:

**(i). Use of Models during Teaching**

The main topics of chemistry are atomic and molecular phenomena, which are not readily observed in a high school environment. By making abstract concepts more approachable and straightforward, teachers can help students better understand abstract ideas by using similar analogies. Apart from functioning as tools for conveying ideas, the models provide means of investigating, defining, and elucidating mathematical and scientific ideas. They also add to the importance, relevance, and appeal of science as a field of study. Therefore, teachers should help students understand the benefits and drawbacks of an analogy when teaching and learning chemistry in secondary schools (Vander, 2016).

**(ii). Use of Information and Communication Technology (ICT)**

Information and communication technology (ICT) offers a creative new learning environment that is beneficial to both teachers and students. ICT is essential to the administration, design, and assessment of lessons (Joseph, 2015). There are two categories for ICT use: A computer is utilized as a tool for communication, information retrieval, and multimedia in the first group. The computer is a scientific instrument in the second group as well, used for interactive simulations, virtual laboratories, and computer-assisted laboratory work (Kigotho, 2015).

There are certain unique benefits to using computers in science classes, especially chemistry. According to Kasisi (2019), cognitive psychologists believed that comprehending chemistry required the capacity to think at three different levels: macroscopic, symbolic, and subatomic level. The submicroscopic level of particles is the most hardest for students to comprehend since it transcends their knowledge and experience. The interactive multimedia could be a useful tool in these situations. According to Tharani (2020), the program aided pupils in comprehending advanced levels of analysis, synthesis, and evaluation. It is highly recommended that secondary school educators seize these chances when they arise. Lastly, educators need to keep up with the latest developments in educational technology and select the resources that will most benefit the chemistry curriculum.

**(iii). Use of Assessment and Evaluation**

Teachers must prepare pertinent questions ahead of time, regardless of the lesson structure they choose, in order to gauge students' understanding at each stage of the session. One of these questions was posed at the start of a lesson to gauge the pupils' prior knowledge. Throughout the class, open-ended questions are utilized to help students learn, and at the conclusion, closing questions are used to assess the students' understanding of the material. Students should respond to the introductory questions with the knowledge that the goal is to challenge their preconceived notions rather than to provide the "correct" response. An issue concerning the dissolution of contaminants and other chemicals in water could be the starting point of an intermolecular forces lesson (Joseph, 2015). Oftentimes, these questions highlight prior beliefs or assumptions that will be addressed later in the lesson. During class, teachers can help students develop their critical thinking and problem-solving skills by using effective questioning techniques.

**(iv). Demonstrations and Experiments**

Since chemistry is a laboratory discipline, learning it effectively requires extensive lab experience. In fact, the core concepts of the topic of chemistry are the identification, handling, and wide application of laboratory equipment. The tools required to carry out insightful experiments and demonstrations should be available in a high school lab (Meri, 2021). Each and every student must have access to the actual laboratory setting. Teachers should be aware that students with limited strength or mobility can engage completely in the laboratory experience with the correct accommodations, such as a lab assistant or assistants. Teaching that is student-centered and heavily emphasizes the purpose of laboratory demonstrations and experiments is the greatest method to guarantee that students understand these fundamental ideas for learning the sciences, particularly chemistry.

**(v). Mathematical Problem Solving (Algorithmic Problem Solving)**

Chemistry has traditionally been taught as a mathematics course, with a near total emphasis on algorithmic problem-solving at all learning stages, according to Batyra (2017a). New approaches to teaching chemistry are required since research showed that students of all skill levels have difficulty understanding the material conceptually. There were chemistry instructors who approached their topic both philosophically and intuitively at every educational level. Most educators were still having difficulty determining which instructional pedagogies to use and how to handle problems using chemistry algorithms.

**(vi). Conceptual Teaching**

This approach is centered on assisting students in understanding the macroscopic, particle, symbolic, and mathematical phases of chemical concept presentations, as well as helping them visualize and explain practical behavior, explain links, and forecast consequences. When a deep comprehension of the concepts is not absolutely necessary, this teaching technique lays a lot of focus on different pedagogies to make chemistry instruction less quantitative and more conceptual. The method can be used in both large and small classes in conjunction with an informal lecture style. It incorporates the use of very small representations, particulate representations (both dynamic and static models), and group problem-solving, algorithmic and conceptual assessments in teaching and learning processes (Kanno, 2018).

**(vii). Design and Construction Approach**

Parchmann (2021) claims that the design and construction techniques were mostly centered on laboratory activities and how they connected to students' past academic achievements and motivations in their chemistry education. According to the author, the two methods for teaching chemistry were regarded as authentic science exercises for middle school students and were rarely utilized in science classrooms. With these approaches, students had to control the variables and create their own experiments. The results showed that students' performance in the design and construction procedures was impacted by the task's level of complexity. The more abstract activities that students were assigned, such creating hypotheses and analyzing data, the worse their scores were for motivation and performance. When assessing the design and building procedures, students expressed the most gratitude for the encouraging classroom environment and their active participation in the laboratory activities to study chemistry. The results of the study demonstrated that students who did better in chemistry also had greater levels of academic self-worth and stronger intrinsic and extrinsic motivation to master the subject.

**(viii). Use of Different Pictorial Materials and Multimedia Environments**

"How Does Students' Understanding of a Dynamic Liquid-Vapour Equilibrium Simulation Depend on Guidance Level?" The subject was heavily researched since molecular structure and dynamics representations are effective teaching tools in chemistry (Oladejo, 2021). As the author pointed out, students usually require assistance to understand what they are seeing in simulations, animations, and static visualizations, particularly when it comes to sub-microscopic chemical processes. Scientists may find scientific visualizations instructive, while novices may find them difficult to comprehend and make frequent mistakes with.

The study investigated how well students learned when given a worksheet with a lot of instruction or one that was more open-ended and provided very little help. Additionally, students completed an attitude survey, a conceptual understanding pre- and post-test, and an attitude survey. The findings indicated that after learning through simulations, a large number of students were able to rectify their comprehension. No variation in conceptual comprehension was observed across the groups utilizing worksheets with varying amounts of help.

On the worksheets and simulation, however, students who had filled out the evaluation questionnaire's open-ended form had more favourable things to say. While students who finished the open-ended worksheet were more likely to focus on the lesson's substance in their remarks, those who completed the more guided worksheets were more likely to focus on the lesson's organization.

**(ix). Use of Predict-Observe-Explain (POE) Instructional Approach**

The Predict-Observe-Explain (POE) pedagogy was used in an in-service teacher program to help students comprehend the concepts of reduction-oxidation (redox) reaction. The effectiveness of this approach was assessed in a study with South African students. Over the course of four weeks, a teacher who had taken part in the program led eight practical experiments involving redox processes. A variety of techniques were used to evaluate the approach, including pre- and post-tests on redox reactions, interviews with students, observations made in the lab, and questionnaires to gauge the opinions of the students toward the use of POE.

The study's conclusions demonstrated that students' comprehension of redox reactions had increased, and they had favorable opinions about the application of POE to strengthen their content mastery of chemistry. Notwithstanding the instruction's generally beneficial effects, a few of pupils showed difficulty distinguishing between the several chemistry concepts that were covered. The authors emphasized the significance of the pedagogy that was provided, emphasizing its increased potential to improve science instructors' constructivist teaching and learning methods (Ilana, 2019).

**(x). Use of Role- Playing and Case Study Approaches**

The main focus of the lesson was on forensic and analytical chemistry case studies and role-playing. Students were instructed to use case studies and role-playing as active learning techniques to improve their comprehension of chemical principles. Role-playing themes frequently touched with hot-button contemporary issues, such forensic and environmental ones. An acceptable example was the introduction of role-playing in a forensics course at the university level, which was based on a true case that was widely publicized in Polish publications. A further instance of role-playing that was demonstrated was the introduction to the required laboratory course in analytical chemistry.

When comparing the perspectives of students, graduates, PhD students, professionals, and the researchers of the classes, it can be claimed that the researchers were the most circumspect when evaluating the impact of their classes on graduates' future professional careers. They all agreed that role-playing instructional techniques were very engaging for both teachers and students (Cooper, 2018).

### 2.2.3 Cultural Factors Influencing Students' Performance in Chemistry in Secondary Schools

Improvements in science and technology are often the main objectives of growth in every nation on the planet. One of the scientific disciplines that has remained essential to the advancement of technology throughout the cosmos is chemistry. Palt (2018) argues that because of the nature of the mind and its reliance on subjective interpretations and personal understandings, cultural processes should be more dynamic and ever-changing. As a result, incorporating cultural knowledge into science lessons will help instructors engage students in practical learning experiences. However, in the case of Indonesia, accommodating the needs of a population comprised of over 17.000 islands, 300 distinct ethnic groups, and over 250 dialects posed challenges beyond the challenges of losing cultural identity (Rahmawati & Taylor, 2017).

The chemistry performance of students was impacted by many cultural aspects that were specific to these ethnic groups. These influences included taboos, beliefs, values, and conventions. As a result, the diverse cultural backgrounds of Indonesian students during their upbringing had an impact on their values and beliefs, which included views toward education. Globally, it also had an impact on cross-cultural interactions between multinational sections and ethnic groups, resulting in varied cultural identities that gave each individual's cultural identity greater weight (Rahmawati et al., 2017). It was shown that individuals may come across several complicated conventions that will mold their cultural identity for enhanced comprehension (Almut, 2017). The approach that could incorporate cultural notions in the classroom was called Culturally Responsive Education (CRT), which recognized the significance of including students' cultural backgrounds in all parts of education (Ludecke, 2018).

According to Kasisi (2019), CRT created learning experiences for students that were relevant to their learning strengths and consistency by utilizing their past experiences, cultural knowledge, and performance styles. Teachers who are sensitive to cultural differences promote intellectual, social, emotional, and political learning by "using cultural referents to instill knowledge, skills, values, and attitudes." Palt (2018) asserts that culturally sensitive educators have realized the importance of upholding cultural identity and legacy in addition to academic success (Rahmawati, 2017). Multidimensional CRT included curriculum content, learning context, classroom environment, student-teacher interactions, instructional tactics, and performance assessments.

Students could actively participate in their own performance evaluations by developing into better individuals and more accomplished learners (Kundakovic, 2017). In this context, empowerment which is characterized as academic proficiency, self-efficacy, and initiative is crucial. Ethnoscience was a cross-disciplinary field that included the social sciences and humanities (such as anthropology, sociology, psychology, and philosophy) that concentrated on the historical and ecological contributions made by people. It also provided insights into how people acquired diverse knowledge and beliefs over time (Bitok, 2017). Ethnoscience is the application of indigenous knowledge, which provided the basis for relevant parts of traditional cultural narratives in science.

The concept of ethnoscience has had a significant impact on education, with reform initiatives in several nations predicated on integrating Indigenous knowledge into the science curricula (Ruschenpohler, 2019). Despite chemistry's significance, there are a number of visible issues with its teaching and learning, particularly in secondary education. Students' perceptions of the subject have an impact on their comprehension and performance (Adebisi, 2015). Numerous pupils held the view that "chemistry was difficult" (Okeke, 2015).

According to literature, most students thought of chemistry as a theoretically challenging, abstract, and boring topic that was only fit for very bright and brilliant pupils (Apsalone, 2015). Low enrollment and a high percentage of failure in external exams in Nigeria were signs that many students were having trouble understanding the material (Eren- Sisman, 2018). According to a related study by Fatokun (2015), Nigerian pupils often performed poorly in ordinary level Chemistry. Therefore, in order to achieve improved student performance in chemistry, additional factors affecting students' performance in the subject matter must also be taken into account in addition to the employment of successful and effective teaching approaches.

Meri (2021) discovered that peer-related factors, including tribal ties, parental, social, and economic status, affected students' academic performance. However, Olalekan (2016) suggested that these components included social variables, which are also referred to as environmental, acquired, external, or phenotypic characteristics. These factors include social features of peer influence, factors connected to instructors, factors associated to the school, and factors related to the home background. Conversely, cultural characteristics included a set of moral standards, language, religion, conventions, and tribal beliefs. Given the paucity of literature on the effects of cultural factors on students' performance in chemistry, this study aimed to bridge the knowledge gap by investigating the relationship between these factors and students' performance in the Kenyan environment.

### 2.3 Cultural Beliefs

According to research by Oluwatosin (2017), some students believed that an outside force controlled the outcome of an event and so determined their results. Palt (2018) conducted interviews with 38 first-year secondary school kids, aged 11 to 12, to learn about their ideas about probability, beliefs, attributions, and probabilistic thinking. While some students believed that God was in complete control of everything that occurred in the world, others believed that God had the freedom to choose what God wanted to control or not control. Coin and dice-related beliefs also exist, such as the notion that throwing a coin and getting "heads" is auspicious. By giving high school pupils tasks requiring two-dimensional probability simulations, Batyra (2017a) investigated the ideas and opinions of the students. Their data analysis revealed several student beliefs. The beliefs were divided into categories based on their usefulness or problems. One startling discovery was that a few students thought to varying degrees that a real world probability problem could not be modeled by a simulation.

It is well established that cultural factors influence learning (Oluwatosin & Ogbeba, 2017). According to Dudovitz (2017), it has shown to be extremely difficult to use scientific knowledge to explain the majority of natural occurrences and problems in African life. This is a result of the mythology and superstitions that have permeated the majority of people's beliefs. It was primarily predicated on the strength of witchcraft and demonic forces, defying accepted scientific theory. As a result, there was a gap between what students encountered on a daily basis in the classroom and what they knew about science, with the majority of them finding it extremely difficult to describe, analyze, and forecast natural events (Fatokun & Omenesa, 2015). Science educators have come to the realization that they need to connect science to the students' cultural environment more deeply in order to reduce the possibility of conflicts between their students' worldviews and scientific ideas. Analyzing closely the relationship between cultural perspectives and scientific conceptions might be one method to accomplish this (Nnamani, 2016).

Idika (2017) asserts that the process of producing new scientific knowledge is greatly impacted by preceding theories that provide context for the findings. Chemistry is taught in secondary education in reference to both common human experiences and physical and chemical processes. Thus, there's a potential that cultural perspectives will affect how science ideas are taught and comprehended. It is crucial that chemistry instructors assist their students in applying their knowledge in ways that draw from their cultural experiences in order for learning to have significance. This study aims to determine the relationship between students' performance in chemistry and cultural beliefs in order to bridge the gap.

### 2.3.1 Cultural Beliefs in Chemistry Learning

Dudovitz (2017) and Kigotho (2015) both agreed that the social and physical environments are the natural sources of Indigenous knowledge domains. Apart from acquiring practical skills, it was customary for an individual to possess a sense of awareness or comprehension regarding their position in society, their role, and the resources available to them for both personal and societal purposes (Oluwatosin, 2017).

Cultural beliefs are important in Africa, as evidenced by the recent conferences on the subject and the National Study Foundation's identification of the Cultural Knowledge System (CKS) as one of the key study topics of interest. What is cultural knowledge? According to Madhusudhana (2016) and Judger (2016), cultural knowledge "reflected on the dynamic ways in which the indigenous people in an area knew themselves in relation to their surroundings and how they managed their knowledge systems." According to Hobart (2016), the phrase "cultural knowledge" globalized the difficulties, anxieties, and encounters associated with certain worldviews. So, it's critical to acknowledge that cultural concepts were ambiguous, critical, and contesting rather than unifying (Sharma, 2017). According to Thomas (2017), cultural beliefs were neither preserved in a "pristine fashion" nor shielded from the influence of other ideas. He believed that bodies of knowledge continued to influence one another, indicating major changes in all knowledge systems (Dur'an, 2015).

Madhusudhana (2016) argues that because colonial connections and ideas continue to influence and manifest in educational activities, individuals shouldn't question them. When cultural concepts were eliminated from schools, there was limited chance for the (re)colonization of knowledge and cultures in the states and neighboring areas (Palt, 2018). If cultural ideas are to have any chance of supporting the reconstruction and change of Africa, education is necessary, claims Vander (2016). The education transformation problem affects all aspects of education, even though curriculum and research were the main areas of focus.

African nations find it difficult to choose which topics and disciplines to add to or remove from their curricula. The problem affected the entire educational system. The topic of integrating cultural knowledge into the curriculum was simultaneously covered by the revised Curriculum Statement for General Education and Training (GET) and the National Curriculum Statement for Further Education and Training (FET). From the foregoing, it is clear that integrating cultural concepts into the chemistry curriculum of educational institutions was a significant problem that had an impact on every country on the globe. This resulted from the different cultural views that existed in different societies or locations. The difficulty in identifying essential topics and competencies that could be added to or subtracted from the chemistry curriculum further underscores the importance of our work in filling this knowledge vacuum.

### 2.3.2 Students' Believes in Cultural interpretations of Phenomena and Performance in Chemistry

Abulude (2016) raised an important question about the knowledge that local doctors have and how it varies from the knowledge and skills learned in foreign universities. The response to this topic affected how traditional African ideas were applied in Western nations and how scientific knowledge was applied in Africa. Thus, understanding how the local African population contributed to their economy as a whole was crucial. Africans realized they had something to offer from their customs and beliefs, and they could not help but feel a part of what the European states had achieved on a worldwide scale.

In order to integrate cultural ideas with those from other areas of the cosmos, one must advance to a new point (Hobart, 2016). Africans also favored using traditional indigenous plants and witchcraft over conventional medicine because it was less expensive, more accessible, and had fewer adverse effects when used (Lomonyang, 2014). The methods used went against the practices of traditional medicine and used inferior, lower standards of medication.

Cultural influences on science technology fell short of expectations about indigenous attitudes toward science and their beliefs that did not align with contemporary scientific knowledge (Ludecke, 2018). Many people still cling strongly to their superstitious beliefs, like the Samburu people of Kenya, the Maasai, Pokot, Njems, Rendile, and the Ibo people of Nigeria. When ill, patients who had medical issues (such cancer or a heart attack) favored conventional medicine over receiving the necessary medical care from the hospital. They suffer until they pass away from not receiving the proper care (Akdemir, 2016).

Every illness has a scientific explanation that has nothing to do with superstitious beliefs (Pearce, 2019). An Ibo community member in Nigeria accused his stepmother of causing his physique to swell in order to fraudulently inherit his late father's wealth. Among other African nations, ignorance and superstitious beliefs have taken over certain Nigerians' thoughts and behaviours, which prevented science from progressing (Navabfard, 2017). A devout Jehovah's Witness opposes the practice of using blood transfusions as a form of medical treatment. They consistently referenced the biblical prohibition found in Lev. 17:11–12, which states, "The soul of the flesh is in the blood and members should not accept blood transfusion by any means" (Dorgu, 2015). Blood transfusions have been used in medicine to help many patients who were suffering from hemorrhage, shock, or blood abnormalities survive (Dur'an, 2015).

Blood transfusions are used for medical situations such as trauma, surgery, gastrointestinal bleeding, and high blood loss after childbirth. The Jehovah Witnesses desired death over receiving blood because they saw it as an evil act committed against God and as cannibalism. Science does not advance because of this religious notion (Madhusudhana, 2016). Qur'an 5:32 says the following: Therefore, we anointed for the children of Israel that anyone who kills a person without intending to kill, or who scatters hatred and mischief in the area, will be deemed to have killed all of humanity. On the other hand, it will be considered that the giver has saved the lives of all individuals if they save a life by offering services or tangible assistance, like giving blood or organs (Muhammed, 2008).

South East and South West Humanity of Nigeria and other African nations, such as Kenya, held the belief that earthquakes were a divine punishment meted out to humanity and that sacrifices were necessary to satisfy the ancestors. But according to research, earthquakes are a part of volcanic eruptions. A person with such views could be appointed Minister of Science and Technology, which is conceivable in emerging nations, but their ignorance would prevent them from coming up with ideas that are supported by science. According to Socrates and Plato, if cultural beliefs are recognized, people will be able to recognize and reject false notions that instill fear in students (Guido, 2015). The aforementioned provides unmistakable evidence that both established and developing nations have various obstacles due to unidentified cultural attitudes. This is because it causes children to develop phobias, which has a bad impact on their performance in chemistry.

According to Navabfard (2017), some scientific-related issues may be forbidden to particular cultures and pupils, which could lead to conflict between indigenous beliefs and science culture in specific parts of science teaching. He used the example of how handling bones or animals like mice, owls, and other nocturnal animals and birds was frowned upon in some Zimbabwean communities due to a belief in the practice of witchcraft. In fact, this also applies to a few of Kenya's indigenous groups, including the Maasai, Turkana, Pokot, and Samburu. For example, an owl's noise throughout the night is thought to indicate the impending death of a human or animal in some traditional societies (Keraro & Okere, 2013). Therefore, persuading a pupil from such a cultural background that Owls make noise in order to communicate with one another will be challenging.

The African herbal treatment belief system's supernatural identity encompassed a number of ceremonies aimed at influencing the spiritual identity in order to favor earthly elements. When a woman has infertility, the Kamba community in Kenya will always explain the traditional ritual bath known as ng'ondu (Vander, 2016). In light of the previously described factors, there is a difference between modern science and cultural conceptions. This study aimed to determine the relationship between students' chemistry abilities and cultural beliefs in order to close the gap that was discovered.

### 2.3.3 Cultural Beliefs Influencing Students' Performance in Chemistry in Secondary Schools

Despite the widespread perception of science as a culturally neutral field, many of the courses taught under this umbrella are steeped in norms, values, and beliefs specific to certain cultures (Judger, 2016). Many kids were able to keep the theories they learned in school and at home separate, enabling them to retain both views at the same time and recall one or the other depending on the context and language used. Most students believe that this area of study leads to misunderstandings and conflicts between cultures (Almerico, 2015). The ideas and agency of humans gave scientific theories their significance and power. It is true that science, as a product of human culture, cannot be immune to other cultural and ideological influences, even if science can borrow some aspects of mythology (Essien, 2015).

Adebisi (2015) asserts that science supported human endeavors to explore, comprehend, and control the natural environment. It is dynamic and primarily focused on finding patterns and meanings in nature's anomalies as well as regularities. It entailed looking for causes and effects, as well as actions and reactions, in the environment. Savya went on to say that science's goal is to improve the environment so that people can live better overall and the globe will be a better place to live. The primary goal of science is to honestly intellectualize values, rules, and facts (Meri, 2021). The science school, which has as its primary goal the cultural transmission of both the national culture and the scientific subculture, is closely associated with Western science (Wan, 2017). A cultural viewpoint on chemistry saw learning as the acquisition of culture and teaching as the transmission of culture (Najdi, 2017). "An ordered system of meaning and symbols, in terms of which social interaction occurred" is what was meant by "culture." Some of the misconceptions that students encounter when learning include the following ones:

**1). Alternative Conceptions**

Students approach formal scientific instruction with a range of alternative conceptions about natural objects and occurrences (Tayyaba, 2017). Numerous scientific fields, such as biology, chemistry, environmental science, physics, and Earth and space science, have alternative concepts. Every related subfield within the disciplines appears to have different ideas on what it is. Learners' alternative ideas transcend age, ability, gender, and cultural divides when it comes to formal science training. Every group of students, no matter how talented, will include members with different perspectives, regardless of their upbringing (Ogembol, 2015).

Diverse personal experiences, such as firsthand observation and perception, peer culture, language, instructor explanations, and instructional materials, are the sources of alternative conceptions (Wortham, 2016 & Sofiani, 2017). Although the various sources of alternate conceptions were, at best, conjectural, research and deductions revealed that a student's social environment has a significant impact on his or her worldview. A wide range of unintended learning outcomes were produced as a result of interactions between students' existing knowledge and the material covered in formal training. Alternative conceptions may not only interfere with new learning, but they may also interact with it to produce unexpected results. Drawing divergent inferences from the same experiences and observations is a common occurrence among students (Deeksha, 2016). Regarding misconceptions, Sakariyau (2016) put up the following theories:

i). Students are not empty vessels or blank slates; they bring a limited but broad range of beliefs about natural things and events to their formal study of science concepts, and these opinions frequently differ from those presented by science teachers and textbooks.

ii). A variety of alternative concepts were strong in terms of age, aptitude, gender, and cultural barriers; these traits are present in all formal science fields, such as Earth and space science, biology, chemistry, and physics. Usually, they performed a beneficial role in people's daily lives.

iii). Students' explanations bore similarities to those of previous scientific and natural philosophy generations.

iv). Alternative conceptions are the result of an alternative set of personal experiences, which include formal educational intervention, peer culture, everyday language, direct observation of natural objects and occurrences, and media.

It is evident from this that children's social and cultural origins gave rise to diverse conceptions. Some fundamental scientific concepts might not be taught or learned in schools because of these misconceptions.

**2). Learners' Worldview and Science**

People view science as a cultural endeavour that is a component of society's larger cultural roots. Scientific education decisions should be made with a broader perspective in mind (Idika, 2017). Making sense of information within a cultural viewpoint and posing questions such, "What ideas are important within a particular student's cultural perspective (a person's cultural social environment)" are key components of learning. Meaningful knowledge: what is it? And how did the understanding of science relate to the person's cultural background? (Wan, 2017).

A person's worldview gives their thoughts, feelings, and actions an irrational foundation. A person's worldview gives those assumptions about the nature of the universe and what constitutes meaningful and legitimate knowledge (Sofiani, 2017). People's perspectives on the world are fascinating. Scientists and scientific educators are interested in how people see the world (Akdemir, 2016). According to Idika (2017), the word "concept" comes from the German word "Weltanschauung," which translates to "look onto the world." A person's worldview, according to Pearce (2019), is the collection of concepts, tenets, and worldviews that direct their perception of and interactions with the world.

A person's worldview is characterized by their "mental lenses," or cognitive and perceptual maps, which are continuously used to negotiate their social and environmental contexts. According to Najdi (2017), the majority of social interactions and the entirety of human existence are often the focus of the prevailing worldview within a society's culture. Nearly everything we come across is shaped by the viewpoint our universe offers. The prevalent world view, held by the majority of people in a society, usually establishes the culturally accepted interpretations of social truth.

The two main categories into which Owojaiye (2016) split global viewpoints were scientific and metaphysical perspectives. He explained that a society is considered to have a scientific culture (i.e., to be scientifically literate) when its common worldview is characterized by the scientific qualities of reason, logic, and analysis. Nonetheless, perceptions and belief systems that support superstition, magic, animism, cosmetology (faith in nature), and theology (confidence in God) are indicative of a metaphysical worldview in a society. Ogembol (2015) asserts that science is a social phenomenon that is greatly impacted by people's worldview and contemporary cultural characteristics, including social values, ethics, beliefs, and ideas. A person's worldview is essentially made up of their sense of themselves, the challenges they encounter on a daily basis, and their physical environment.

Tayyaba (2017) defines worldview as an individual's defining perspective on the universe. It was made up of assumptions, attitudes, and ideas about how a particular cultural group viewed individuals and situations. Whether something fit their perception of reality or not determined whether it was good or terrible. As to Wortham (2016), the predominant worldview within a society's culture usually encompasses the entirety of human existence and the majority of societal aspects. The perspective that their worldview affords shapes almost everything that is encountered. The majority of people in that culture typically held the main worldview, hence it typically produced the culturally accepted notions of social reality. It is acquired through socialization and contact processes, and over the course of a person's lifetime, the customs of the community constantly reinforce it.

Students gained firsthand knowledge of their surroundings before to participating in any kind of formal schooling (Sofiani, 2017). They also used indirect forms of information to learn about distant locations, such as picture books, radio, television, newspapers, and rumor (Sharma, 2017). According to Sakariyau (2016), depending on how they gathered and interpreted information, children's knowledge could be incomplete or even fake, and their knowledge from indirect experience could be sound or rudimentary (Deeksha, 2016). For example, previous studies have demonstrated that children use visual cues associated with rainy weather, such as clouds, rain bows, the sun, and the sky, to formulate their own hypotheses about how rain forms (Najdi, 2017).

### 3). African Worldviews and Belief Systems

Even after decades of Western influence, traditional African modes of thinking and reasoning were very different from the mainstream worldwide perspective (Abulude, 2016). Pearce (2019) identified five categories that are commonly mentioned in Africa's various religious practices. Among them were God, the ultimate source of explanation for the creation and upkeep of everything, spirits made up of superhuman beings and ancestors, man both born and unborn animals, plants, and other biologically based remnants, as well as inanimate objects devoid of life. Beyond these five divisions, there was a vital force, power, or energy that penetrated the entire planet. Africans believe that all living things, including plants and animals, are channels for the divine (Dorgu, 2015).

African belief, according to Sakariyau (2016), maintains that God is the ultimate source and controller of such life-giving energies, with spirits having access to certain of them. Some people are skilled and able to access, manage, and utilize these energies; some have done so for the good of their society, while others have done the opposite (Essien, 2015). These people include healers, sorcerers, clergy, and precipitators. To appease the gods, humanity had to perform certain rituals and offerings. Numerous rituals were performed, such as those for birth, initiation, marriage, and death; for making rain, planting, and harvesting; and for the fertility of people, crops, and animals (Guido, 2015).

According to Adebisi (2015), because African traditional knowledge encompasses integrative socio-cultural and even spiritual aspects, it is less transportable than Western science. Almerico (2015) described African notions as profound wisdoms rooted in spirituality. According to traditional African belief, all beings are inherently tied to and dependent upon one another as part of a spiritual and material unity that is the universe. The most serious cultural infractions occurred when certain animals held special religious significance and discussing or reading about them was strictly forbidden. From the above, it is evident that cultural views had a significant impact on students' comprehension of contemporary scientific concepts when they were studying chemistry in secondary schools. Still, there remains a gap in the available data. This study aimed to determine the relationship between students' chemistry abilities and cultural beliefs in order to close the gap that was discovered.

### 2.4 Cultural Practices

Every community on the planet has its own cultural customs, which are acts carried out regularly. Certain activities may stem from societal norms or expectations, or from religious convictions. For instance, when someone passes away in the United States, their friends and family attend a funeral, a service where the person's rights are respected before they are buried or cremated. Cultural practices were practiced differently depending on personality, culture, and region (Wondwossen, 2015).

Worshiping one's ancestors is mostly done to please them so that they would be looked after in life and death. Worship made sure that the ancestors' spirits are at rest in exchange for their blessing. Alongside this kind of worship, there were other sacrifices, ornate funeral rituals, and the preparation of particular meals (Ember, 2017). While in mourning, people can choose to cut their hair short but avoid going to events or gatherings in public (Ayodele, 2015 & Olalekan, 2016). Nearly all African cultures, including the Samburu and Turkana of Kenya, customarily have close relatives cut the hair of the departed.

Cultural practices can be traced back to ancient traditions between gods and humans through their roots in religion and mythology. However, a ritual didn't have to be religious; graduation ceremonies and birthday parties might also be regarded as rites (Dur'an, 2015). A collection of socially acceptable ideas and practices might be referred to as religion. These techniques postulated a reality distinct from that which is immediately apparent to the senses. Religion is one of the various shapes that a society's members might adopt to build a worldview, or collective representation of reality. Over time, religions underwent changes and evolved alongside cultures. In many communities, religion was practiced through cultural activities (Kundakovic, 2017).

Strong symbolic connotations are attached to colors in every culture. The connotations of colors in Western, Far Eastern, Middle Eastern, Indian, and African cultures differed significantly. White, for instance, may denote innocence in certain cultures but death in others (Kasisi, 2019). In Indian tradition, red is considered the most potent color and carries numerous symbolic implications. They are terror and fire, power and money, fertility and purity, seduction and beauty. Additionally, red was associated with specific moments and eras in one's personal life, such as a woman's marriage. A married woman may be recognized by the red powder, called sindoor, worn along her hairline and the crimson henna on her hands. Among other African nations, South Africa has a red stripe on its flag, which represents the country's struggle for freedom and the bloodshed and sacrifices made during that time (Apsalone, 2015).

Numerous religions also have specific meanings attached to different colors. For example, blue is symbolic of riches and hope, and it is found in many Latin American countries with large Catholic populations. It is also associated with the Virgin Mary, who is frequently seen wearing a blue gown and headscarf. Blue is the color of sanctity and divinity in Judaism. It is the color of Krishna, the most revered Hindu deity who shattered sin and suffering by embodying joy and love (Kasisi, 2019).

On the other hand, black was linked in many cultures to formality and elegance, but it was also associated with death, evil, mourning, magic, fierceness, illness, bad luck, and mystery. In the Middle East, black could represent both hope and rebirth (Ruschenpohler, 2019). In Africa, it stood for manhood, age, and maturity. With the globalization of schooling, it has become increasingly beneficial to understand the cultural meanings associated with colours. Comprehending the diverse worldwide connotations of hues can facilitate effective communication with an audience while adhering to cultural practices (Joseph, 2015).

A safe, conventional method for applying color in educational spaces is the use of pastels. During their chemical practicals in class, students also observe various colors. Colors had an impact on every student, affecting everything from their hunger to their mood (Ben-Jochannan, 2019). According to Nnamani (2016), pastel colors in the classroom encourage critical thinking. Students struggle to interpret the colors they see during their learning process because different colors have varied symbolic meanings in African cultural contexts (Senthamarai, 2015). Based on the aforementioned data, there was a knowledge vacuum on the ways in which cultural practices and related behaviors were not transmitted from one generation to the next. Consequently, the elder generations died out without leaving behind relevant information and ideas that could have helped students succeed in chemistry.

### 2.4.1 The Components of Rites of Passage on Students' Achievement in Chemistry

Rituals in and of themselves are practices for rites of passage. These are practices from a different culture that represent a person moving up or down the social ladder. Consequently, the following components helped facilitate the process of altering one's living situation. The guides, elders, or knowers who helped the novice through part or all of the transitory stages;

i. The Separation: from home or community; in route to the sacred place, in which the novice experienced his or her ordeal.
ii. The Sacred Place: can be a recreation of the original archetype, it was the place where human and the spiritual would come together.
iii. Revelation: the revealing of inner meanings, the explanation of legends and transcendental knowing.
iv. Symbolic Death: the personal identity of the novice in the pre-liminal stage when transformed; the old identity of the novice had died completely.
v. Resurrection and Rebirth: the novice have been recreated, with a new identity and status in society.
vi. Reincorporation: where the novice returns home or entered into a new society, along with their new status.
vii. A celebration is performed to commemorate the completion of the rite of passage (Ember, 2017).

The real argument was not about defending the surgical procedure or its specifics, but rather about realizing a crucial fact about the tribal psychology of the society: the cultural practice is still seen as the fundamental component of an African institution, with enormous implications for education, society, morality, and religion that extend beyond the practice itself (Batyra, 2017b). According to the aforementioned, there is enough data to conclude that people living in industrialized nations had a solid grasp of cultural customs and how they applied them to their daily lives. This study is relevant in bridging the knowledge gap because, in the case of Kenya, there is a lack of sufficient and precise data regarding the connection between cultural practices and students' performance in chemistry.

### 2.4.2 Cultural Practices in Chemistry Learning

According to Rahmawati and Nurbaity (2017), chemistry is a field of study that examines materials found in the universe, their interactions with one another, and changes in energy that are either related to or brought about by education: theory, practice, and natural changes. In order to address difficulties by developing their own knowledge, students studying chemistry are supposed to comprehend chemical ideas (Kasisi, 2019). However, many chemical topics are thought to be hard and difficult to contextualize with student lives, which presents obstacles for students trying to do this (Bitok, 2017).

In addition to the attributes of comprehensive and important chemistry education when linked to the three levels of symbolic, microscopic, and macroscopic (Rahmawati, 2017). Nevertheless, the study found that the majority of the time, students' difficulties in chemistry were due to their inability to connect the structure and function at the submicroscopic level to the other levels of learning that are indicative of chemistry (Olalekan, 2016). It was clear that learning chemistry in Indonesia presented several challenges. Connecting abstract concepts with students' real-world experiences, rote learning or memorizing of concepts, and an overburdened curriculum all contributed to the challenge of poorly expressing chemistry topics in the classroom (Ayodele, 2015).

It is expected that students will be able to relate problems to chemistry, understand chemistry concepts, and actively contribute to problem solutions through ideas or actions. Thus, learning chemistry must be a way for students to improve their social skills and find solutions to the kinds of problems that require chemistry teachers to be more creative in applying chemistry to real-world problems in order to create engaging learning opportunities. According to Ben-Jochannan (2019), there are three learning stages that kids go through in school: rote learning, in-depth meaning construction, and learning as a cultural phenomenon. Habermas' three areas of interest; technical, practical, and critical were associated with these stages. It is the teachers' responsibility to engage pupils in these modes of learning through culturally sensitive instruction.

Senthamarai (2015) argues that because of the subjectivity and individualized nature of the mind, cultural processes ought to be extremely dynamic and ever-evolving. As a result, integrating culture into science will assist educators in getting pupils interested in their own lives. Senthamarai (2015) notes that in addition to the difficulties associated with losing cultural identity, another issue facing Indonesia was meeting the needs of a population that spoke more than 250 dialects and was distributed throughout more than 17.000 islands, as reported by Rahmawati and Taylor (2017).

The values, beliefs, and cultural practices of the various ethnic groups had an impact on the chemistry performance of the pupils. As a result, the many cultural backgrounds of Indonesian students during their upbringing shaped their values and ideas, particularly those toward education. Apart from its effects on globalization, globalization also altered the cross-cultural connections between various ethnic groups and foreign locations, resulting in distinct cultural identities that limited the individual's ability to express their own cultural identity (Ruschenpohler, 2019).

Culturally Responsive Teaching (CRT), which emphasized the value of incorporating students' cultural origins into all facets of education, was one teaching methodology that included culture into the classroom learning process (Joseph, 2015). According to Ben (2019), CRT created meaningful learning experiences that tapped into the capabilities of a diverse group of students by utilizing their past experiences, cultural knowledge, and performance styles. Culturally aware educators cultivate political, intellectual, social, and emotional learning by "using students' cultural backgrounds to impart knowledge, skills, and attitudes." According to Kundakovic (2017), educators who are culturally sensitive understand the value of maintaining students' cultural identity and legacy in addition to the importance of academic achievement (Rahmawati, 2015).

Multidimensional CRT included curriculum content, learning context, classroom environment, linkages between students and teachers, instructional tactics, and performance assessments. Students could actively participate in their own performance evaluations by improving themselves as individuals and more successful learners (Rahmawati, 2017). This context includes the interaction between cultural practices and students' performance in chemistry, which can be defined as academic competence, self-efficacy, and initiative. Students were given the opportunity to respect the cultures and experiences of different societies through the CRT approach, which used these opportunities as teaching and learning tools. Learning chemistry from cultural perspectives can incorporate cultural practices. Ethnochemistry, a branch of ethnoscience, studied culture from a scientific angle (Rahmawati & Nurbaity, 2017).

From the standpoint of the cross-disciplinary fields of social sciences and humanities, including anthropology, sociology, and psychology, and philosophy, ethnoscience focused on the historical and ecological contributions made by people. It also helped to explain how humans changed over time in terms of their knowledge and beliefs (Bitok, 2017). Ethnoscience is the use of indigenous knowledge that formed the basis for the scientific investigation of relevant elements of cultural narratives. The concept of ethnoscience has impacted education, and in various countries, including Nigeria in Africa, reform programs have been based on incorporating indigenous knowledge into the science curricula (Ayodele, 2015). Therefore, understanding the connection between chemistry performance and cultural conventions will increase students' opportunities to engage with the academic community.

Indonesia's standards-based education system was based on eight national education standards that covered graduation competencies, content, procedure, assessment, educators and supporting staff, financial and management standards, and educators and supporting staff (Government Law 20/2003). These guidelines governed Indonesia's educational system in all its guises, from formal to informal, across all grade levels. The Ministries of Higher Education and Education and Culture oversee the many types of schools. The current curriculum, Curricula 2013, was created using the skills as a foundation, following a series of curriculum revisions in Indonesia. The 2013 curriculum was distinct from the previous one, which concentrated on content-related subjects, in that it gave equal weight to structure and results. The 2013 curricula placed more emphasis on attitude toward learning than on knowledge and skill skills. The teaching methods, exams, and learning of the students were all impacted by these changes in Indonesian education.

Developing students' scientific inquiry through pertinent, interesting, and meaningful chemistry learning in relation to the national character which was made up of 18 characters on spirituality, nationality, cultural competences, and teamwork was the primary goal of Curricula 2013 in terms of Indonesian chemistry education. Scientific inquiry refers to the activities that assist students in learning about and comprehending scientific concepts as well as how scientists investigated the natural world. Furthermore, taking into account the prior beliefs, backgrounds, and characteristics of the students, Curricula 2013 strongly emphasized student-centered learning.

Because culture is essential to learning and motivation, western concepts have dominated the chemistry curriculum and student instruction at every level, isolating students from their cultural roots (Rahmawati, 2017). Teachers face a problem, though, in putting into practice a learning process that considers the variations in students' cultural origins and features and uses these as teaching and learning tools. Investigating the relationship between cultural practices and chemistry student performance is the aim of this study.

**2.4.3 Cultural Practices Influencing Students' Performance in Chemistry in Secondary Schools**

Finding the impact of each component of cultural practices on students' performance especially in chemistry is essential to evaluating the extent to which cultural practices affect students' performance. Meri (2021) observed that students' comprehension and ability to expound on scientific discoveries were impeded by their prior knowledge of cultural practices and beliefs. Funda (2015) discovered that cultural influences around the globe had a substantial impact on students' views toward science and scientifically linked professions like medical, forensic science, agriculture, and so forth.

According to Kasisi (2019), the majority of people's beliefs are topped with mythology and superstition, which makes it difficult to use scientific knowledge to explain the majority of natural occurrences and problems in African life. Students' everyday experiences describing, comprehending, interpreting, and forecasting natural phenomena have diverged as a result of this. Therefore, additional study is required to ascertain the ways in which these sociocultural factors such as sex, parental educational background, and peer group affect Nigerian chemistry students' academic performance.

Without a doubt, the parents' educational background can serve as a tool for evaluating their students' intellectual achievement in school. George (2016) discovered that a student's academic achievements were significantly impacted by low income, low occupational status, lack of high qualification, and parental participation. Research by Almut (2017) and Okeke (2015) shows that low poverty and low education are strong predictors of poor mental and physical health as well as poor academic success. This implies that parents with strong educational backgrounds support and mentor their children while they pursue their academic goals, and the results will be very gratifying. A few fundamental characteristics of chemistry are that it requires a greater level of focus, is very practical, and takes a fair amount of time. Therefore, in order to avoid ruining students' chances of success in the topic, all variables related to the home environment must be accommodating to its unique characteristics.

According to Ember (2017), teenagers who were popular with lots of their peers showed signs of strong ego growth, secured attainment, and improved relationships with their closest friends. Additionally, students' contentment with school was found to be higher when they hung out with peers who shared a positive attitude toward learning, but the opposite was true (Batyra, 2017b). According to Wondwossen (2015), friendships among students are an important interpersonal tool that help them mature and grow physiologically. They also foster social compassion, which has an impact on how personal assessment develops. According to Ayodele (2015), peer pressure sparked pupils' academic zeal and drive for success. According to Olalekan's (2016) study, students were generally greatly impacted by their peer group. Additionally, by observing and modeling the behaviors of their peers, students can avoid engaging in a lot of pointless random behavior and get closer to replicating the behaviors that group members are known for.

Gender was one of the sociocultural factors that had a big impact on students' academic success. Gender is one of the sociocultural factors that research has demonstrated to have a major impact on students' academic achievement, especially in chemistry, according to Apsalone (2015). When examining student performance based on gender, Kundakovic (2017) noted that gender is mostly influenced by the socio-cultural differences between males and females. Scholars such as Joseph (2015) and Okeke (2015) discovered disparities in academic achievement and persistence between genders in several subject areas. It was also demonstrated that there was a significant difference, with either the girls or the boys performing better.

Parents' educational backgrounds have a big influence on their students' academic success because they are the first teachers that students meet. According to Nnamani's (2016) research, children from families with more educated parents typically outperform their peers academically. Furthermore, students of educated parents tend to imitate their parents, which encourages them to work harder in their academic endeavors, claims Ruschenpohler (2019). Parents with high levels of education invested a great deal of time, money, and effort into helping their students succeed academically. Sociocultural factors and chemistry education are not the same, considering the previously mentioned aspects. This study aimed to determine the relationship between cultural practices and students' performance in chemistry in order to close the observed gap.

### 2.5 Cultural Traditions

Among the Sustainable Development Goals (SDGs) is gender equality. Women's roles have been totally subverted in most civilizations, according to Altugan (2015), prohibiting them from actively taking part in and benefiting from development projects. They continued by saying that certain courses, like science and math, were associated with men, while other subjects, like home economics and secretarial studies, and were associated with women. In comparing the abilities of male and female social studies teachers, Abulude (2016) found that male tutors had a far greater understanding of environmental education than female tutors. According to Chan (2020), the universe in which men and women are classified now is one in which men have historically been regarded as more valuable than women. In this world, where there were widespread conventional norms and beliefs that women were inferior to men, men were given more authority, opportunities, and responsibilities than women across the board due to the influence of associations based on these ideas, traditions, and beliefs. The old, discriminatory method had a detrimental effect on female students' ability to understand chemistry (Revelle, 2017).

Inequality against women in science, technology, and math was mentioned by Nwona (2015). These were seen as topics more appropriate for men. Studies had shown that various approaches to instruction resulted in various outcomes. To get the best outcomes, the ideal teaching technique for a particular group of pupils should have been determined. Male students outperformed female students in chemistry, according to Lomonyang (2014), and these results were consistent with Olusegun (2015)'s findings that science, technology, and math were seen as topics best left to men. Could the low enrollment of female students in science disciplines be explained by the recent adaptation of teaching methodologies or knowledge systems by tutors?

The relationship between students' cultural traditions and their chemistry performance is not made clear in research papers. According to Tharani (2020), the majority of studies revealed that girls outperformed guys in the classroom. This supported a previous study by Adebisi (2015), which found that even though the girls had poor marks when they entered Jurkish universities, they did better than their male peers. In their comparison, Freathy (2019) discovered no discernible variation in the performance of males and girls. This was consistent with Eren's (2018) findings, which indicated that there was no appreciable variation between boys' and girls' performance. There were still many problems arising from cultural customs even with the help. These included the gender aspects of poverty, such as harassment and discrimination against women, the amount of work that needed to be done, and negative attitudes toward children, particularly girls. Numerous kids appear to be quitting school, and some of them probably received extremely low scores on their final course exams (Nwona, 2015).

Numerous African countries have diverse cultural societies, and each has some own cultural customs. More than thirty percent of students' subpar academic performance was caused by cultural values such as widow/widower inheritance, polygamy, initiation rites, traditional dances, and rituals (URT, 2007). The Kenyan constitution, according to the Ministry of Education (2007), stressed social justice and equal opportunity in education while forbidding discrimination based on gender, tribe, customs, or geography. Other policy texts also reaffirmed an equal opportunity policy, irrespective of social-cultural, traditional, religious, regional, and gender barriers.

In Kenya, cultural conservatism which views contemporary education as irrelevant, particularly for girls is attributed to some of the educational gaps among pastoralist communities, according to a 1996 Ministry of Education policy paper. In these communities, there are still some parents who would rather see their daughters married off young than continue their education. Even single people aren't motivated to put in a lot of effort since they realize they won't finish school, which is the root of their subpar performance. According to World Bank policy research on education in Sub-Saharan Africa (1988), the reason why girls were performing poorly in school was that most parents believed that the social benefits of a female education would not likely have a substantial influence on the family's private investment decision (Muller, 2019). It was crucial to note that none of the studies looked at the relationship between cultural traditions and students' performance in chemistry, despite the inconsistent research results. For this reason, the study is relevant in closing the gap and promoting chemistry to all secondary school students, regardless of gender.

### 2.5.1 Cultural Traditions in Chemistry Learning

Using publications and other resources pertaining to Ethnochemistry and cultural understandings, students built their knowledge during the cultural understanding phase. This stage was a reference to the knowledge production process known as the Culturally Responsive Transformative (CRT) stage, where the role of the instructor was to facilitate the students' ability to develop their own skills. When it comes to assisting pupils in creating their own ideologies, teachers are crucial. According to Bohacek (2017), students' early concepts in chemistry served as the foundation for learning through CRT, which made it simpler for them to comprehend new materials.

According to Hanson (2015), students were more likely to become engaged in the learning process when cultural ideology and prior experiences were used to make learning more relevant and beneficial for them to build new abilities. Some of the active teaching techniques utilized in secondary school chemistry instruction include the following:

**(i). Collaboration**

During the collaborative phase, students discuss cultural topics and viewpoints in groups (Wentzel, 2017). At this level, students work together with peers and professors. This level of Culturally Responsive Transformative Teaching (CRTT) addressed the removal of prejudice. Prejudice reduction, according to Wickham (2017), is a process in which instructors employ excellent communication to establish a safe and encouraging learning environment for each and every student.

The teacher in the study used a number of techniques, such as Think Pair Share (TPS) and conversation, to promote a cooperative environment. The subsequent student response showcases how a heterogeneous learning pedagogy comprising different genders, achievement levels, and learning styles within cooperative learning groups promoted positive interactions amongst students, irrespective of their cultural backgrounds: "Learning by group can develop our interaction." Since every student brings a different perspective to the group, there will always be someone the group does not understand, so having everyone in the group participate and work together could encourage tolerance and cooperative skills in the children. It was anticipated that the students would be aware of and appreciative of these differences. Students met their learning goals and developed their interpersonal skills such as empathy, compassion, and tolerance for cultural differences by using CRTT (Inchley, 2016). Asking questions and sharing ideas will lead to collaboration in order to identify the solution.

**(ii). Critical Reflective Thinking**

According to Wan (2017), during the learning process, students at this level critically reflected on their beliefs in order to identify the various viewpoints that presented challenges to their conceptual comprehension. In line with the social justice tenets, students were urged to be more critical and to pose questions at this level of CRTT. The following passage from the teacher observation sheets and diaries illustrates how students' critical thinking was demonstrated: "Students were quite interested and critical enough to answer the questions asked by the teacher during the learning process by researching the topic and developing their understanding of chemical materials." Students' homework involved solving problems that their peers presented. The project was based on publications that addressed the use of electrolyte and non-electrolyte solutions in daily life in Sukabumi, Sunda, or West Javan culture linking to culture."

> **Teacher:** Regarding the topics we have covered, are there any more questions you would want to ask?
>
> **Student:** What would happen if we discovered the identical electrolyte solution, but at a distinct concentration? Which electrolyte solution is stronger?

According to Wickham (2017), learning with the method could improve students' comprehension and representation of material as well as assist them develop into critical and reflective thinkers.

**(iii). Transformative Construction**

Transformative construction is the final stage of CRTT integration, during which learners modify their beliefs and comprehension (Jugder, 2016). The stage, which was based on Henry's (2017) instruction, gave pupils the chance to meet their academic objectives while also growing in their understanding of other people's cultures and their ability to tolerate differences when working together. The students' attitudes about learning chemistry changed, as evidenced by the reflective journal and interview. Additionally, they developed a new perspective on studying chemistry. It has been seen that when they study chemistry, students take on a greater responsibility for protecting their own culture and growing to love their nation and its customs.

According to Koul (2016), CRTT instilled in pupils a deeper passion for their country by teaching them to respect and utilize both their own and other people's cultures. The study's findings showed that students' values shifted as they felt more capable of understanding chemistry ideas and were more conscious of and accountable for their culture. Through the development of an understanding of national pride, cultural diversity, and learning identity, the incorporation of CRTT shaped students' cultural identities in the context of chemistry education.

**(iv). Cultural Identity**

Cherry (2015) defines cultural identity as the visible and unseen aspects of the self that have an impact on how one constructs their identity. The domains encompassed, but were not restricted to, physical and intellectual capacity, nationality, gender, sexual orientation, ethnicity, and skin color. Marasinghe (2016) defined identity as the sum of our experiences both positive and negative and our parents, culture, customs, genetic make-up, and traditions. Simpson (2016) defines cultural identity as the understanding of the intricate, asynchronous, and linked links that pervade and influence nearly every aspect of human existence, including socioeconomic class, language, race, ethnicity, values, and behaviors. Students developed their cultural identities in sociocultural contexts by integrating CRTT and exchanging beliefs, customs, language, and social ties (Thomas, 2017).

Some of the comments made by the students illustrated how their cultural identities have changed over time. These findings supported Smith's (2018) claim that educational opportunities could increase students' interest in learning and motivation to learn in order to improve their comprehension of culture and chemistry. Students who were learning about chemistry in connection to their cultural traditions seemed more engaged. According to Revelle's (2017) research, there was a favourable correlation between learning and chemistry that followed cultural traditions.

#### (v). Cultural Identity in the Chemistry Classroom

Students' opinions regarding teamwork and their experiences studying in groups were made clear by their answers to the critical reflective thinking activity. The students found working in groups to be challenging, but it also taught them how to propose and accept different ideas a process that fosters empathy and communication skills. Good group work results from this. Students thought about the advantages of imparting knowledge and asking questions to other group members who were struggling to understand particular chemistry ideas as they were studying. Muller's (2019) study revealed that group cooperative learning contributed to the enhancement of students' attitudes and general skills, such as communication, teamwork, and critical thinking.

By organizing themselves into groups according to differences in gender, ethnicity, learning style, and performance evaluations, students were urged to cultivate empathy for others. The introduction of CRTT promoted students' development of self-assurance. Students were motivated by the experience to present their group's work in front of the class, something they would not have done before. Students confidently shared their opinions and provided information to their classmates when speaking in groups (Dahl's, 2016).

**(vi). Learning Identity**

Rahmawati (2019) posits that learning identity is fundamental to learning, occurring when people perceive themselves as learners, approach real world situations with an open mind, and have confidence in their ability to learn. It was difficult for Indonesian students to transition from their areas of interest as passive learners to become more active learners as a result of the 2013 Curriculum's encouragement of active learning. According to constructivism theory, educators should view themselves as facilitators who assist students build their own skills by continuously evaluating how well an activity was advancing their understanding (Markic, 2016). As a result, education should recognize how cultural experiences span borders. Through reading articles that described regional customs and behaviors, learning through integrated CRTT also gave students the confidence to embrace their own cultures.

The data presented above demonstrated how the CRTT method encouraged students to explore their cultural identities. They talked about how they started to love and be more involved in Indonesian culture. Due to the detrimental effects of globalization, students today have a limited awareness of their own cultures, which causes them to lose their sense of cultural identity (Altugan, 2015). The results were linked to Olusegun's (2015) assertion that teachers who are culturally responsive focus primarily on the academic performance and cultural identification of their pupils.

**(vii). Awareness of Cultural Differences**

Students were able to collaborate in groups and have discussions throughout the CRTT learning levels cooperation level. Collaborating in groups increased students' understanding of diverse cultures by having them complete an assignment that linked their own cultural experiences to chemistry principles. Students work together to make chemistry subjects more achievable through knowledge.

The results were linked to Broman (2015), who reported that when students examined chemistry ideas via the prism of cultural practices, they seemed more engaged. A subset of the research study's participants persisted in concentrating on exam preparation and how to score higher. However, as part of the CRTT integration, students encountered problems presented by the articles that explored local culture in relation to chemical principles, which required them to think critically and creatively. As a result, the incorporation of CRTT compelled students to focus on both applying the material in real-life scenarios and comprehending the material in order to get high exam scores.

Effective understanding gained through critical thinking was important for students to retain new information, as required for them to be regarded as active learners, according to the Ministry of Education and Culture (2013). The study's findings showed that pupils required to develop a solid understanding of chemistry. In order to enhance students' cultural identities, CRTT integration must be applied in chemistry instruction. Modern education theory urged students to create a conceptual knowledge in addition to making connections to real-life situations in order to study and apply culturally relevant pedagogy (Majalah, 2015). However, teachers and students alike needed to change their ideas on teaching and learning in order to provide a relevant learning environment where strategies like CRTT can thrive.

According to the aforementioned, there is sufficient data to suggest that even in affluent nations, including cultural customs into the chemistry curriculum is a significant challenge. This is due to the nature of cultural traditions, which differ between societies and even within regions. Finding the subjects and abilities that may be added to or removed from the secondary school chemistry curriculum was similarly difficult, which is why this study is important for filling the gap.

### 2.5.2 Cultural Traditions Influencing Students' Performance in Chemistry in Secondary Schools

Science education has been seen by cultural anthropologists as a way to both acquire and transfer culture (Tharani, 2020; Muller, 2019). According to Freathy (2019), culture is "an ordered system of meaning and symbols, in terms of which social interaction took place". Members of these groups typically discourse about Western or Oriental cultures because they share a system of meaning and symbols for the purpose of social interaction (Henry, 2017).

In some studies that have been published in the literature, certain cultural traits have been selected to emphasize a particular interest in multicultural or cross-cultural scientific education (Chan, 2020). For example, Smith (2018) listed "beliefs, attitudes, technologies, languages, and leadership and authority structures." Culture is a community's norms, values, beliefs, expectations, and customary behaviors, according to anthropologist Revelle (2017). This is how Wentzel (2017) understood culture. Koul (2017) talked about how a cultural traditions nature, people, and thought processes.

Every culture has subgroups based on shared traits such race, language, ethnicity, gender, customs, social class, occupation, and religion. According to Bohacek (2017), a variety of significant factors, such as the family, peers, school, media, and the physical, social, and economic contexts, had an effect on science education. Individuals who usually follow a predetermined set of rules and symbols that constituted the social interaction space comprise each acknowledged category. In short, each subgroup used its shared culture referred to as a "subculture" to convey its identity. Discussing the subcultures of science, women, peers, and a particular scientific classroom are a few examples of subcultures that might be brought up.

Science is a subculture of Western or Euro-American culture, according to Eren (2018), which is why "Western science" is also known as "subculture science." Scientists shared a distinct meaning and symbol system that promoted social communication. Since Western science appears to be a Western cultural icon of prestige, power, and development, it may always easily infiltrate the culture of people who engage with it (Thomas, 2016). The process of assimilation or acculturation may pose a threat to non-Western cultures, potentially leading to the perception of Western science as a dominant symbol of cultural imperialism (Judger, 2016). Analogously, albeit far more delicately, efforts to integrate Western students who associated with Hanson's (2015) non-science culture into the scientific subculture may cause estrangement and foster an anti-science sentiment in Western nations (Wickham, 2017).

School science, whose primary objectives have been the cultural transmission of the nation's dominant culture (Wan, 2017) and the subculture of science (Simpson, 2016), is closely connected with Western science. As a result, at least two significant cultural influences were dynamically integrated into the subculture of school science (Henry, 2017). Introducing pupils to a scientific subculture can have two possible outcomes: positive or negative. Science training would tend to promote the student's worldview and the findings being enculturated if the scientific subculture generally coincided with the student's everyday culture (Dudovitz, 2017).

According to epitaphs (inscriptions) like "educational hegemony" (Brogger, 2019), "cultural imperialism" (Hanson, 2015), the "arrogance of ethnocentricity" (Koul, 2017), and "racist" (Wentzel, 2017), the outcomes are assimilations (Sharma, 2017), which have extremely negative implications. The cultural divide between the scientific subculture and the students' native subcultures was difficult for them to traverse. However, by doing this, students frequently end up rejecting significant facets of their own native culture. Based on a series of studies done between 1972 and 1980, Smith (2018), for example, reported that science education in Papua New Guinea had a strong alienating effect that kept students apart from their traditional culture. The idea that "the more formal schooling a person has received, the greater the alienation" was presented. The process of assimilation led to the supremacy of scientific thought over common cognitive processes (Marasinghe, 2016).

Assimilation has led to worldwide repression and the detriment of all social groups (Bohacek, 2017). There are several unambiguous rules in the game that Wan (2017) named "Fatima's Rules," named for an astute high school chemistry student. One of the cultural assumptions of school science is that "most schooling is based on the ability to answer questions unrelated to any context outside of the school room," as noted by Wichham (2017), who foresaw the issue. Workplace guidelines based on Fatima's Rules were given without a full understanding of the problem.

Three pathways to "learning" science have emerged from conventional science education: Fatima's Rules, assimilation, and enculturation. When the cultural study of science education was expanded to encompass cross-cultural learning, two new approaches surfaced: "anthropological" learning and autonomous acculturation (Inchley, 2016). Examples abound in Wickham's (2017) case study of a Trinidadian woman who combined components of her traditional medicine with Western medicine, as well as Henry's (2017) use of traditional iron smelting processes from Uganda as the basis for chemistry lectures in secondary schools. Dahl (2016) offered a paradigm for teaching practice in his case study of a youngster from First Nations (Native American tribe) who was studying the seashore. The phrase "autonomous acculturation" attempts to avoid the negative connotations of both assimilation and acculturation (described earlier).

According to Broman (2015), students could learn about the scientific subculture without having to alter the salient features of their own culture. Stated differently, conceptual proliferation imposed by certain social or practical settings trumped the conceptual shift associated with the primary acculturation (Batyra, 2017). An alternative method of instruction known as "anthropological" scientific learning (Markic, 2016) kept students in a position similar to that of an anthropology. "Anthropological" learning is linked to students who like science's "foreign" subculture and can make sense of it, without assimilating or acculturating to its cultural baggage. However, they are able to smoothly transition between their regular activities and the scientific subculture.

Cross-cultural learning is inherently linked to cultural shifts. Jugder (2016), who took inspiration from Thomas (2017) and Border Crossings, believed that non-Western students and their foreign tutors should act as "cultural border changers." Marasinghe (2016) defined the experiences of the students in the classroom as a shift from the subcultures of their family and friends into the subcultures of science and school science using these skills to science students from overseas. From the aforementioned, it was evident that, in contrast to those in developing nations, teachers in developed nations had a favorable awareness of how cultural traditions affected secondary school chemistry instruction. But in the case of Kenya, there is a lack of sufficient and precise data regarding the connection between cultural customs and students' chemistry ability, which is why this study is important in filling the gap.

### 2.6 Religion

Theologians, scientists, philosophers, and other academics from many cultures and regions of the world had discussed the many pertinent issues surrounding the interaction between science and religion. It was crucial to think about whether religion and science could coexist together, if religious concepts could advance or impede science, and what religion actually is during this discussion.

Even if knowledge in the ancient and Middle Ages was not equivalent to what is known now as "science" or "religion," some characteristics of modern thinking about the subject have endured over the previous few decades (Harrison, 2015). The pair-structured phrases "religion and science" and "science and religion" first appeared in literature in the 19th century (Cooling, 2020). At the same time, due in part to colonization, globalization, Protestant reformation, professionalization of the sciences, and globalization, "religion" and "science" (derived from the study of "natural philosophy") were evolving into more sophisticated concepts over the preceding several centuries (Arnold, 2016). Since then, the relationship between science and religion has been characterized by a range of words, such as "disharmony," "harmony," "complexity," and "cordial freedom."

Religion and science are complex, social, and cultural endeavours that vary between civilizations and usually change throughout time (Oladejo, 2021). The bulk of scientific (and technological) developments prior to the scientific revolution were produced by religiously-based societies. Scholars who were pagan, Islamic, and Christian in antiquity were among the first unique elements of scientific teaching (Kitavi, 2015). The four elements of the tangible world were divided into categories by the ancient Greeks and Indians: air, earth, fire, and water. This categorization was more philosophical, and prominent intellectuals of the day, such Anaxagoras, questioned parts of the conventional wisdom regarding Greek gods and the Middle Eastern scholars' empirical classification of objects (Fujiwara, 2019).

The scientific revolution and the Age of Enlightenment were linked to European events like the Galileo affair in the early 17th century. This led scholars like John William Draper to propose a conflict thesis in the late 1874, claiming that science and religion had historically disagreed on methodological, factual, and political issues. Many modern scientists supported the theory, including Richard Dawkins, Peter Atkins, Lawrence Krauss, and Donald Prothero. However, the conflict theory has recently been unpopular among scientific historians (Pearce, 2019).

Throughout history, a considerable number of prominent scientists, philosophers, and theologians have considered whether religion and science can coexist or require one another. Examples of these individuals are Francisco Ayala, Kenneth R. Miller, and Francis Collins (Oladejo, 2021). Along with a number of other scientists and modern theologians, biologist Stephen Jay Gould held the view that science and religion dealt with fundamentally different types of thought and concepts of life, and that these facts did not intersect. John Lennox, Thomas Berry, Brian Swimme, and Ken Wilber were among the theologians and science historians who maintained that science and religion were intertwined, in contrast to Ian Barbour and other theologians who believed that science and religion existed apart (John, 2015).

Sometimes, a person's acceptance of scientific concepts might be influenced by their religious beliefs. This was the situation in the US, where some individuals disapproved of the idea that evolution by natural selection occurred, especially when it came to humans (Richard, 2018). As stated by the American National Academy of Sciences, "the evidence for evolution could be fully compatible with religious faith" is endorsed by most religious groups globally (Thomas, 2017). Nevertheless, despite their religious practices and conviction in the existence of a supernatural person (God), Africans are unable to distinguish between scientific facts and religious beliefs (Shaw, 2018).

In Kenya, a lot of people follow African Traditional Religion (ATR) as a form of worship. Most individuals wanted to learn more about and engage more sincerely and seriously with the ideas revealed by Mbiti's thorough academic study of ATR. Some academics believed it to be a major threat to Christianity and as such, it was pervasive. Mbiti was praised by David (2018) and numerous other religious scholars for his outstanding contribution in laying the foundation for his methodological approach to the study of African religions (AR). Regarding approach, Mbiti wrote in African religion and philosophy, "In his study, he stressed more on the unity of the African religions and philosophy in order to give out a general outlook of the whole African issues." Even before missionaries arrived in Kenya, Africans were devout people (Kitavi, 2015). Holy locations, such as certain enormous trees, mountains, and valleys, were sites of worship. Offerings to God were also made in the worship spaces.

The revered trees are viewed similarly to how the majority of Christians view churches as the "House of God." In African culture, gods can appear to humans in a variety of ways, such as the sun, moon, stars, thunder, lightning, rain, and other natural phenomena (Kasisi, 2019). As can be seen from the above, there is a lack of concrete evidence suggesting that one of the main issues faced globally is the introduction of new cultural and religious concepts into the chemistry curriculum. This is because religious beliefs differ depending on the society in which they are practiced. But in the instance of Kenya, there are insufficient and unreliable data regarding the connection between students' performance in chemistry and their religious beliefs; for this reason, this study is important in filling in the gaps.

### 2.6.1 Religious Practices in Chemistry Learning

Arthur Holmes is among the first Christian scholars to use the phrase "integrating faith and learning" (Cooling, 2020). He saw that the integration of study and beliefs distinguished Christian higher education from secular ideas. By connecting human schooling to comprehend beliefs and developing a Christian global outlook for the arts and sciences, faith learning integration could reach all spheres of life and education. He recommended using liberal arts as one of the pedagogies for advanced studies' incorporation of faith-learning (Harris, 2021). Turley mentioned Wilson, who placed a strong emphasis on religious studies. All the fundamental questions of learning require religious answers. Thus, new religious concepts emerge as a result of teaching learners (Chan, 2020).

One of Tangerang, Indonesia's educational institutions stood out for the way it approached teaching religious themes. The entire curriculum, including the goals, objectives, and homework assignments with religious explanations, exhibited the integration of faith-based instruction. Tutors teaching major- and career-related courses were including faith-based learning into their lessons, with a focus on Biblical values in the course design (Dockory, 2022).

There were fewer disciplines that explained how religion learning was integrated. Regarding the constraints, there were two explanations. First, there should be enough time and little resources available. Second, normative themes that needed theological explanations were not taken into consideration because of the limited time and resources (Harris, 2021). The ideas of mathematics, physics, chemistry, and biology were from a universal standpoint that did not change over time or space and required no justification.

Holmes placed a strong emphasis on the idea that the primary driving force behind intellectual inquiry is Christ and the truth. James (2021) identified five postulations that lead to the assimilation of beliefs and understandings by being true to Christ, the truth as the foundation of discovery and understanding. The first was believing that all information is inspired by God (Richard, 2018). Biblical authority served as the foundation for Christian ideals and was regarded as an integral component of spiritual abilities. According to Dockory (2022), who evaluated different courses of beliefs and skills related with one another and concluded that beliefs were the correct means of understanding religious notions, Harris had faith in the relationship between beliefs and understandings of its existence. Second, there was no misinterpretation of one truth for another in relation to God's truth (Meri, 2021).

When there are opposing interpretations and worldviews, conflicts result. Third, nonreligious education was typically disjointed and incomplete. For instance, naturalism undermined the veracity of Earthly materials, and scientific obligations were established by scientific findings and empirical obligations. Fourth, a biblical framework of truth served as the foundation for Christian integration. The framework functioned as the primary tool for analyzing the claims made by the subject matter experts in the field of study because the nonreligious instruction was incomplete. The primary goal of education was to discover the fifth truth. Finding a cohesive, shared knowledge and the harmony of all reality was the goal of incorporating faith learning (Fujiwara, 2019). In Harris's defense, Hasker respectfully defended the significance of the justifications for incorporating faith-learning;

**First:** There are multiple ways to interpret despite having a same religious goal (Smith, 2018). For example, scientific understanding is not attained through religious ways of responding to divine calling, but rather through data analysis and practical application. For example, science views the physical world as the ultimate reality and bases its research on it. Scientific theories that incorporate the supernatural are labeled as pseudo-science, despite Christianity's insistence that there are irrefutable, transcendent facts concerning God. To achieve the oneness of facts, multiple skills must be integrated.

**Second:** Given that Christian universities only provided a limited number of graduate programs, it's plausible that some Christian faculty members enrolled in graduate programs in non-religious universities (Eskola, 2020). Because they have to deal with different sets of information and beliefs, they are unable to train in their Christian beliefs.

**Third:** For religious reasons, the various theological ideologies need to be integrated. Rather of referring to the secular and sacred domains, the Lord's Prayer, "Thy will be done, on earth as it is in heaven," implied that there is only one world created by Almighty God and one ultimate truth.

An interview with a chemistry lecturer found that the professor included her religious beliefs into her teaching. She quoted a number of biblical passages to support her claims about God's existence, the existence of a designer, the authority, God's creation, intervention, pattern, and order. When asked how she blended faith and education, she gave two examples of how she taught about the elements of the periodic system and an atom. During her atoms lecture, she named the proton, electron, and neutron the three constituents that comprise an atom. Every object has an identical mass and a single, negative electron. The electron's consistent properties provide strong evidence for God's existence. On the other hand, there is disagreement over the reality of atoms. Since atoms cannot be recognized by human senses, Fujiwara (2019) defined reality as objects that the human sensory system can perceive, suggesting that atoms are not real (Pearce, 2019). When the chemistry lecturer tried to include faith and learning into her explanation of the atom, she did not voice this disagreement.

In addition to drawing the connection between the existence of God and the atom, as will be discussed below, the chemistry professor was able to assist her students in comprehending the awe of God. For example, how are atoms related to one another? Every element has a certain trait in common. "Hey, do you see that what we are learning is so beautiful and it would be impossible if there was no authority behind this?" She questioned her students.

The chemistry lecturer goes on to elucidate on Almighty God by describing the primary goal of studying chemistry. According to her, in order for pupils to thank God and govern the cosmos, they must learn about the ingredients that make up the universe through chemistry. She went on to explain that studying Chemistry helped students understand creation. People came to know God through creation "the God's work and control." According to David (2018), science education should compel students to revere God and serve Him assiduously. This was in line with what Holmes mentioned. Teachers and students alike must understand that teaching is a divine calling. Therefore, it necessitates stewardship, love, worship, and an unshakeable dedication to the Creator (Richard, 2018).

Another example is when the periodic table's elements were first discussed by the chemistry lecturer. She explained the concepts of the elements in the periodic table to the students by using the electron configuration of each element. The periodic table started with hydrogen, then helium, and so forth. The speaker continued by explaining that the periodic table's elemental arrangements correlate to God's creation narrative. The elements that comprise the first entries of the periodic table were the light-related elements hydrogen and helium, indicating that light played a part in the first day of creation. She continued by saying that only a Creator could have created this. If there hadn't been a powerful force at work throughout creation, this would not have occurred. The Creator's efforts have allowed the World to continue existing.

Oladejo (2019) mentioned that faith learning incorporation was thought to be the responsibility of tutors and schools that placed students as less active students and the tutors as aggressive Christian faith providers in the process of teaching approach for disseminating information utilized by the tutors. The pedagogies for important reasoning from cognitive psychology, which comprised four sequential skills, supported the crucial reasoning ideas model that was proposed. 1) Determining the source of revelation, 2) applying reprimanding techniques, 3) scrutinizing the reality, 4) utilizing incorporation model(s), and 5) collaboration in the workplace. He went on to describe how a challenge-based technique was used to operationalize the model (Shaw, 2018).

The incorrect portions of the course's content skills were assessed using the integration pedagogy. Extra remedial classes on academic disciplinary informed views were the tutors' standard method of teaching about beliefs in the classroom. According to Smith and Smith, Christian behavior should transcend the notions of knowledge and communication (Meri, 2021). Instead, it need to use a Christian approach that transforms students into obedient individuals. The development of virtues, rituals, and habits should be aided by education. The aforementioned illustrates the dearth of evidence indicating that educators and students in developed countries possess a firm understanding of how to incorporate faith into their education and apply it to their everyday lives. This study is relevant in bridging the gap because, in the Kenyan situation, there is little evidence regarding the association between students' performance in chemistry and their religion.

### 2.6.2 Religious Practices Influencing Students' Performance in Chemistry in Secondary Schools

Evolution has long been seen as a domain where science and faith collide. Despite this presumption, there were hints that religious convictions had shaped and were still shaping the most recent biological hypotheses of evolution. There is currently evidence that the theological perspectives on predestination on evolution that have been previously investigated in the Jewish, Christian, and Muslim traditions have had an influence on some theories on the nature of biological evolution (Muller, 2019).

#### i. The Jewish Tradition

Numerous pre-New Testament writings examined the concept of predestination in connection to life, destiny, and relationship with God. These literature included papers from the Qumran (Dead Sea scrolls), wisdom books, and several apocalypses. Predestination as a primary belief postponed the application of the Deuteronomic strategy (rewards for loyalty to Yahweh and following his commands) to Israel's religion and, eventually, to the heritage of spiritual wisdom (sapiential). This might have been a reaction to Jewish persecution, which might have compelled the learned teachers to embrace a novel eschatological dualism in which salvation ultimately depended on covenantal choice as well as legal compliance (Eskola, 2020). Thus, despite being basic, predestination is not deterministic in nature.

After the publication of Sefer ha-bahir, also known as the "Book of Brightness," in the twelfth century, Judaism underwent a transformation through the Kabbala, which is Hebrew for "tradition." Originating in first-century Palestine, Kabbalism is a kind of esoteric Jewish mysticism. Its teachings and practices were introduced to adherents by a personal guide who shared with them some of the "secret wisdom" of the unwritten Torah (law), which was revealed to Moses and Adam by God (Fujiwara, 2019).

Judaism's fundamental belief in following the Torah endured, and the Kabbala, a Jewish mystical reading of the Bible, provided a way to speak with God directly and gave rise to the idea of soul conversion (gilgul). Sefer ha-temuna, sometimes called the "Book of the Image," and Sefer ha-zohar, popularly called the "Book of Splendor," are two other books that, in terms of their impact on non-Judean perspectives on predestination, are crucial. They talked about cosmic cycles and beliefs about the soul and salvation. Not only do they preserve some of the fundamental ideas regarding predestination that were drawn from ancient Judaism, but they are also noteworthy because they were written in medieval Spain (Tharani, 2020).

### ii. The Origins and Christian Traditions

One of the most well-known pre-Christian religious writings that inspired the concept of predestination is the Quran. Predestination was a concept that coexisted with eschatological and apocalyptic ideas (Freathy, 2019). The words, "In your wisdom you established eternal; before creating them, you know all their deeds for ever and ever," encapsulated these concepts wonderfully. Without your will, nothing is understood or accomplished (without you). (Cooling, 2020). Paul the Apostle, who briefly converted from being a devoted antichristian and a Jew to the new faith after Jesus' death, was the first Christian author to put forth the concept of predestination and went on to become one of the most influential characters of ancient Christianity. The writer said: "God foreknew those who would likewise be predestined to reflect the likeness of his Son, so that he might be the firstborn among many brethren." According to Romans 8:29–30, he called those who he predestined, justified those who he called, and exalted those who he justified.

However, the concept of predestination is not fully defined until the works of Saint Augustine.

His synthesis of early Christian notions, Roman and Platonism, and later developments into a theological framework that was adopted by both Catholicism and Protestantism, had a profound impact on Christian thought. To put it another way, God's roles include determining the course of human history and destiny both here on Earth and beyond, including whether or not people will repent and face eternal damnation, or turn to God and face their fate (Shaw, 2018).

St. Augustine was more or less reacting to Pelagius's thoughts when he put forward those concepts academically. He and his adherents claimed that individuals are inherently good and that free choice determines one's destiny. His main concern was that Christians were becoming less morally upright. Additionally, he believed that their moral character would strengthen if they assumed more personal accountability (David, 2018). Pelagius and his adherents, who denied the existence of original sin and maintained that humans have the ability to choose between right and wrong, were a threat to the Christian church. He attacked those notions on philosophical grounds. As a result, the babies' baptism was unimportant. As a result, Pelagius and a few of his followers were excommunicated and Pelagianism was declared to be heresy.

Notwithstanding the Church's administrative responsibilities and St. Augustine's theological objections, the miscommunication was far from being resolved. Others, such as Julian of Eclanum, supported Pelagianism in spite of the Church's activities and threats directed towards them. However, they concurred with St. Augustine that human nature was corrupted by original sin and that this corruption could not be overcome apart from God's charity. Consequently, they acknowledged the importance of the newborns' baptisms while also concurring with the Pelagians regarding the strength of the human will (Dockory, 2022). They came to the conclusion that people's inherent depravity was not so great that it could not be overcome by willpower alone.

The Semi Pelagians were led by Johannes Cassian. He was an ascetic monk and theologian whose writings influenced the idea of monasticism in the West due to his experiences living among Egypt's hermits (Ruschenpohler, 2019). This affected his sense of self-control. The Church did not punish Cassian and his followers harshly, despite the fact that the Semi Pelagians' teachings which held that human will might be rescued without the aid of divine intervention were ultimately wrong.

Christian theologians continued to debate the concept of predestination throughout the Middle Ages in Europe. Theologian and monk Godescalc, also known as Gottschalk of Orbais, held that only a limited group of holy people might be saved by Christ, meaning that only the righteous would go to eternal glory and the wicked would go to torment. Godescalc was imprisoned because this was not accepted as gospel truth (Meri, 2021). According to Aquinas, God's will is for everyone to be saved, even though some people have exceptional abilities that effectively foretell their salvation. As a result, the coursed people were only condemned to hell because God anticipated that they would reject the abilities that God had granted them. Gregory, however, thought that good will alone could not bring about the deep love required for the God-image that Christians yearned for. He said that children who die before being baptized will not be saved, confirming the Church's beliefs on baptism.

Peter Auriol was a philosopher and critical thinker who lived before William of Ockham. He contrasted the role of experience in the facts with reasoning, challenging the idea of (scholastic) knowledge held by St. Thomas Aquinas. He addressed predestination and advanced the theory that salvation came to those who obediently accepted God's freely offered glory to every human being in his books Commentariorum in primum librum sententiarum, Tractatus de paupertate, Tractatus de principiis naturae, and Tractatus de conceptione beatae Mariae Virginis (Chan, 2020).

Since the development of contemporary synthesis, a steady stream of evidence has demonstrated that evolution was nonlinear. The basic mechanism of evolution was a process that followed a preset path due to natural selection, rather than being directed towards a certain goal by any supernatural force or direct entities. For evolutionary processes, direction did not exist. Still, biospeleologists found "preadaptations" and "regressive evolution" (which indicated direction) in every place when it came to cave fauna (John, 2015). As a result, the ideas covered in this section demonstrated how predestination belief has influenced contemporary evolutionary biology. Based on the above described rationale, there exists a disparity between students' comprehension of scientific principles and their religious beliefs when they are studying the sciences. This study examined the relationship between students' religious views and their chemistry performance in an effort to bridge the gap.

## 2.7 Theoretical Framework

Social constructivist theory was used in an effort to comprehend the connection between cultural elements and secondary school students' chemistry performance. Thus, this hypothesis provided guidance for this investigation. Theoretical formulations related to Vygotsky's Social Constructivist theory (1968) are helpful in examining the connection between a few chosen cultural elements and chemistry student performance. The theory is a branch of psychology that studies how culture affects behaviour in people. Even while human brain and behaviour share many traits, cultural differences can lead to frequently unanticipated differences in people's attitudes, feelings, and actions.

The fundamental idea of this theory is that knowledge is not a copy of an objective reality, but rather the result of the mind's selection, interpretation, and recreation of events (Kapur, 2018). This suggests that interactions between environmental and subjective factors result in knowledge. For example, individualism and the importance of personal autonomy may be highly valued in some cultures. Collectivism and cooperation among group members, however, could be highly prized in different cultures. Numerous aspects of life could be significantly impacted by these disparities. The study of social constructivism psychology is also growing in significance as researchers attempt to understand the differences and similarities that exist between people from various cultural backgrounds worldwide. These days, a lot of psychologists are studying the ways that behaviours differ throughout cultures (Oluwatosin, 2017).

Among the many benefits of the theory are the following: when students explain their ideas to others, they are forced to organize and clarify them; when they interact with other students, they are exposed to a variety of viewpoints; and they are able to spot mistakes and contradictions in their thinking. Inquiries, theories, and conclusions derived from data and experiences are also encouraged of learners. By using distributed cognition, learners arrive at conclusions or solutions together, gain a deeper comprehension of the subject, and ultimately become more creative. Students develop the metacognitive abilities they will need to solve problems on their own in the future.

Since psychology evolved in Europe and North America, researchers began to question whether many of the observations and theories that were once thought to be universal would apply to cultures outside of those countries.

Are our conclusions and presumptions about human psychology skewed by the sample we use to make our observations? For instance, one may think about how a collectivist culture like China might differ from an individualistic society like the United States in terms of things like social cognition. Did Chinese individuals rely on social cues in the same way that Americans did? What differences in culture could influence how people view one another? A social constructivist psychologist might investigate issues such as these (Tharani, 2020).

Social constructivist psychologists examine both universal and particular behaviors to ascertain how culture influences our behavior, family life, education, social experiences, and other domains (Kendra, 2019). One of the major tenets of the theory is the zone of proximal development. This illustrates the difference between an individual's capacity for problem-solving and their level of autonomy in solving problems. The same person may display under the guidance of more seasoned peers or adults, or in collaboration with them. "Proximal" refers to skills and knowledge that a learner is getting closer to but still requires support to completely understand.

The main points of the theory are as follows: people interact with their surroundings to create meaning; people build knowledge through human activity; people in a society collaborate to create reality; learning is an active and social process; and, lastly, meaningful learning occurs when people engage in social activities. The theory also addresses research issues in the relational, causal, descriptive, and consequential domains. Social constructivist theory was used in this study to show how the Samburu community has enhanced their quality of life over time by sustainably employing cultural resources in their community. A suitable theoretical approach served as the foundation for this investigation of the potential contributions of ideas, customs, traditions, religion, and other cultural factors to a group's process of cultural adaptation.

By taking into account the holistic concept approach, which emphasizes that many significant cultural factors, such as kinship structures, land tenure, land use, parental and teacher influence, learning environments, and resources, among many others, should not be considered in isolation from their interrelationships, the interpretation of data findings avoids the inherent weakness of this theory (Oladejo, 2021). Therefore, the Social Constructivist theoretical approach provided guidance on how cultural factors relate to Samburu County, Kenya, students' performance in chemistry.

### 2.8 Conceptual Framework

Vygotsky's (1968) Social Constructivist Theory is cited in Section 2.7 as the source of the conceptual framework used in this investigation. Figure 1's conceptual model representation used as the study's guidance in order to apply Vygotsky's Social Constructivist Theory in an efficient manner.

*Figure 1:*

*Conceptual Framework for determining the Relationship between Cultural Factors and Students' Performance in Chemistry*

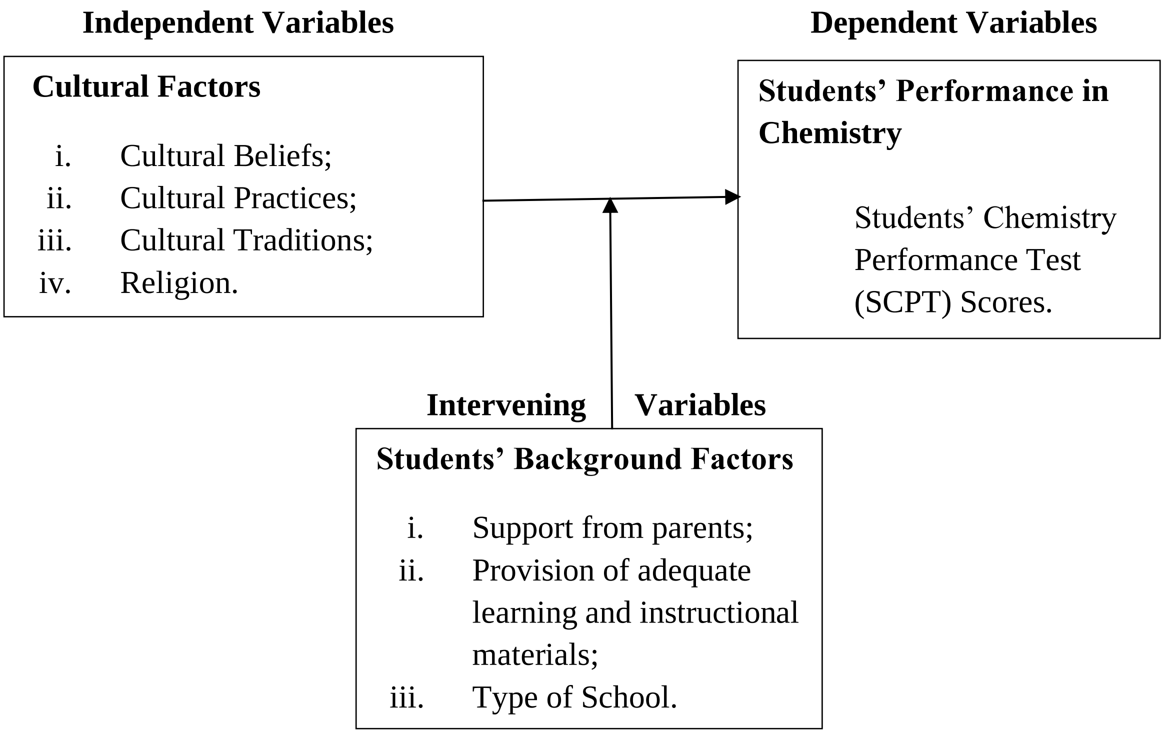



Figure 1 shows the conceptual framework that was used to connect the many cultural factors that were assumed to affect students' performance in chemistry. Its three main interrelated variables are the independent, dependent, and intervening variables. The independent variables are those whose values are not influenced by the other factors under investigation. The values of the dependent variables are determined by the effect that arises from modifications in the independent variables. In conclusion, intervening factors facilitate a more profound comprehension of the relationship between the independent and dependent variables by serving as a link between them.

The type of school, the availability of adequate teaching and learning resources, and family support are the study's intervening variables. These were managed in the manner described below: Involving Form Three children, who never skip class due to indiscipline cases, missing school because they are unable to pay for their education, or who lack learning and other instructional resources for use in the classroom, helped to control parental support and the supply of adequate learning and instructional materials. The kind of school was managed by combining Form Three students from both public and private secondary schools with qualified chemistry teachers and well-stocked scientific labs. Students' development of scientific abilities and improved understanding of chemistry ideas will benefit from this. The performance of the students in chemistry is the dependent variable in this study, and the independent variables are cultural factors. The anticipated results of this study are improved chemistry performance from the students, and the intervening variables are the students' background characteristics.

Nonetheless, the literature assessment revealed the following gaps: First, several of the research that were previously mentioned in relation to the current study were carried out of context. The researcher also found that, as far as he was aware, no empirical research had been done to examine the aforementioned variables and how they related to the chemistry performance of Samburu County students. Thus, in order to close these gaps, the researcher planned to gather enough information about the cultural elements that influence Samburu County students' performance in chemistry. These elements included religious beliefs, customs, behaviors, and cultural beliefs.

## 2.9 Chapter Summary

Based on the literature review done for this study, the researcher concluded that a number of factors affected students' performance in chemistry in both public and private secondary schools. The findings demonstrated how important it is to have a clear and efficient understanding of how cultural factors affect students' performance in chemistry in order to transform that understanding into learning outcomes, particularly in that subject area of chemistry.

Additionally, the study demonstrated that effective utilization of cultural factors in teaching and learning is necessary to achieve high expectations for students' success in chemistry. Other factors, like as the students' mindset, the teaching and learning methods employed, the school environment, and the qualities of the teachers, may also have an effect on the students' success in chemistry. Students' performance in chemistry improved as a result of the teaching and learning resources that helped them fulfill high academic requirements and study more efficiently. Details and explanations on research technique are given in the upcoming chapter (chapter 3).

# CHAPTER THREE

# METHODOLOGY

## 3.1 Introduction

This chapter provides a description of the research methodology used in this study. Research design, study population, study location, sample size and procedures, instrumentation, data collection, data analysis methodologies, ethical issues, and chapter summary all address them in the ensuing subsections.

## 3.2 Research Design

This correlational research endeavour used a correlational survey design. The design involved measuring two variables and correlating them to ascertain the potential relationship's strength and direction (Leedy, 2010). The importance of correlation studies has been highlighted by Palt (2018) and Almut (2017). The design of the study is significant because it offers a way to ascertain the relationships between cultural factors and students' performance in chemistry. The study would provide an analysis of the associations between the variables, which is the significance of the correlational survey methodology.

## 3.3 Study Location

The study was conducted in Samburu County, one of the Great Rift Valley's counties. Turkana County to the north-west and Baringo County to the south shared its borders. Marsabit is situated in the northeast, with the counties of Isiolo and Laikipia to the east and south, respectively. The County lies between latitudes 0o40'S and 2o 31' N, north of the Equator, and longitudes 30o 20'W and 38o 10' East of the Prime Meridian (Republic of Kenya, 1997). The entire area is 21,200 square kilometers. Three sub-Counties comprise the County: Samburu North, Central, and East. Eleven public secondary schools and four private institutions are located within the County. The County is well-known for its high prevalence of non-academic cultural practices among its residents, including as child labour, cattle rustling, moranism, and early child marriages, as well as its high percentage of illiteracy and lack of acceptance of formal education. The County was selected since it is unclear how much cultural factors and students' chemistry performance are correlated.

### 3.4 Target and Accessible Population

Mugenda and Mugenda (2003) define the target population as the group from which the researcher extrapolates the results of the study. All Samburu County secondary school students, attending both public and private institutions, were the study's target demographic. There were 1,238 Form Three Chemistry students' with a total of 495 girls and 743 boys who made up the accessible population. Form Three was utilized since a higher proportion of the KCSE chemistry examination questions, which included both mathematical and spatial ability problems, dealt with themes related to chemistry that were covered in this class. As a result, most students find the topic difficult to study since they have trouble with the mathematical and spatial skills issues. Additionally, industrial chemistry was included to the KICD (2002) secondary school level syllabus, which would aid pupils in developing practical abilities for a deeper comprehension of chemistry ideas.

The students in Form Three who were chosen for this study had similar language for comprehending concepts related to chemistry, and it was also simpler for them to follow up with the study later on while they were still in school. The students also hailed from an ethnic background that was rich in culture and had a wide range of religious connections, customs, behaviors, and cultural beliefs. The Ministry of Education classifies the 15 secondary schools in the county as 2 National, 4 Extra-County, and 9 County schools, and as 11 public and 4 private schools (one Extra-County and three County schools). Three of the county's nine schools were private, and six were public.

### 3.5 Sampling Procedures and Sample Size

The sampling units for the study were the secondary schools. The cluster sampling technique was used to choose all nine of the county's secondary schools that satisfied the Ministry of Education's requirements for having enough resources for instruction and learning. The researcher visited the schools to ensure they were suitable for the study. The two groups of the nine schools selected using the cluster sampling technique were county schools that were public and those that were private. Class lists were used as sampling frames, and because it's possible that students from other ethnic groups have slightly different customs, only members of the Samburu ethnic community were included in the study. The following section describes other sampling techniques that were used to choose the various samples.

**(a) School type:**

The approach of stratified sampling was employed due to its ability to ensure the necessary representation of pertinent subgroups, hence improving the population estimation's efficiency.

**(b) Individual Schools:**

Based on the kind of school and the gender distribution of the student body, the schools were selected using the stratified sample technique. This stratification was done with the knowledge that differences in gender-based student performance in chemistry could be related to the type and efficacy of the institution. The stratification by kind of school was as follows: -

(i) Girls' schools,

(ii) Boys' schools,

(iii) Co-educational schools.

**(c) Students:**

A simple random sampling process was used to choose the study's student sample. A list of students' names was included in each class register; these names were written down on paper and deposited in a basket. The required number of students was drawn at random from the container. The piece of paper was consistently returned to the basket prior to selecting the next student.

**(d) The Sample Size:**

Stratified and simple random selection was used to choose boys and girls in single-sex, mixed or coeducational schools since it offered an equal opportunity for every unit in the population to be included in the sample (Kathuri & Pals, 1993). Nkapa (1997) asserts that there isn't an empirical standard for determining sample size. However, in this study, the formula,

$$n = \frac{Z^2 PqN}{(N-1)e^2 + Z^2Pq}$$

was applied to calculate a sample size (n) in accordance with the Kothari (2004) approach, which is displayed in appendix (V) and involves finding the sample size from a known population size.

n = Required Sample Size,

Z = Value of Standard Variate =1.96 @ 95% Coefficient Interval (Cl),

N = The given Population Size (N = 1,238),

e = Acceptable Error and Degree of Accuracy (e = 0.05),

P = Proportionate Target Population with Particular Traits (P = 0.141),

q = 1- P = 0.859.

Using this approach, a sample size of 286 students 114 girls and 172 boys from nine secondary schools was selected in a proportionate manner. As a result, using a simple random selection method, the minimum number of girls chosen for each school was 19, while the minimum number of boys chosen for each school was 29. Table 3 shows that in order to guarantee a uniform distribution of respondents' responses, the total sample size was selected.

*Table 3:*

*Selection of the Sample Size per School Type and Gender*

| School Type | Total no. of Schools | Total no. of Girls | Total no. of Boys | Total |
|---|---|---|---|---|
| Girls' schools | 3 | 84 | - | 84 |
| Boys' schools | 3 | - | 109 | 109 |
| Co-educational | 3 | 30 | 63 | 93 |
| **Total** | **9** | **114** | **172** | **286** |

Out of the 286 individuals in the sample, 114 were female and 172 were male. This corresponds to 40 (%) and 60 (%) percent of the sample total, respectively. The study employed cluster sampling to guarantee that every school group was fairly chosen. Schools in Samburu County's sub-Counties were clustered together using the cluster sampling approach so that each sub-County's schools could be easily studied separately. Two major sub-Counties, Samburu North and Central, were created when small sub-Counties with one or two secondary schools and large sub-Counties with numerous schools on the same side of the County were combined due to the uniformity of the schools throughout the sub-Counties in the County. Table 4 illustrates how the distribution of schools was carried out for sampling purposes within each of the two major sub-Counties.

*Table 4:*

*Selection of School Category for Sample Size*

| School Type | Samburu North | Samburu Central | Total |
|---|---|---|---|
| Boys | 1 | 2 | 3 |
| Girls | 2 | 1 | 3 |
| Co-education | 1 | 2 | 3 |
| **Total** | **4** | **5** | **9** |

One advantage of cluster sampling is that it ensures inclusion in sample subgroups that other sampling approaches would completely exclude due to their small population size (Mugenda & Mugenda, 2003). In this instance, cluster sampling would guarantee equal opportunities for inclusion in the sample for all the schools from the sub-Counties. Since the majority of Samburu County's schools only have one stream, all nine of the county's schools in the two main sub-Counties were chosen to represent each type of school, ensuring that every region of the county was represented. There were nine schools in all since five schools from Samburu Central and four from Samburu North sub-County were sampled. Three schools were sampled for each type of school.

### 3.6 Instrumentation

Four instruments were used to acquire the data. These included the following: the students' chemistry performance exam (SCPT), the students' cultural beliefs and practices questionnaire (SCBPQ), the students' religion questionnaire (SRQ), and the students' cultural traditions interview schedule (SCTIS). The interview survey was an essential part of the research because its purpose was to enable the study subjects to advocate for themselves (Gatsinzi, 2014). Although questionnaires save time and money, according to Mugenda and Mugenda (2003), they cannot probe into the thoughts and feelings of respondents, and some items may be perplexing to them. Therefore, in order to remedy these deficiencies, an interview schedule is required. Here is a quick description of each of the SCPT, SCBPQ, SRQ, and SCTIS components.

### 3.6.1 Students' Chemistry Performance Test (SCPT)

An 18 item SCPT was developed by the researcher and used in the study. The exam consisted of both structured and short response questions covering Form Three Chemistry topics, including The Mole Concept, Organic Chemistry I, and lastly Nitrogen and its compounds. For each topic, six questions totaling thirty marks were generated, ranging from the Mole Concept to Nitrogen and its compounds. The test items evaluated application, comprehension, and knowledge. They were graded polydichotomously, which means that a score of one or more was awarded for the correct response, while a score of zero was given for the erroneous response. There is a half mark minimum and a three mark maximum for each question. The test items were self-administered.

### 3.6.2 Students' Cultural Beliefs and Practices Questionnaire (SCBPQ)

The closed-ended questions on the SCBPQ, which was derived from Kiboss (1997), asked students about their cultural practices and beliefs. It consisted of twenty four closed-ended questions intended to collect relevant information in line with the research aims and assumptions of the study (1 & 2). It was employed to gather data regarding cultural customs and beliefs. There were twenty-four Five Point Rating Scale items in the SCBPQ, which assessed students' positive and negative remarks about cultural practices and beliefs. The SCBPQ was scored by evaluating the participants' degree of agreement with the weights assigned to each position on the scale, ranging from 1 to 5. Positive remarks would be rated from five (5) to one (1) on a weighted scale of 5, 4, 3, 2, 1. The weights of the unfavorable statements were inverted. As a result, they were ranked from one (1) to five (5), with weights of 1, 2, 3, 4, and 5. Self-administered questionnaires were used.

### 3.6.3 Students' Religion Questionnaire (SRQ)

There were closed-ended questions on religion in the SRQ that asked students to respond. It was composed of twelve closed-ended questions that were designed to elicit the necessary data in accordance with the study's hypothesis and research purpose (4), respectively. It was employed to gather religious data. Twelve Five Point Rating Scale-style questions about students' positive and negative statements about religion were included in the SRQ. The SRQ was scored by assigning weights to each position on the scale, ranging from 1 to 5, based on how much they agreed. Positive remarks would be ranked from five (5) to one (1), with a weighting of 5, 4, 3, 2, 1. The weights of the unfavorable statements were inverted. As a result, they were ranked from one (1) to five (5), with weights of 1, 2, 3, 4, and 5. The researcher self-administered the questionnaires.

### 3.6.4 Students' Cultural Traditions Interview Schedule (SCTIS)

A structured interview schedule including twelve open-ended questions was created to extract the required information in line with the research objective (3) and hypothesis, respectively. Open-ended questions were used to elicit thorough responses from the respondents and provide them the opportunity to react to the probing inquiries. It was used to gather information about the relationship between students' chemistry performance and their cultural customs. The proportionate sample of 30 students, selected from a total of 286 students for the interview schedules, consisted of 18 boys and 12 girls. The student interview schedule was self-administered by the researcher.

### 3.6.5 Validity of the Instruments

Five research experts from the Faculty of Education and Community Studies at Egerton University assessed the tools. Before the research started, they checked on face, construct, and content validity to make sure the instruments would accurately represent the variables under study in accordance with the purpose and objectives of the study (Abramson, 1990). This allowed them to advance on their level of measurement of efficiency, appropriateness, effectiveness, and acceptability. The content validity of the questions was assessed by three seasoned secondary school chemistry instructors who also function as KNEC chemistry examiners. The test's pilot testing included three schools chosen from the Samburu East sub-County's Wamba division, as well as all of the study questionnaires.

There are numerous parallels between the schools in this sub-County and the sample schools used in the study. After going through several reviews, their input was taken into account while creating the final instruments. An independent test-retest assessment was provided. Structure To improve the stability, consistency, reliability, and correctness of the research instruments and avoid tainting the research data, three students agreed not to participate in the study. As per Monette et al. (2002), examining 20 to 50 cases before the primary study was usually sufficient to detect the inadequacies in research instruments and facilitate their enhancement. In the pilot study, the investigator selected twenty cases at random.

### 3.6.6 Reliability of the Instruments

Using Guttman's formula (Guttman's λ6, 1945), the reliability coefficient of SCPT was calculated following the research instruments' piloting. In comparison to other approaches, Guttman's Lambda estimations of Item-Score Reliability demonstrated a reduced interquartile range (IQR) and examined whether or not each item measured the same attribute or quality.

Because it is a very suitable technique for evaluating item-score reliability (ISR) for polydichotomously scored test items, teacher-made tests, and brief experimental tests created by a research worker, Guttman's formula was applied in this study. It can also be used to answer many questions in a small space within a short amount of time. Additionally, it provides ranked data, has a higher reproducibility and is more than one-dimensional than Likert-Scaling. The following formula was used to get the reliability coefficient.

$$\lambda_6 = 1 - \left[\frac{\sum^{J}_{i=1} €^2_i}{ɕ^2X}\right].$$

Where: $\lambda_6$ = Required Item- Score Reliability Coefficient Estimate,

$\sum^{J}_{i}$ = Sum of the ratio of Item Scores across latent classes K and Test Item,

J = Item scores for the sum across latent classes K,

i = Test Item,

$€^2_i$ = Variance of the estimation Error on J item scores,

X = Test score (or sum of J items score),

$ɕ^2X$ = Variance of Test score (or sum of J items score).

Utilizing Cronbach's (1957) coefficient alpha, the reliability of the SCBPQ and SRQ was assessed. The approach can be used to score items that produced a range of results, assess scale reliability among test items, and gauge internal consistency between test items. The following formula represents the coefficient of alpha employed in this investigation.

$$\alpha = \frac{K}{K-1}\left[1 - \frac{\sum S^2}{KS^2}\right].$$

Where: K = Number of items in the Test,

$\sum S^2$ = The sum of Variance of the individual Items.

Reliability coefficient values of 0.80, 0.85, and 0.81 were obtained for the Students' Chemistry Performance Test (SCPT), Students' Cultural Beliefs and Practices Questionnaire (SCBPQ), and Students' Religion Questionnaire (SRQ), in that order. According to Rukangu (2000), an instrument with a coefficient of alpha value above 0.7 is considered appropriate to produce workable group predictions that are adequately accurate, hence all of the instruments used in this study were considered dependable. This approach was selected because it reduces the time required to provide the instruments to a sample of participants. Unlike the other methods, it moreover assesses several responses to each item (Kathuri & Pals, 1993).

### 3.7 Data Collection Procedure

Before beginning the pilot project and the main study, the researcher acquired an introduction letter from the university (Egerton University Board of Postgraduate Studies). This enables the researcher to conduct research at Samburu County's secondary public and private schools with a research permission from the National Commission for Science, Technology, and Innovation (NACOSTI). The researcher proceeded to see the local County Director of Education (CDE) and sample school principals to identify himself and get permission to perform the study in the schools. The delivery of the test items (SCPT), questionnaires (SCBPQ), interview schedule items (SCTIS), and survey questions to the participants was scheduled by the investigator.

The respondents were instructed to self-administer the SCPT, SCBPQ, SRQ, and SCTIS, which they were to complete on their own and then bring to the interview schedule (SCTIS) on a designated day and time. The respondents had one hour to complete the surveys under the researcher's supervision and thirty minutes to respond to the SCPT questions in order to ensure correctness and consistency of the information provided. The researcher gathered the research items on the same day that they were filled. A mere thirty participants, drawn equitably from a sample of 286 in total, agreed to reconvene for the interview at a later time and day. Respondents were assured of confidentiality by the researcher.

### 3.8 Data Analysis

The SCPT, SCBPQ, SRQ, and SCTIS were graded by the researcher in order to generate both quantitative and qualitative data, respectively. The quantitative data received by SCPT, SCBPQ, and SRQ was evaluated using Simple Linear Regression using the Statistical Package for Social Sciences (SPSS) version 23.0 for Windows (Kothari, 2004). Regression analysis is a quantitative research approach used to model and analyze several variables in a study where there was a relationship between one or more independent variables and a dependent variable.

To put it simply, regression analysis is a quantitative method that looks at the relationships that exist between a dependent variable and one or more independent variables.

In their most basic form, regression models consisted of three variables: the independent variables (X), the dependent variable (Y), and the unknown parameters (β). Regression models, shown as Y = f (X, β), basically depict the connection between the dependent variable (Y) and a function of independent variables (X) and unknown parameters (β). Given a known value for "x," one may use the regression equation to predict the values of "y," where "x" and "y" represent the two sets of measures for a sample size of "n." The formula for the regression equation is Y = a + bX.

Where: a =Y- Intercept,

b = Slope,

X = Independent/ Predictor or Explanatory Variable,

Y = Dependent/ Response Variable.

The visual intricacy of the correlation and regression calculations above should not scare you. The procedure should not be utilized by hand; instead, correlation and regression analysis can be performed using commonly used analytical software such as Microsoft Excel, SPSS, and Microsoft Access.

**Primary Premises of the Analysis of Linear Regression:**

1. Linearity is assumed. The relationship between the independent and dependent variables is linear.

2. The homoscedasticity assumption. The variances of the data for the independent and dependent variables are comparable.

3. The belief that there is neither multicollinearity nor collinearity. Two or more independent variables don't relate to each other.

4. The normal distribution is assumed. Both the dependent and independent variable's data follow a normal distribution.

Most phenomena have natural linear linkages, or lines, which make them simpler to work with. In situations where variables exhibit nonlinear relationships, mathematical techniques may be employed to convert them into linear relationships, hence facilitating comprehension for the investigator.

**(i). Simple Linear Regression**

Most academics have probably worked with line graphs that contain just one X and Y axis. Some contexts designate the X variable as the independent variable and the Y variable as the dependent variable. In a basic linear regression, one independent variable (X) is plotted against one dependent variable (Y). In a regression study, the independent variable is usually referred to as the predictor variable, while the dependent variable is known as the criterion variable. However, the majority of people just called them the independent and dependent variables. More sophisticated regression techniques, such multiple regression, used several independent variables. Regression analysis can result in either linear or non-linear graphs. The associations between the variables in a linear regression can be represented by a straight line. Non-linear regression produces curved lines.

**(ii). Overview of Linear Regression Equation**

Regression analysis helps identify equations that make sense for the data. Once the regression equation is known, the model can be utilized to make predictions. One type of regression analysis is linear analysis. When a data scatter plot shows a straight line and a correlation coefficient suggests that the data may be able to predict future events, simple linear regression can be used to find a predictive function. The equation for a line in elementary algebra is Y = mx + b. This formula shows how to take some data, identify the linear regression, and then use that information to produce the equation y' = a + bx. In AP (Advanced Placement) statistics classes, the equation can be expressed as b0 + b1x. This is the same as using variables b0 + b1 instead of a + b. Linear regression is one technique for simulating the relationship between two variables. The slope formula is another name for the equation.

X is the independent variable (plotted on the X axis), Y is the dependent variable (that is, the variable that goes on the Y axis), **b** is the slope of the line, and **a** is the y-intercept. The equation is expressed as Y= a + bX. The first step in finding a linear regression equation is determining if the two variables are related. Usually, the researcher has to decide on this. It would also be required to have two columns with the independent and dependent variables, or an x-y list of the data. Because regression analysis depends so largely on data, it is important. The real numbers and figures that define the research project are called data. The advantage of regression analysis is that it can practically crunch the data to aid in decision-making for current and upcoming research. Regression analysis is a forecasting technique that looks at the correlations between data points and can be used to:

**i**. Predict the relationships between variables in the near- and long-term studies.

**ii**. Understand inventory levels in research work.

**iii.** **U**nderstand predictors and responses in research.

**iv.** Review and understand how different variables impacted on each other in the correlation studies.

Regression analysis has the advantage of making many different patterns in the data simpler to comprehend. These fresh perspectives could frequently be quite helpful in figuring out what variables affect regression analysis. The following student groups' answers to the SRQ about religion and how it impacted their performance in the lab: There was a correlation found between the chemistry performance of Christians, Muslims, and Others (which included non-believers, African Traditional Religion, and Sects, among others).

The researcher used a deductive technique to code and evaluate the qualitative data obtained by SCTIS in a descriptive manner. This approach was based on a preset structure (Gabriel, 2013). Utilizing hypotheses as a guide, data analysis involved identifying patterns of agreement and disagreement in the responses provided by different interviewees. Strong statements made by the interviewees regarding the connection between students' cultural customs and their chemistry performance were paraphrased in order to objectively illustrate their points of view.

The data collected using SCTIS was also evaluated using the Chi-Square Test (x2 test), which was used to ascertain whether the frequency distribution of the respondents' replies fell into a specific pattern and to ascertain the relationship between the variables. The Chi-Square test helps researchers compare the observed distribution to the theoretical distribution, assess the goodness-of-fit of the model, and determine whether proportions in a distribution are homogeneous. It also informs researchers of any statistically significant differences in the ways that various groups or segments employed the study instruments to address a particular problem. The following are some basic assumptions of the Chi-Square Goodness-of-Fit test.

1. A random sample of data was employed to obtain the information.
2. Each topic falls into a single category since the sample categories are mutually exclusive.

3. Rather of being expressed as percentages, the data ought to be presented as counts or frequencies within a specific category.

In order to get dependable conclusions from the data, all significance tests were carried out with an alpha (α) level of 0.05 for the coefficient of significance. Table 5 lists the study hypotheses, independent and dependent variables, and statistical techniques utilized to examine each research hypothesis.

*Table 5:*

*Variables and Methods of Data Analysis*

| Research Hypotheses | Variables: Independent | Variables: Dependent | Methods of Data Analysis |
|---|---|---|---|
| **Ho1:** There is no statistically significant relationship between cultural beliefs and Secondary school students' performance in chemistry in Samburu County. | Cultural beliefs. | Students' performance in chemistry. | Simple Linear Regression. |
| **Ho2:** There is no statistically significant relationship between cultural practices and Secondary school students' performance in chemistry in Samburu County. | Cultural practices. | Students' performance in Chemistry. | Simple Linear Regression. |
| **Ho3:** There is no statistically significant relationship between cultural traditions and secondary school students' performance in chemistry in Samburu County. | Cultural traditions. | Students' performance in chemistry. | Deductive Approach and Chi-Square Test. |
| **Ho4:** There is no statistically significant relationship between religion and secondary school students' performance in chemistry in Samburu County. | Religion. | Students' performance in chemistry. | Simple Linear Regression. |

Tested for significance at Coefficient Alpha (α) = 0.05

### 3.9 Ethical Considerations

Before starting the pilot project and the main study, the researcher received consent from the relevant authorities, including the principals of the schools where the study would be done. The validity of the results would be significantly impacted by the respondents providing information voluntarily and without the use of any kind of inducement, as the researcher ensured by having them sign a consent letter. Students who participated in the study were asked to sign a consent notice that the researcher gave to them during the data collection session.

### 3.10 Chapter Summary

The present chapter delineates the research design employed, the population of interest and accessibility, the sampling strategies employed, the instrumentation, the validity and reliability of the instruments, the procedures for collecting and analyzing data, ethical considerations, and a summary of the findings. An explanation of the data acquired, its analysis, and its interpretation is given in the next chapter (chapter 4).

# CHAPTER FOUR

# RESULTS

## 4.1 Introduction

This chapter presents the findings from both descriptive and inferential statistics. The results are presented using tables and pie charts along with their implications. To assess the research hypotheses about the relationship between cultural practices, beliefs, and religion and students' chemistry performance, the Simple Linear Regression Coefficient was employed. The association between cultural customs and students' chemistry performance was represented and ascertained using deductive statistics and the Chi-Square test. Data on students' performance in chemistry was gathered via the Students' Chemistry Performance Test (SCPT), and information on the impact of cultural practices, religious views, and student surveys was gathered as well. Students' interview schedules provided information on the relationship between cultural practices and chemical performance.

The following sections of this chapter contain details on the following subjects:

a) Students’ Chemistry Performance Test (SCPT) results.

b) The connection between students' performance in chemistry and cultural practices and beliefs.

c) Chemistry students' performance and cultural traditions' relationship.

d) A Look at the Connection between Religion and Chemistry Student Performance.

## 4.2 Results on Students’ Chemistry Performance Test (SCPT)

Data on students' performance in chemistry was gathered using the items from the Students' Chemistry Performance Test (SCPT). 286 students in all took the test. Information was gathered, examined, and displayed. Respondents in Samburu County's Central and North Sub-Counties took the Students' Chemistry Performance Test (SCPT), with results shown in Table 6.

*Table 6:*

*Students' Performance in Chemistry per Sub- County (N= 286)*

| Sub- County | No. of Respondents | Mean (%) |
|---|---|---|
| Samburu North | 115 | 28.90 |
| Samburu Central | 171 | 19.53 |
| **Total** | 286 | 23.64 |

Table 6 results indicate that Samburu North Sub-County led with a mean of 28.90%, while Samburu Central came in second with a mean of 19.53%. This was explained by the fact that Samburu North Sub-County had fewer but more completely equipped schools than Samburu Central. The study included both boys and girls from the sampled schools. Table 7 summarizes the results of the Students' Chemistry Performance Test (SCPT) and the scores assigned to each student's gender.

*Table 7:*

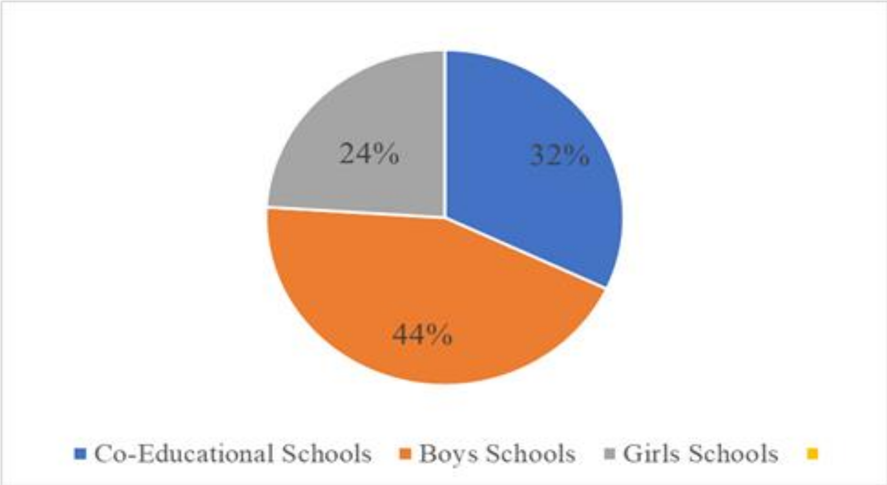
*Students' Chemistry Performance Test (SCPT) Scores by Gender of Students (N= 286)*

| Gender | No. of Students | Mean (%) |
|---|---|---|
| Female | 114 | 17.12 |
| Male | 172 | 26.80 |
| **Total** | 286 | 23.64 |

Table 7 shows that male students outperformed female students based on their respective means (girls, 17.12% and boys, 26.80%). The sample's overall mean percentage is 23.64%, which is much lower than the average performance of 50%. This may be related to the widespread belief that women should not pursue careers in the sciences. Figure 2 displays a pie-chart that summarizes the results of the various school categories on the performance of the students in the chemistry test.

*Figure 2:*

*Pie- Chart of the different School Categories on Students' Chemistry Performance Test (SCPT)*




The pie-chart used to display the results of the various school categories and students' performance on the given chemistry test is depicted in Figure 2. The mean for boys' schools was 44%, for coeducational schools it was 32%, and for girls' schools it was the lowest at 24%. This was mostly linked to students' disinterest in the sciences and had a greater impact on female students' chemistry performance. Table 8 displays the mean scores for the students' cultural beliefs.

*Table 8:*

*Students' Cultural Beliefs Mean Scores (N = 286)*

| Questions | Cultural Beliefs Mean Scores |
|---|---|
| 1. When someone travels and a black Cat cross in front is an indication of a bad luck. | 2.81 |
| 2. An Owl making noise near a homestead very early in the morning or late in the evening is an indication that one of the family members will die. | 3.30 |
| 3. Someone giving birth to a mutant is an indication of a curse from the family or very close relative. | 2.78 |
| 4. Rainbow means rain will not fall. | 3.55 |
| 5. Raining and Sun shines, signifies that the Hyena is giving birth. | 2.34 |
| 6. Brightness of the moon indicates that there will be no rain fall. | 2.81 |
| 7. Collecting rain water by use of hand can lead thunderstorm to strike. | 2.17 |
| 8. Wearing a red colour material when raining can make thunderstorm to strike. | 2.98 |
| 9. Standing by the doorpost when raining can lead thunderstorm to strike. | 2.73 |
| 10. The occurrence of whirlwind is an illustration of evil spirits. | 2.42 |
| 11. Heavy and Stormy rain that damages is an illustration of the punishment of God on mankind. | 2.75 |
| 12. When a lake, river or dam flows over the bank is a sign that the goddess of the lake, river or dam is unhappy with mankind. | 1.91 |

Based on students' answers to the SCBQ questionnaire, Table 8 displays the average results for each question. Weights ranging from 1 to 5 were assigned to each place on the rating scale based on the degree of agreement expressed by the students in their answers to the SCBQ questionnaire. The mean scores for each question in the SCBQ questionnaire were obtained by using the Statistical Package for Social Sciences (SPSS) version 23.0 for Windows. With a mean score of 3.55, question four was the most well-liked by students according to the cultural beliefs mean scores, while question twelve received the lowest mean score of 1.91. This demonstrates unequivocally that the majority of students struggled to understand some scientific facts because of the influence of their cultural beliefs.

### 4.3 Relationship between Cultural Beliefs and Students' Performance in Chemistry

The correlation between students' performance in chemistry and their cultural beliefs was determined by analyzing the mean results from the Students' Chemistry Performance Test (SCPT) and the students' SCBQ questionnaires. The Simple Linear Regression statistical test was applied. These details are shown in Tables 9 and 10, correspondingly.

*Table 9:*

*Model Summary for the Relationship between Cultural Beliefs and Students' Performance in Chemistry (N= 286)*

| Model | R | $R^2$ | Adj. $R^2$ | Std. Error Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $R^2$ Change | F Change | df 1 | Change Statistics | |
| 1 | 0.043[a] | 0.002 | - 0.002 | 14.14651 | 0.002 | 0.532 | 1 | df 2<br>284 | Sig. F. Change<br>0.466 |

a. Predictors: (Constant), Cultural Beliefs.

Cultural beliefs account for a -0.2% decrease in students' chemistry performance, according to the modified R2 - Value of -0.002, which has a P-Value of 0.466. This indicates that the Adjusted R2 value (adjusted R2 ≠ 0) is most likely the result of chance and does not differ significantly from zero. Table 10 presents a summary of the coefficients pertaining to the correlation between students' performance in chemistry and their cultural beliefs.

*Table 10:*

*Coefficients for the Relationship between Cultural Beliefs and Students' Performance in Chemistry (N= 286)*

| Model | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | ß(Beta) | Std. Error. | Beta | T | Sig. |
| 1 (constant) | 26.281 | 3.712 | | 7.080 | 0.000 |
| Cultural Beliefs. | -0.865 | 1.187 | -0.043 | -0.729 | 0.466 |

There is no significant correlation at the 0.05 (2-tailed) level.

a. Dependent Variable: Chemistry Performance.

r- Value = -0.002, P = 0.466, P > 0.05.

**Equation for the Model**

Y = 26.281 – 0.865X.

Y = Students' Performance in Chemistry.

X = Students' Cultural Beliefs.

The correlation results between cultural beliefs and students' performance in chemistry for the first hypothesis of the study are shown in Table 10. The study's first hypothesis looked for a connection between students' performance in chemistry and their cultural beliefs. Table 10's results showed that students' cultural beliefs cause their performance in chemistry to decline by -0.865. At alpha (α) equal to 0.05, the change is not statistically significant (r = -0.002, N = 286, p > 0.05). The connection showed that there was no relationship between cultural beliefs and students' chemistry performance. This was ascribed to the students' inability to comprehend the connection between cultural beliefs and chemical performance. The fact that the p-value of 0.466 is higher than the significance level at alpha (α) = 0.05 indicates that there is enough data to rule out the claim. The variables do not have a linear connection as a result. The results are not statistically significant, and the data support the null hypothesis. Additionally, there is evidence to suggest that there was no relationship between the variables. The null hypothesis was so accepted.

### 4.4 Relationship between Cultural Practices and Students' Performance in Chemistry

The correlation between cultural practices and students' performance in chemistry was determined using the students' mean scores from the SCPQ surveys and their scores on the Chemistry Performance Test (SCPT). The Simple Linear Regression statistical test was applied. An overview of this data is shown in Tables 11, 12, and 13, respectively. Table 11 provides a summary of the overall findings for the mean scores related to students' cultural practices.

*Table 11:*

*Students' Cultural Practices Mean Scores (N = 286)*

| **Questions** | **Cultural Practices Mean Scores** |
|---|---|
| 1. Traditional initiations. | 2.69 |
| 2. Traditional ceremonies. | 2.80 |
| 3. Myth and rituals. | 2.24 |
| 4.Mourning rituals during and after the burial of a deceased member of the family. | 2.43 |
| 5. Child birth rituals. | 2.65 |
| 6. Practices of food preservation using honey. | 3.24 |
| 7. Shaving of hair from the heads when a family member dies. | 2.84 |
| 8. Cultural uses of salts. | 3.50 |
| 9. Cultural uses of smoke. | 3.28 |
| 10. Libations. | 2.44 |
| 11. The Tattooing processes. | 2.30 |
| 12. Burning of sacrifices. | 2.45 |

Based on students' answers to the SCPQ questionnaire, Table 11 displays the average scores for each item. Weights ranging from 1 to 5 were assigned to each point on the rating scale based on the degree of agreement that students expressed in their answers to the SCPQ questionnaire. Students' mean scores for each question on the SCPQ questionnaire were calculated using the Statistical Package for Social Sciences (SPSS) version 23.0 for Windows. Based on the average ratings for cultural practices, students found that question eight, with a mean score of 3.5, was the most popular question, while question three, with a mean score of 2.24, was the least popular. Few students were able to connect cultural myths and rituals with science education, even though the majority of students were aware of the traditional applications of salts and could connect them to contemporary scientific methods. Table 12 presents the model summary results regarding the correlation between cultural practices and students' chemistry performance.

*Table 12:*

*Model Summary for the Relationship between Cultural Practices and Students' Performance in Chemistry (N= 286)*

| Model | R | $R^2$ | Adj. $R^2$ | Std. Error Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $R^2$ Change | F Change | df 1 | Change Statistics | |
| 1 | 0.343[a] | 0.118 | 0.115 | 13.29967 | 0.118 | 37.920 | 1 | df 2<br>284 | Sig. F. Change<br>0.000 |

a. Predictors: (Constant), Cultural Practices.

Cultural practices account for 11.5% of the variation in students' chemistry performance, according to the modified R2 - Value of 0.115 and P-Value of 0.000. This indicates that the study's variables did not correlate with one another. Table 13 summarizes the findings of the coefficients pertaining to the correlation between cultural practices and students' chemistry performance.

*Table 13:*

*Coefficients for the Relationship between Cultural Practices and Students' Performance in Chemistry (N= 286)*

| Model | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | ß(Beta) | Std. Error. | Beta | T | Sig. |
| 1 (constant) | 43.051 | 3.248 | | 13.253 | 0.000 |
| Cultural Beliefs. | -6.496 | 1.055 | -0.343 | -6.158 | 0.000 |

There is no significant correlation at the 0.05 (2-tailed) level.

a. Dependent Variable: Chemistry Performance.

r- Value = 0.115, P = 0.000, $P < 0.05$.

**Equation for the Model**

$Y = 43.051 – 6.496X$.

Y = Students' Performance in Chemistry.

X = Students' Cultural Practices.

The association results of hypothesis two of the study between cultural practices and students' performance in chemistry are shown in Table 13. The study's second hypothesis looked for a connection between students' performance in chemistry and cultural practices. Table 13's results show that students' cultural practices caused their chemistry performance to decline by -6.496. At alpha (α) equal to 0.05, the change was statistically significant ($r = 0.115$, $N = 286$, $p < 0.05$). The correlation showed that students' performance in chemistry was influenced by cultural practices. This was ascribed to the students' ability to understand how modern science, particularly chemistry, translates their cultural practices of scientific phenomena. The fact that the p-value of 0.000 was less than the significance level at alpha (α) equal to 0.05 meant that there wasn't enough data to support the assertion. As a result, the variables had a linear connection, the data refuted the null hypothesis, and the conclusions were statistically significant. Additionally, there was evidence that the variables had an effect on one another. Consequently, the null hypothesis was disproved.

### 4.5 Relationship between Cultural Traditions and Students' Performance in Chemistry

The performance of students in chemistry and cultural traditions do not have a statistically significant correlation. Data on the correlation between students' performance in chemistry and their cultural customs was gathered through the interview schedule of the students. In order to enable respondents to provide detailed responses to the probing questions, open-ended questions were employed, which aided in the collection of qualitative data for the study. Thirty students in all were questioned. Data was gathered, coded, and subjected to a deductive analysis using the Chi-Square test. Figures provided tabular data illustrations. Table 14 displays the findings from the students' interview schedule regarding the potential impact of traditional rituals on their chemistry performance.

*Table 14:*

*Relationship between Traditional Rituals and Students' Performance in Chemistry (N= 30)*

| Response | Frequency (f) | Percentage (%) |
|---|---|---|
| Yes | 11 | 37 |
| No | 19 | 63 |
| **Total** | 30 | 100 |

According to Table 14, 63% of respondents said that traditional rituals had no bearing on students' performance in chemistry and did not limit it, whereas 37% said that traditional rituals had a bearing on students' performance in chemistry. The association between students' performance in chemistry and customary ceremonies was also examined using the Chi-Square test.

**Chi-Square ($x^2$) Test;** $X^2 = \frac{\sum(O - E)^2}{E}$

Where; O = Observed frequency,

E = Expected frequency,

α= Level of significance set,

df = Degrees of freedom,

P = Critical/Probability value,

r = Calculated value.

$= \frac{(11-15)^2 + (19-15)^2}{15} = 2.133$. $\alpha = 0.05$, df = 1, P = 3.841, r = 2.133.

Given that the r-value of 2.133 is smaller than the P-value of 3.841, meaning that r < p, it can be concluded that there is enough evidence to reject the claim. As a result, the variables don not relate to one another. The results are not statistically significant, and the data support the null hypothesis. Additionally, there is evidence to suggest that there was no relationship between the variables. The null hypothesis was so accepted. The students' interview schedule for YES and NO indicated the association between traditional rites and students' performance in chemistry; the replies are shown in Tables 15 and 16, respectively.

*Table 15:*

*Reasons for the Relationship between Traditional Rituals and Students' Performance in Chemistry for YES; Responses (N= 11)*

| Reasons | | Frequency (f) | Percentage (%) |
|---|---|---|---|
| i. | Control one's behaviours. | 01 | 09 |
| ii. | Waste class time. | 06 | 55 |
| iii. | Do not promote Education. | 04 | 36 |
| | **Total** | 11 | 100 |

According to Table 15, 55% of the participants stated that traditional rituals had a negative correlation with learning chemistry and result in wasted time on assignments. 36% thought traditional rituals made it harder to promote education, and 9% thought they governed people's behaviour. Findings regarding the causes of the correlation between traditional rituals and students' chemistry performance for NO; answers are enumerated in Table 16.

*Table 16:*

*Reasons for the Relationship between Traditional Rituals and Students' Performance in Chemistry for NO; Responses (N= 19).*

| Reason | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Not related to students' performance in Chemistry. | 19 | 100 |
| **Total** | 19 | 100 |

Table 16 results demonstrate that all respondents (100%) claimed traditional rituals had no bearing on students' achievement in the sciences because they were unrelated to their chemistry proficiency. Tables 17, 18, and 19 provide a summary of the findings regarding the degree to which certain specified Cultural Traditions influenced students' performance in chemistry.

*Table 17:*

*Relationship between Folklore and Students' Performance in Chemistry (N= 30)*

| Responses on Folklore | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Very much | 06 | 20 |
| ii. Much | 00 | 00 |
| iii. Some | 00 | 00 |
| iv. Little | 03 | 10 |
| v. Very little | 21 | 70 |
| **Total** | 30 | 100 |

Based on their comments in the interview schedule, Table 17 indicates that 70% of the respondents believed there was no correlation between Folklore and students' chemistry performance. 20% of the participants said that there was a strong correlation between students' success in chemistry and folklore. 10% of the participants stated that there was no correlation between folklore and students' chemistry performance. This association was also verified using the Chi-Square test.

**Chi-Square ($x^2$) Test; $X^2 = \frac{\sum(O - E)^2}{E}$**

Where; O = Observed frequency,

E = Expected frequency,

α= Level of significance set,

df = Degrees of freedom,

P = Critical/Probability value,

r = Calculated value.

$= \frac{(6-6)^2 + (0-6)^2 + (0-6)^2 + (3-6)^2 + (21-6)^2}{6} = 51$. α = 0.05, df = 4, p= 9.488,

r = 5 1.

The fact that the r-value of 51 is significantly higher than the P-value of 9.488, or r > p, suggests that there was insufficient data to support the assertion. As a result, the variables had a link, the data refuted the null hypothesis, and the findings were statistically significant. Additionally, there was evidence that the variables had an effect on one another. Consequently, the null hypothesis was disproved. Table 18 summarizes the findings about the correlation between Magic and students' chemistry performance.

*Table 18:*

*Relationship between Magic and Students' Performance in Chemistry (N= 30)*

| | Responses on Magic | Frequency (f) | Percentage (%) |
|---|---|---|---|
| i. | Very much | 00 | 00 |
| ii. | Much | 02 | 07 |
| iii. | Some | 05 | 17 |
| iv. | Little | 04 | 13 |
| v. | Very little | 19 | 63 |
| | **Total** | 30 | 100 |

Table 18 results show that, according to respondents' comments during the interview schedule, 17% believed that Magic had some association with students' performance in chemistry, while 63% believed it had very little. According to 13% and 7% of the respondents, respectively, there was little or no correlation between the variables and the chemistry performance of students. Table 19 displays the findings about the correlation between customs and students' chemistry performance.

*Table 19:*

*Relationship between Customs and Students' Performance in Chemistry (N= 30)*

| | Responses on Sorcery | Frequency (f) | Percentage (%) |
|---|---|---|---|
| i. | Very much | 00 | 00 |
| ii. | Much | 01 | 03 |
| iii. | Some | 03 | 10 |
| iv. | Little | 04 | 13 |
| v. | Very little | 22 | 74 |
| | **Total** | 30 | 100 |

Based on their comments in the interview schedule, Table 19 shows that 74% of the respondents believed there was very little correlation between Customs and students' performance in chemistry, while 13% disagreed. 10% and 3% of the participants indicated that there was little to no link between the factors, respectively. Table 20 displays the findings of the correlation between students' performance in chemistry and the use of Traditional Norms.

*Table 20:*

*Relationship between Practice of Traditional Norms and Students' Performance in Chemistry (N= 30)*

| Response | No. of Respondents (N) | Frequency (f) | Percentage (%) |
|---|---|---|---|
| Yes | 25 | 25 | 83 |
| No | 05 | 05 | 17 |
| **Total** | 30 | 30 | 100 |

According to Table 20 findings, 83% of the respondents who were questioned agreed that using conventional norms has an impact on students' chemistry performance. 17% of respondents disagreed with the application of conventional norms, and as a result, they had little bearing on how well students performed in chemistry. This association was also verified using the Chi-Square test.

**Chi-Square ($x^2$) Test; $X^2 = \sum \frac{(O - E)^2}{E}$**

Where; O = Observed frequency,

E = Expected frequency,

α= Level of significance set,

df = Degrees of freedom,

P = Critical/Probability value,

r = Calculated value.

$= \frac{(25- 15)^2 + (5- 15)^2}{15} = 13.333$, α = 0.05, df = 1, P = 3.841, r = 13.333.

The fact that the r-value of 13.333 is significantly higher than the P-value of 3.841 (r > p) suggests that there was insufficient data to support the assertion. As a result, the variables had a link, the data refuted the null hypothesis, and the findings were statistically significant. Additionally, there was evidence that the variables had an effect on one another. Consequently, the null hypothesis was disproved. Results for the reasons why students' success in chemistry is related to the application of customary norms for YES and NO; answers are compiled in Tables 21 and 22, respectively.

*Table 21:*

*Reasons for the Relationship between Practice of Traditional Norms and Students' Performance in Chemistry for YES; Responses (N= 25)*

| | Responses | Frequency (f) | Percentage (%) |
|---|---|---|---|
| i. | Gain moral values. | 13 | 52 |
| ii. | Shapes students' behaviours positively. | 12 | 48 |
| **Total** | | 25 | 100 |

According to Table 21, 52% of those surveyed thought that following traditional norms helped students develop moral values in the community, while 48% thought that following traditional norms positively impacts students' behaviors, which is why it is linked to students' performance in chemistry. Findings about the correlation between adhering to conventional norms and students' chemistry test scores for NO; answers are shown in Table 22.

*Table 22:*

*Reasons for the Relationship between Practice of Traditional Norms and Students' Performance in Chemistry for NO; Responses (N= 5)*

| Responses | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Not related to students' performance in chemistry. | 05 | 100 |
| **Total** | 05 | 100 |

Table 22 findings show that the absence of a relationship between students' chemistry performance and established norms was cited by all interviewers (100%) as their main defense for deviating from them. It was therefore ineffective for understanding scientific concepts in chemistry. An overview of the results regarding the relationship between students' chemistry performance and widely accepted traditional norms may be seen in Table 23.

*Table 23: Relationship between Common Traditional Norms and Students' Performance in Chemistry (N= 30)*

| Common Traditional Norms | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Respect, | 09 | 30 |
| ii. Honesty, | 09 | 30 |
| iii. Humility, | 07 | 23 |
| iv. Obedience. | 05 | 17 |
| **Total** | 30 | 100 |

According to Table 23 results, which are based on the interview schedule, the most prevalent traditional norms associated with students' performance in chemistry were obedience to elders, respect, honesty, and humility (30%, 30%, 23%, and 17%, respectively). Therefore, in terms of percentages, obedience and humility were the least common ethical criteria associated with students' performance in chemistry. Table 24 presents the findings about the correlation between students' performance in chemistry and their adherence to traditional community customs.

Table 24:

*Relationship between Beliefs in Community Traditional Customs and Students' Performance in Chemistry (N= 30)*

| Response | No. of Respondents (N) | Frequency (f) | Percentage (%) |
|---|---|---|---|
| Yes | 30 | 30 | 100 |
| No | 00 | 00 | 00 |
| **Total** | 30 | 30 | 100 |

According to Table 24, all of the respondents who were questioned felt that there was a connection between students' performance in chemistry and their beliefs about the traditional practices of their community. This suggested that students' performance in chemistry was correlated with their attitudes about local traditional traditions. Beliefs in the customs of the society, thus, have a good impact on students' performance in the sciences, particularly chemistry. Table 25 shows the findings on a few customs that have been linked to students' chemistry performance.

*Table 25:*

*Traditional Customs Related to Students' Performance in Chemistry (N= 30)*

| Traditional Customs | | Frequency (f) | Percentage (%) |
|---|---|---|---|
| i. | Peace, | 13 | 43 |
| ii. | Unity, | 10 | 33 |
| iii. | Love, | 02 | 07 |
| iv. | Harmony. | 05 | 17 |
| | **Total** | 30 | 100 |

According to Table 25 findings, 43% of the respondents stated that paying respect to elders was the primary custom that was associated with students' chemistry performance. This was followed by unity (33%), harmony (17%), and love (7%). These findings unequivocally show that students' comprehension of science subjects was improved by following customs from the past. Table 26 displays the findings of the correlation between conventional taboos and students' chemistry performance.

*Table 26:*

*Relationship between Traditional Taboos and Students' Performance in Chemistry (N= 30)*

| Response | No. of Respondents (N) | Frequency (f) | Percentage (%) |
|---|---|---|---|
| Yes | 10 | 10 | 33 |
| No | 20 | 20 | 67 |
| **Total** | 30 | 30 | 100 |

According to the results of the interview schedule, Table 26 reveals that 63% of the respondents who were interviewed disagreed that Traditional Taboos had an impact on students' performance in chemistry. 33% of the participants concurred that conventional taboos had an impact on students' chemistry performance. Results for the YES and NO answers to the questions about the relationship between traditional taboos and students' performance in chemistry are shown in Tables 27 and 28, respectively.

*Table 27:*

*Reasons for the Relationship between Traditional Taboos and Students' Performance in Chemistry for YES; Responses (N= 10)*

| Reason | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Affects the character of students negatively in academics. | 10 | 100 |
| **Total** | 10 | 100 |

Based on Table 27, all respondents (100%) stated that traditional taboos had a beneficial impact on students' performance in chemistry since they were related to students' success in chemistry. Table 28 presents the explanations for the correlation between traditional taboos and students' chemistry performance for NO responses.

*Table 28:*

*Reasons for the Relationship between Traditional Taboos and Students' Performance in Chemistry for NO; Responses (N= 20)*

| Reason | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Not related to students' performance in chemistry. | 20 | 100 |
| **Total** | 20 | 100 |

Table 28 reveals that all respondents (100%) claimed that traditional taboos had a negative impact on students' chemistry performance even though they were unrelated to the interview schedule outcomes, which indicated that students' performance in chemistry was not affected. Table 29 provides an overview of the findings regarding the correlation between students' chemistry performance and moranism.

*Table 29:*

*Relationship between Moranism and Students' Performance in Chemistry (N= 30)*

| Response | No. of Respondents (N) | Frequency (f) | Percentage (%) |
|---|---|---|---|
| Yes | 13 | 13 | 43 |
| No | 17 | 17 | 57 |
| **Total** | 30 | 30 | 100 |

According to Table 29, 57% of the respondents disagreed that moranism and students' chemistry performance were related. This indicated that Moranism had no effect on the chemistry performance of the students. According to 43% of respondents, there is a connection between students' chemistry performance and moranism. Results for the YES and NO replies to the questions about the relationship between moranism and students' performance in chemistry are compiled in Tables 30 and 31, respectively.

*Table 30:*

*Reasons for the Relationship between Moranism and Students' Performance in Chemistry for YES; Responses (N= 13)*

| Reasons | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Leads to time wastage in non-academic issues. | 07 | 54 |
| ii. Leads to school dropout. | 06 | 46 |
| **Total** | 13 | 100 |

Table 30 above demonstrates that every respondent who was questioned believed that moranism had an impact on how well pupils performed in chemistry. 54% of respondents said that moranism caused them to waste time on non-academic matters, and 46% said that it caused pupils to quit school. Moranism is the primary cause of the significant problem of early school dropouts among Samburu County youngsters. Explanations for the correlation between students' performance in chemistry and moranism for NO; Table 31 shows the responses.

*Table 31:*

*Reasons for the Relationship between Moranism and Students' Performance in Chemistry for NO; Responses (N= 17)*

| Reason | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Not related to students' performance in chemistry. | 17 | 100 |
| **Total** | 17 | 100 |

Table 31 displays the replies from the students, demonstrating that all of the respondents felt that moranism had no bearing on the students' performance in the sciences, particularly chemistry, with 100% of them believing this to be the case. Table 32 presents the findings about the correlation between students' performance in chemistry and the majority of traditional laws.

Table 32:

*Relationship between Most Common Traditional Laws and Students' Performance in Chemistry (N= 30)*

| Most Common Traditional Laws | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Honesty, | 10 | 33 |
| ii. Respect, | 12 | 40 |
| iii. Harmony, | 06 | 20 |
| iv. Peace. | 02 | 07 |
| **Total** | 30 | 100 |

From Table 32, the most often mentioned traditional laws pertaining to students' achievement in chemistry were respect (reported by 40% of the respondents), honesty (33%), harmony (20%), and peace (7%). The conventional regulations control students' behaviour, which helps them do well in school. Table 33 presents the findings about the correlation between students' performance in chemistry and culturally acceptable gender roles.

*Table 33:*

*Relationship between Culturally Accepted Gender Roles and Students' Performance in Chemistry (N= 30)*

| Response | No. of Respondents (N) | Frequency (f) | Percentage (%) |
|---|---|---|---|
| Yes | 06 | 06 | 20 |
| No | 24 | 24 | 80 |
| **Total** | 30 | 30 | 100 |

Table 33 reveals that while 20% of respondents agreed, 80% of those surveyed stated that there was no connection between students' success in chemistry and culturally acceptable gender roles. This resulted from the different cultural norms surrounding gender roles, which are prevalent in different societies worldwide. The Chi-Square test was also used to ascertain this association.

**Chi-Square ($x^2$) Test; $X^2 = \sum \frac{(O - E)^2}{E}$**

Where; O = Observed frequency,

E = Expected frequency,

α= Level of significance set,

df = Degrees of freedom,

P = Critical/Probability value,

r = Calculated value.

$= \frac{(6-15)^2 + (24-15)^2}{15} = 10.8$. α = 0.05, df = 1, P = 3.841, r = 10.8.

The fact that the r-value of 10.8 is significantly higher than the P-value of 3.841 (r > p) suggests that there was insufficient data to support the assertion. As a result, the variables had a link, the data refuted the null hypothesis, and the findings were statistically significant. Additionally, there was evidence that the variables had an effect on one another. As a result, the null hypothesis was rejected because it was not accepted. The results for the reasons why students' success in chemistry and culturally acceptable gender roles are related for both YES and NO; the answers are compiled in Tables 34 and 35, respectively.

*Table 34:*

*Reasons for the Relationship between Culturally Accepted Gender Roles and Students' Performance in Chemistry for YES; Responses (N= 06)*

| Reasons | | Frequency (f) | Percentage (%) |
|---|---|---|---|
| i. | Waste time for academic activities. | 02 | 33 |
| ii. | Promote gender biasness. | 04 | 67 |
| **Total** | | 06 | 100 |

Table 34 shows that whereas 33% of the respondents mentioned that academic activity tardiness was linked to students' chemistry performance, 67% of the respondents thought that culturally accepted gender norms encouraged gender biasness. Findings about the correlation between students' performance in chemistry and culturally acceptable gender roles for NO; answers are compiled in Table 35.

*Table 35:*

*Reasons for the Relationship between Culturally Accepted Gender Roles and Students' Performance in Chemistry for NO; Responses (N= 24)*

| Reasons | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Not related to students' performance in chemistry. | 24 | 100 |
| **Total** | 24 | 100 |

According to Table 35 results, all interviewees (100%) concurred that there was no correlation between students' success in chemistry and culturally normative gender roles, and that there was therefore no impact on students' performance in other sciences. The findings concerning the correlation between early marriage, child labour, and chemistry students' performance are displayed in Tables 36 and 37, respectively.

*Table 36:*

*Relationship between Child Labour and Students' Performance in Chemistry (N= 30)*

| Responses on Child Labour | Frequency (f) | Percentage (%) |
|---|---|---|
| i. Very much; | 28 | 94 |
| ii. Much; | 01 | 03 |
| iii. Some; | 00 | 00 |
| iv. Little; | 01 | 03 |
| v. Very little. | 00 | 00 |
| **Total** | 30 | 100 |

Given that children spent more time engaged in child labour activities than in academic pursuits, Table 36 shows that 94% of the respondents who were interviewed thought that there was a strong correlation between child labour and students' performance in chemistry. This had a very detrimental impact on the chemistry performance of the students. Table 37 provides an overview of the findings regarding the correlation between early marriage and students' chemistry test scores.

*Table 37:*

*Relationship between Early Marriage and Students' Performance in Chemistry (N= 30)*

| Responses | Early Marriage | Frequency (f) | Percentage (%) |
|---|---|---|---|
| i. Very much; | 27 | 27 | 90 |
| ii. Much; | 03 | 03 | 10 |
| iii. Some; | 00 | 00 | 00 |
| iv. Little; | 00 | 00 | 00 |
| v. Very Little. | 00 | 00 | 00 |
| **TOTAL** | 30 | 30 | 100 |

According to Table 37, 90% of the respondents who were questioned felt that early marriage had a significant impact on students' performance in chemistry because it could cause students to drop out of school and become less focused on their studies, while 10% disagreed. Early marriage has a detrimental impact on students' academic achievement and is strongly associated with parents' overall poverty levels. This association was also verified using the Chi-Square test.

**Chi-Square ($x^2$) Test; $X^2 = \sum \frac{(O - E)^2}{E}$**

Where; O = Observed frequency,

E = Expected frequency,

α= Level of significance set,

df = Degrees of freedom,

P = Critical/Probability value,

r = Calculated value.

$$= \frac{(27-6)^2 + (3-6)^2 + (0-6)^2 + (0-6)^2 + (0-6)^2}{6} = 93. \alpha = 0.05, df = 4,$$

P =9.488, r = 93.

The fact that the r-value of 93 is significantly higher than the P-value of 9.488 (r > p) suggests that there was insufficient data to support the assertion. As a result, the variables had a link, the data refuted the null hypothesis, and the findings were statistically significant. There was evidence to suggest that the variables had an effect on one another. Consequently, the null hypothesis was disproved. Table 38 presents the findings about the correlation between students' performance in chemistry and their cultural traditions.

*Table 38:*

*Relationship between Cultural Traditions and Students' Performance in Chemistry (N= 30)*

| Response | No. of Respondents (N) | Frequency (f) | Percentage (%) |
|---|---|---|---|
| Yes | 23 | 23 | 77 |
| No | 07 | 07 | 23 |
| **Total** | 30 | 30 | 100 |

Table 38 reveals that while 23% of respondents disagreed, 77% of those surveyed felt that cultural customs had an impact on students' chemistry ability. Students performed poorly in the sciences as a result, particularly in chemistry. This association was also verified using the Chi-Square test.

**Chi-Square ($x^2$) Test;** $X^2 = \sum \frac{(O - E)^2}{E}$

Where; O = Observed frequency,

E = Expected frequency,

α= Level of significance set,

df = Degrees of freedom,

P = Critical/Probability value,

r = Calculated value.

$$= \frac{(23-15)^2 + (7-15)^2}{15} = 8.533. \quad \alpha = 0.05, df = 1, P = 3.841, r = 8.533.$$

The fact that the r-value of 8.533 is higher than the P-value of 3.841 (r > p) suggests that there was insufficient data to support the assertion. As a result, the variables had a link, the data refuted the null hypothesis, and the findings were statistically significant. Additionally, there was evidence that the variables had an effect on one another. Consequently, the null hypothesis was disproved. Table 39 presents the findings for the primary strategies used to control the connection between students' performance in chemistry and their cultural traditions.

*Table 39:*

*Main Ways of Managing the Relationship between Cultural Traditions and Students' Performance in Chemistry (N= 30)*

| Main Ways of Managing Cultural Traditions | | Frequency (f) | Percentage (%) |
|---|---|---|---|
| i. | Sensitization of students on the relationship between cultural traditions and students' performance in chemistry. | 10 | 33 |
| ii. | Using guidance and counseling in Schools. | 11 | 37 |
| iii. | Use of peer counseling among students in secondary schools. | 09 | 30 |
| **Total** | | 30 | 100 |

Table 39 shows that 37% of the respondents who were interviewed agreed that the main ways to manage the relationship between cultural traditions and students' performance in chemistry in secondary schools were to guide and counsel students on the relationship between cultural traditions and students' performance in chemistry, sensitize students (33%), and use peer counseling among students (30%). When teachers, students, and parents completely accept this, it could result in improved chemistry performance from the learners. This association was found using the Chi-Square test.

**Chi-Square ($x^2$) Test;** $X^2 = \sum \frac{(O - E)^2}{E}$

Where; O = Observed frequency,

E = Expected frequency,

α= Level of significance set,

df = Degrees of freedom,

P = Critical/Probability value,

r = Calculated value.

$$= \frac{(10-10)^2 + (11-10)^2 + (9-10)^2}{10} = 0.2. \quad \alpha = 0.05, df = 2, P = 5.991, r = 0.2.$$

The fact that the r-value of 0.2 is smaller than the P-value of 5.991, or $r < p$, suggests that there is enough data to reject the assertion. As a result, the variables don not relate to one another. The results are not statistically significant, and the data support the null hypothesis. Additionally, there is evidence to suggest that there was no relationship between the variables. The null hypothesis was so accepted.

### 4.6 Relationship between Religion and Students' Performance in Chemistry

The association between religion and students' performance in chemistry was ascertained using the students' overall scores from the SRQ surveys and their results on the Students' Chemistry Performance Test (SCPT). The Simple Linear Regression statistical test was applied. The information gathered about the religious beliefs of the students was further divided into groups based on their religious affiliations, such as African Tradition Religion (ATR), Islam, and Christianity. Table 40 presents the mean ratings for students' religious views.

*Table 40:*

*Students' Religious Beliefs Mean Scores (N = 286)*

| Questions | Religious Beliefs Mean Scores |
|---|---|
| 1. My religion does not prevent my performance in chemistry. | 3.19 |
| 2. Religious beliefs have connection with students' performance in chemistry. | 2.64 |
| 3. Non-religious beliefs have no connection with students' performance in chemistry. | 2.67 |
| 4. Religious worship affect students' performance in chemistry. | 2.09 |
| 5. Non-religious worship do not affect students' performance in chemistry. | 2.72 |
| 6. Religion forms the basic foundation for students' performance in chemistry. | 2.80 |
| 7. Performance in chemistry is not connected to students' religion. | 2.71 |
| 8. Good achievers in chemistry do not perform well in religious studies. | 1.86 |
| 9. Religion is a key tool for better performance in chemistry. | 2.59 |
| 10. Exam questions in chemistry are easier than religious questions. | 2.24 |
| 11. Religion promote students' performance in chemistry. | 2.66 |
| 12. Religion does not promote students' performance in chemistry. | 2.41 |

Based on students' answers to the SRQ questionnaire, Table 40 displays the average scores for each item. Weights ranging from 1 to 5 were assigned to each point on the rating scale based on the degree of agreement that students expressed in their answers to the SRQ questionnaire. Students' mean scores for each question in the SRQ questionnaire were calculated using the Statistical Package for Social Sciences (SPSS) version 23.0 for Windows. With a mean score of 3.19, question one was the most popular among students based on their religious beliefs, while question eight received a mean score of 1.86, making it the least popular question. These findings unmistakably showed that students struggled to connect scientific ideas in chemistry with their religious convictions. Table 41 presents the model summary results for the correlation between students' performance in chemistry and their religious views.

*Table 41:*

*Model Summary for the Relationship between Religion and Students' Performance in Chemistry (N= 286)*

| Model | R | $R^2$ | Adj. $R^2$ | Std. Error Estimate | Change Statistics $R^2$ Change | F Change | df 1 | Change Statistics | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.185[a] | 0.034 | 0 .031 | 13.91646 | 0.034 | 10.017 | 1 | df 2<br>284 | Sig. F. Change<br>0.002 |

a. Predictors: (Constant), Religious Beliefs.

The corrected R2 - Value of 0.031 and P-Value of 0.002 show that religious views account for 3.1% of the variation in students' chemistry performance. This indicated that the variables in the study had a linear connection with one another. Table 42 presents the findings on the coefficients pertaining to the correlation between students' performance in chemistry and their religion.

*Table 42:*

*Coefficients for the Relationship between Religion and Students' Performance in Chemistry (N= 286)*

| Model | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | ß(Beta) | Std. Error. | Beta | T | Sig. |
| 1 (constant) | 36.828 | 4.246 | | 8.673 | 0.000 |
| Religious Beliefs. | -4.629 | 1.463 | -0.185 | -3.165 | 0.002 |

There is no significant correlation at the 0.05 (2-tailed) level.

a. Dependent Variable: Chemistry Performance.

r- Value = 0.031, P = 0.002, P < 0.05.

**Equation for the Model**

Y = 36.828 – 4.629X.

Y = Students' Performance in Chemistry.

X = Students' Religious Beliefs.

The coefficient results for the study's fourth hypothesis, which examines the connection between students' performance in chemistry and religion, are displayed in Table 42. The study's fourth hypothesis looked for a connection between students' performance in chemistry and their religious beliefs. Table 42 results showed that students' religious views caused their chemistry performance to decline by -4.629. At alpha (α) equal to 0.05, the difference was not statistically significant ($r = 0.031$, $N = 286$, $p < 0.05$). This was ascribed to the students' distaste for the sciences and their inability to comprehend the connection between faith and academic achievement, particularly in chemistry. Given that the p-value of 0.002 was less than the significance level at alpha (α) equal to 0.05, it can be concluded that there is insufficient data to support the claim. As a result, the variables have a linear connection, the data refutes the null hypothesis, and the findings are statistically significant. Additionally, there is evidence that there was a relationship between the variables. As a result, the null hypothesis was rejected because it was not accepted. Table 43 presents the results for the mean scores on religious beliefs of Christian students as determined by the SRQ questionnaires.

*Table 43:*

*Christian Students' Religious Beliefs Mean Scores (N = 275)*

| Questions | Religious Beliefs Mean Scores |
|---|---|
| 1. My religion does not prevent my performance in chemistry. | 3.19 |
| 2. Religious beliefs have connection with students' performance in chemistry. | 2.64 |
| 3.Non-religious beliefs have no connection with students' performance in chemistry. | 2.67 |
| 4. Religious worship affect students' performance in chemistry. | 2.09 |
| 5. Non- religious worship do not affect students' performance in chemistry. | 2.70 |
| 6. Religion forms the basic foundation for students' performance in chemistry. | 2.77 |
| 7. Performance in chemistry is not connected to students' religion. | 2.69 |
| 8. Good performers in chemistry do not perform well in religious studies. | 1.85 |
| 9. Religion is a key tool for better performance in chemistry. | 2.55 |
| 10. Exam questions in chemistry are easier than religious questions. | 2.24 |
| 11. Religion promote students' performance in chemistry. | 2.62 |
| 12. Religion does not promote students' performance in chemistry. | 2.40 |

The mean scores for each item as reported by Christian students on the SRQ questionnaire are displayed in Table 43. Weights ranging from 1 to 5 were assigned to each point on the rating scale based on the degree of agreement that students expressed in their answers to the SRQ questionnaire. Students' mean scores for each question in the SRQ questionnaire were calculated using the Statistical Package for Social Sciences (SPSS) version 23.0 for Windows. With a mean score of 3.19, question one was the most popular among students based on their religious beliefs, while question eight received a mean score of 1.85, making it the least popular. These findings make it evident that students' performance in chemistry was impacted by their religious convictions. Table 44 presents the model summary results regarding the correlation between Christian students' chemistry performance and their faith.

*Table 44:*

*Model Summary for the Relationship between Religion and Christian Students' Performance in Chemistry (N= 275)*

| Model | R | $R^2$ | Adj. $R^2$ | Std. Error Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $R^2$ Change | F Change | df 1 | Change Statistics | |
| 1 | 0.186[a] | 0.035 | 0 .031 | 13.77341 | 0.035 | 9.766 | 1 | df 2 | Sig. F. Change |
| | | | | | | | | 273 | 0.002 |

b. Predictors: (Constant), Religious Beliefs.

The corrected R2 - Value of 0.031 and P-Value of 0.002 show that religious views account for 3.1% of the variation in students' chemistry performance. This indicated that the variables in the study had a linear connection with one another. Table 45 presents the findings on the coefficients pertaining to the correlation between Christian students' performance in chemistry and their faith.

*Table 45:*

*Coefficients for the Relationship between Religion and Christian Students' Performance in Chemistry (N= 275)*

| Model | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | ß(Beta) | Std. Error. | Beta | T | Sig. |
| 1 (constant) | 36.724 | 4.340 | | 8.461 | 0.000 |
| Religious Beliefs. | -4.674 | 1.496 | -0.186 | -3.125 | 0.002 |

There is no significant correlation at the 0.05 (2-tailed) level.

b. Dependent Variable: Chemistry Performance.

r- Value = 0.031, P = 0.002, P < 0.05.

**Equation for the Model**

$Y = 36.724 – 4.674X$.

Y = Students' Performance in Chemistry.

X = Students' Religious Beliefs.

The coefficient values for the study's fourth hypothesis, which examines the connection between Christian students' performance in chemistry and their faith, are displayed in Table 45. The study's fourth hypothesis looked for a connection between students' performance in chemistry and their religious beliefs. Table 45 results showed that students' religious beliefs caused their chemistry performance to decline by -4.674. At alpha (α) equal to 0.05, the difference was not statistically significant ($r = 0.031$, $N = 275$, $p < 0.05$). This was ascribed to the students' distaste for the sciences and their inability to comprehend the connection between faith and academic achievement, particularly in chemistry. The fact that the p-value of 0.002 was less than the significance level at alpha (α) equal to 0.05 indicates that there is insufficient data to support the assertion. As a result, the variables have a linear connection, the data refutes the null hypothesis, and the findings are statistically significant. Additionally, there is evidence that there was a relationship between the variables. As a result, the null hypothesis was rejected because it was not accepted. Table 46 presents the mean ratings for the religious beliefs of Muslim students.

*Table 46:*

*Muslim Students' Religious Beliefs Mean Scores (N = 8)*

| **Questions** | **Religious Beliefs Mean Scores** |
|---|---|
| 1. My religion does not prevent my performance in chemistry. | 3.50 |
| 2. Religious beliefs have connection with students' performance in chemistry. | 2.75 |
| 3. Non-religious beliefs have no connection with students' performance in chemistry. | 2.50 |
| 4. Religious worship affect students' performance in chemistry. | 1.50 |
| 5. Non- religious worship do not affect students' performance in chemistry. | 3.25 |
| 6. Religion forms the basic foundation for students' performance in chemistry. | 3.63 |
| 7. Performance in chemistry is not connected to students' religion. | 3.00 |
| 8. Good performers in chemistry do not perform well in religious studies. | 1.75 |
| 9. Religion is a key tool for better performance in chemistry. | 4.25 |
| 10. Exam questions in chemistry are easier than religious questions. | 2.88 |
| 11. Religion promote students' performance in chemistry. | 3.75 |
| 12. Religion does not promote students' performance in chemistry. | 2.50 |

The mean scores for each item as reported by Muslim students on the SRQ questionnaire are displayed in Table 46. The SRQ questionnaire was administered to students, and their answers were scored based on how much they agreed with the attachment of weights ranging from 1 to 5 for each position on the rating scale. Students' mean scores for each question in the SRQ questionnaire were calculated using the Statistical Package for Social Sciences (SPSS) version 23.0 for Windows. With a mean score of 4.25, question nine was the most popular among students based on their religious beliefs, while question four received a mean score of 1.50, making it the least popular question. These findings demonstrate the significant impact of religion on students' chemistry performance. Table 47 presents the model summary results regarding the correlation between Muslim students' chemistry performance and their religion.

*Table 47:*

*Model Summary for the Relationship between Religion and Muslim Students' Performance in Chemistry (N= 8)*

| Model | R | $R^2$ | Adj. $R^2$ | Std. Error Estimate | Change Statistics $R^2$ Change | F Change | df 1 | Change Statistics | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | df 2 | Sig. F. Change |
| 1 | 0.210[a] | 0.039 | 0 .031 | 0.29196 | 0.039 | 0.210 | 1 | 6 | 0.002 |

a. Predictors: (Constant), Religious Beliefs.

The corrected R2 - Value of 0.031 and P-Value of 0.002 show that religious views account for 3.1% of the variation in students' chemistry performance. This indicated that the variables in the study had a linear connection with one another. Table 48 displays the results of the coefficients relating to the performance of Muslim students in chemistry and their religion.

*Table 48:*

*Coefficients for the Relationship between Religion and Muslim Students' Performance in Chemistry (N= 8)*

| Model | Unstandardized Coefficients | | Standardized Coefficients | | |
|---|---|---|---|---|---|
| | ß(Beta) | Std. Error. | Beta | T | Sig. |
| 1 (constant) | 1.068 | 0.123 | | 0.243 | 0.000 |
| Religious Beliefs. | -0.134 | 0.042 | -0.188 | -2.273 | 0.002 |

There is no significant correlation at the 0.05 (2-tailed) level.

a. Dependent Variable: Chemistry Performance.

r- Value = 0.031, P = 0.002, P < 0.05.

**Equation for the Model**

Y = 1.068 – 0.134X.

Y = Students' Performance in Chemistry.

X = Students' Religious Beliefs.

The coefficient values of hypothesis four of the investigation between Muslim students' performance in chemistry and their religion are displayed in Table 48. The study's fourth hypothesis looked for a connection between students' performance in chemistry and their religious beliefs. Table 48 results showed that students' religious views caused their chemistry performance to decline by -0.134. At alpha (α) equal to 0.05, the difference was not statistically significant ($r = 0.031$, $N = 8$, $p < 0.05$). This was ascribed to religious beliefs that did not provide the necessary practical skills for students learning the sciences, which prevented them from understanding scientific concepts, particularly in chemistry. Given that the p-value of 0.002 was less than the significance level at alpha (α) equal to 0.05, it can be concluded that there is insufficient data to support the claim. As a result, the variables have a linear connection, the data refutes the null hypothesis, and the findings are statistically significant. Additionally, there is evidence that there was a relationship between the variables. As a result, the null hypothesis was rejected because it was not accepted. Table 49 presents the results for the mean scores on religious beliefs of ATR students derived from SRQ questionnaires.

*Table 49:*

*ATR Students' Religious Beliefs Mean Scores (N = 3)*

| **Questions** | **Religious Beliefs Mean Scores** |
|---|---|
| 1. My religion does not prevent my performance in chemistry. | 2.33 |
| 2. Religious beliefs have connection with students' performance in chemistry. | 2.33 |
| 3. Non-religious beliefs have no connection with students' performance in chemistry. | 4.00 |
| 4. Religious worship affect students' performance in chemistry. | 3.67 |
| 5. Non- religious worship do not affect students' performance in chemistry. | 3.33 |
| 6. Religion forms the basic foundation for students' performance in chemistry. | 3.33 |
| 7. Performance in chemistry is not connected to students' religion. | 4.33 |
| 8. Good performers in chemistry do not perform well in religious studies. | 3.00 |
| 9. Religion is a key tool for better performance in chemistry. | 2.67 |
| 10. Exam questions in chemistry are easier than religious questions. | 1.33 |
| 11. Religion promote students' performance in chemistry. | 3.00 |
| 12. Religion does not promote students' performance in chemistry. | 2.33 |

The mean scores for each item as reported by ATR students on the SRQ questionnaire are displayed in Table 49. The SRQ questionnaire was administered to students, and their answers were scored based on how much they agreed with the attachment of weights ranging from 1 to 5 for each position on the rating scale. Students' mean scores for each question in the SRQ questionnaire were calculated using the Statistical Package for Social Sciences (SPSS) version 23.0 for Windows. According to the mean scores for religious views, students preferred question seven (4.33), which had the highest mean score, over question ten (1.33), which had the lowest mean score. These findings suggested that students' performance in chemistry was unaffected by their religious beliefs. Table 50 presents the model summary results for the correlation between religion and chemistry performance of ATR students.

*Table 50:*

*Model Summary for the Relationship between Religion and ATR Students' Performance in Chemistry (N= 3)*

| Model | R | $R^2$ | Adj. $R^2$ | Std. Error Estimate | Change Statistics $R^2$ Change | F Change | df 1 | Change Statistics | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.211[a] | 0.039 | 0.031 | 0.04866 | 0.039 | 0.035 | 1 | df 2 | Sig. F. Change |
| | | | | | | | | 1 | 0.002 |

a. Predictors: (Constant), Religious Beliefs.

The corrected R2 - Value of 0.031 and P-Value of 0.002 show that religious views account for 3.1% of the variation in students' chemistry performance. This indicated that there was enough data to draw the conclusion that the variables had a linear relationship. Table 51 presents the findings on the coefficients pertaining to the correlation between religion and the chemistry performance of ATR students.

*Table 51:*

*Coefficients for the Relationship between Religion and ATR Students' Performance in Chemistry (N= 3)*

| Model | Unstandardized Coefficients ß(Beta) | Std. Error. | Standardized Coefficients Beta | T | Sig. |
|---|---|---|---|---|---|
| 1 (constant) | 0.401 | 0.046 | | 0.091 | 0.000 |
| Religious Beliefs. | -0.050 | 0.016 | -0.191 | -0.852 | 0.002 |

There is no significant correlation at the 0.05 (2-tailed) level.

a. Dependent Variable: Chemistry Performance.

r- Value = 0.031, P = 0.002, P < 0.05.

**Equation for the Model**

Y = 0.401 – 0.050X.

Y = Students' Performance in Chemistry.

X = Students' Religious Beliefs.

Table 51 shows the coefficient values for the fourth hypothesis of the study, which looks at the relationship between religion and chemistry performance for ATR students. The fourth hypothesis of the study sought to determine whether students' religious views and their chemical performance were related. According to Table 51 findings, students' performance in chemistry decreased by 0.050 points as a result of their religious beliefs. The difference was not statistically significant at alpha (α) equal to 0.05 ($r = 0.031$, $N = 3$, $p < 0.05$). This was attributed to religious convictions that lacked the application skills necessary for students pursuing science courses and, consequently, did not serve as the essential foundation for understanding chemistry-related material. The claim cannot be supported by the available data, as the p-value of 0.002 is less than the significance level at alpha (α) equal to 0.05. Consequently, the data rejects the null hypothesis, the variables show a linear relationship, and the results are statistically significant. Furthermore, there is proof that the variables had a relationship with one another. Because it was not accepted, the null hypothesis was consequently rejected.

### 4.7 Chapter Summary

This chapter contains the data, analysis, and interpretation of the results in relation to the predefined research objectives. The main overall findings demonstrated a relationship between cultural factors and students' chemistry performance. In every instance, female students were clearly at a disadvantage. Specifically, it was found that the following results were related to the students' performance in chemistry.

**i.** Boys and girls performed differently in chemistry almost all the time, with female students' plainly performing worse. In chemistry, boys did better than girls. Boys tended to be more interested in and affinity with chemistry. Girls' negative attitudes about chemistry may be one of the reasons they do less than boys on the Chemistry National Examinations.

**ii**. The performance of students in chemistry was unrelated to cultural beliefs as a cultural component.

**iii.** Religious beliefs, traditions, and cultural practices were the cultural factors correlated with students' performance in chemistry.

The outcomes of the investigation are discussed in the upcoming chapter (chapter 5).

# CHAPTER FIVE

# DISCUSSION

## 5.1 Introduction

In the sections that followed, the findings for each of the four research hypotheses and the students' Chemistry Performance Test (SCPT) studies were examined.

## 5.2 Results on Students' Chemistry Performance Test (SCPT)

The findings showed both coeducational and boy-only schools underperformed compared to their counterparts. According to the data, coeducational schools accounted for 32%, girl's schools for 24%, and boy's schools for 44%. The sample mean percentage for all boys was 26.70%, for girls it was 17.12%, and for the entire sample as a whole, it was 23.64%. Overall, the performance was not up to par.

The findings of Kigotho (2015), who discovered that most Kenyan students quit scientific classes when given the chance and perform below average even when they do enroll in them, were consistent with the findings of this study. At this point, it is crucial to remember that a student's background is a broad phrase that varies from civilization to society and is composed of a wide range of elements (Ludecke, 2018). For example, views on education varied depending on what the society desired. Parental poverty limited their ability to purchase educational materials and pay for their children's tuition (Meri, 2021).

The outcomes also agreed with those of Nnamani (2016) and Eren (2018), who discovered that a number of factors, including the fact that most students found chemistry to be abstract and boring and that teachers did not utilize effective teaching strategies, had a substantial influence on students' subpar performance in the subject. Apart from issues originating from the society, cultural influences frequently condemned women to marry young before finishing their schooling. Particularly in secondary education, these factors made academic underperformance and school dropout rates worse (Irungu, 2019).

### 5.3 Relationship between Cultural Beliefs and Students' Performance in Chemistry

The findings of Oluwatosin and Ogbeba (2017) that cultural beliefs changed in the local environment and were especially tailored to the needs of the indigenous and their circumstances were supported by the study's results. In addition, it was imaginative and exploratory, continuously fusing internal and exterior advances to produce the most recent circumstances. Generally speaking, it was incorrect to assume that cultural views were unrelated to current social challenges. The correlation study revealed no significant relationship between the two variables at alpha ($\alpha$) = 0.05 ($r = -0.002$, $N = 286$, $P > 0.05$) based on cultural attitudes and chemical performance. This supported the null hypothesis by showing that there was no relationship between students' chemistry performance and cultural beliefs. The findings of this inquiry corroborated those of Essien's (2015) research, which concluded that cultural and ideological factors affect science. Research projects and management strategies that took into account cultural knowledge were given legitimacy and credibility by both domestic and international scientists, which boosted cultural pride and motivated people to employ resources and inventiveness to solve local issues.

In spite of this, Madhusudhana (2016) stated, individuals should examine the production relations and imperial ideology that have continuously defined and shaped academic practices. Furthermore, the exclusion of cultural concepts from educational establishments fostered an environment that was unassailable for the (re)colonization of knowledge and cultures in local contexts and places (Palt, 2018). The study's findings further supported Meri's (2021) argument that science's main goal should be the objective intellectualization of values and facts.

The findings of Judger's (2016) study, which showed that students approach formal science instruction having a diversity of alternative ideas about natural objects, events, and multiple scientific explanations for natural phenomena, were consistent with the findings of this analysis. There were two revolutionary challenges facing education: first, it had to change for its own sake, and second, it was essential to changing other facets of social life (Irungu, 2019). The education transformation challenge affected all aspects of education, even though curriculum and research were the main areas of focus. Kundakovic (2017) defines curriculum as the selection and organization of knowledge about beliefs, and research as the act of generating knowledge about reality.

**5.4 Relationship between Cultural Practices and Students' Performance in Chemistry**

According to the study, there is a strong positive association ($r = 0.115$, $N = 286$, $P < 0.05$) between the variables influencing how well students perform in chemistry and cultural behaviours. This was explained by the fact that students, especially in the area of chemistry, were able to modify their cultural practices and conceptions of scientific phenomena to fit the limits of what is now known about science. As a result, the null hypothesis was shown to be false.

The results aligned with Meri's (2021) observations, which indicated that students' comprehension and capacity to elucidate scientific phenomena were influenced by their perceptions of cultural practices. According to Kasisi (2019), pupils found it difficult to apply scientific knowledge to explain the majority of natural events and problems in African life. This resulted from the mythology and superstitions that pervaded the majority of people's beliefs. Students' everyday experiences in perceiving natural occurrences diverged as a result (Nnamani, 2016).

Most participants agreed that information should be provided so that individuals may choose which cultural customs to maintain and which to abandon (Kasisi, 2019). It should be noted that there was a sizable body of educated Africans who strongly supported the traditional customs. The rite of passage which applied to both boys and girls was the decisive element in the marriage relationship. In the Gikuyu community, for instance, an adult Gikuyu male would never consider being married to a girl who had not undergone circumcision, and vice versa. Gikuyu men and women were not allowed to date anyone who had not engaged in that cultural ritual (Ember, 2017).

The actual argument rested not in the defense of the surgical procedure or its specifics, but rather in the recognition of a crucial fact in the community's tribal psychology: the cultural practice was still seen as the fundamental component of an African institution with significant implications for education, society, morality, and religion, independent of the cultural practice itself (Batyra, 2017b). The findings of Almut (2017) and Okeke (2015), who discovered that low parental income and low educational attainment were major predictors of students' poor academic performance and physical and mental health, were not supported by the results of this study.

### 5.5 Relationship between Cultural Traditions and Students' Performance in Chemistry

The findings of the cultural traditions associated with students' performance in chemistry showed that, among the thirty respondents surveyed, 70%, 63%, and 74% agreed that there was very little correlation between folklore, magic, and customs and students' performance in chemistry. The community's adoption of traditional norms was linked to kids' chemistry performance, primarily because it assisted them in developing moral principles. According to the interview results, the frequent conventional standards associated with students' achievement in chemistry were obedience with 17%, respect with 30%, honesty with 30%, and humility with 23%.

Based on survey responses, 40% and 33% of respondents indicated that respect and honesty were the most common conventional laws associated with students' achievement in chemistry. Chemistry student performance was highly linked with early marriage (90%) and child labor (94%), among other characteristics. The results of the Chi-Square test showed that, as Table 35 illustrates, the r-value of 8.533 was more than the P-value of 3.841 ($r > p$). This proved that the variables were related to each other and that there was sufficient information to make inferences regarding the relationship between cultural practices and students' aptitude for chemistry. As a result, the null hypothesis was shown to be false.

The outcomes corroborated those of Bohacek (2017), who identified several significant subgroups that had an impact on science education. Some of the smaller groupings or units were the family, friends, school, media, and the physical, social, and economic surroundings. The findings supported the theory put forth by Eren (2018) that science was a subculture of Western, or Euro-American, culture. Because of this, "Western science" could also be called "subculture science," with its traditions influencing how well students succeed in chemistry. The research findings of this study on cultural traditions unrelated to students' performance in chemistry included traditional rituals, conventions, taboos, moranism, and the main tactics for managing the relationship between cultural traditions and students' performance in chemistry.

The outcomes corroborated those of Tharani (2020), who discovered that the success of traditional cultures in schools was determined by societal needs. The bulk of the community's medical experts learned about the effects of medicinal plants on human health from their elders (Freathy, 2019). They had a deep-seated worry for the curing procedures, which caused them to keep the treatment method secret. The most effective strategies, according to research findings from this study on the main tactics employed in secondary schools to manage the relationship between students' performance in chemistry and cultural traditions, were guidance and counseling (37% of respondents), students' sensitization (33%), and peer counseling (30%).

People's powers were withdrawn and persecution occurred throughout the cosmos as a result of assimilation (Bohacek, 2017). The majority of students persisted and actively opposed being assimilated, despite the fact that the traditional job of school science was typically to introduce or integrate kids into the new culture of science (Ruschenpohler, 2019). Because they were playing a specific type of school game, some students were able to complete their scientific course without learning the subject that the teacher and society expected them to learn. The game might have made clear the regulations, which Wan (2017) discovered to be called "Fatima's Rules," after a perceptive high school chemistry student. When he mentioned some of the cultural expectations of science education, Wichham (2017) acknowledged the phenomena, saying that "most learning was tied to the ability of students to answer questions which were not related to any content taught in school." Fatima's Rules provided guidance on how to learn without explicitly taking the subject's substance into account (Simpson, 2016).

Three approaches to "understanding" science have emerged from modern science education: Fatima's Rules, assimilation, and enculturation. New approaches, such as autonomous acculturation and "anthropological" learning, emerged as a result of extending cultural analysis of scientific education to encompass cross-cultural learning (Inchley, 2016). The two primary examples were Henry's (2017) use of traditional Ugandan iron smelting techniques as the basis for secondary school chemistry education and Dudovitz's (2017) case study of a Trinidadian woman who blended her traditional medicine with outside medical expertise. A change in the educational process was shown by Dahl's (2016) case study of a First Nations (Native American) boy studying the shore. In an effort to avoid any negative connotations related to adapting into a foreign culture, the phrase "autonomous acculturation" was used.

The first acculturation served many purposes than only displaying the intended knowledge. According to Broman (2015), learners could become familiar with the scientific subculture without having to alter any aspects of their traditional culture. To put it another way, some social or traditional practices were prioritized over the conceptual shift associated with the primary acculturation (Batyra, 2017). Comparatively speaking, cultural anthropologists rejected the customs that their "subjects" were expected to learn and apply to their daily lives (Eren, 2018). In contrast to anthropologists, another type of instruction known as "anthropological" science learning (Markic, 2016) kept students engaged. "Anthropological" education was associated with students who did not absorb or acculturate the cultural conceptions of science, but who found enjoyment in the ability to understand new ideas from the "foreign" subculture of science. However, they managed to compromise on the differences between their everyday lives and the scientific subculture.

### 5.6 Relationship between Religion and Students' Performance in Chemistry

The factors between students' chemistry performance and religion had a significant positive linear association at alpha (α) equal to 0.05 ($r = 0.031, N = 286, P < 0.05$), according to the data. The reasons given for this were the students' lack of enthusiasm in the sciences, their religious convictions' deficiency in useful concepts for science education, and their incapacity to see the link between religion and academic success in the sciences especially chemistry. As a result, the null hypothesis was shown to be false. Three categories were formed based on the data of the relationship between students' religious affiliations and their performance in chemistry: African Tradition Religion (ATR), Muslims, and Christians.

#### i. Religion and Christian Students' Performance in Chemistry

A substantial positive linear linkage at alpha (α) equal to 0.05 was discovered to exist between the religion and chemical skills of Christian students ($r = 0.031, N = 275, P < 0.05$). This was attributed to the students' contempt for the sciences and their failure to understand the relationship between religion and academic success, especially in the area of chemistry. As a result, the null hypothesis was shown to be false.

#### ii. Religion and Muslim Students' Performance in Chemistry

According to the results, there was a positive connection at alpha (α) = 0.05 ($r = 0.031, N = 8, P < 0.05$) between the chemistry proficiency of Muslim students and their faith. This suggested that there was a linear relationship between the chemistry and religion scores of the pupils. This was related to the fact that religious beliefs did not offer the more hands-on activities that are ideal for the study of sciences, making them an inadequate basis for the explanation of specific scientific concepts in chemistry. As a result, the null hypothesis was shown to be false.

### iii. Religion and ATR Students' Performance in Chemistry

The results demonstrated a positive correlation between religion and ATR students' chemistry ability, at alpha (α) equal to 0.05 ($r = 0.031$, $N = 3$, $P < 0.05$). This suggested that there was a linear relationship between the chemistry and religion scores of the pupils. This was clarified by the claim that religion did not contribute to the advancement of scientific knowledge because it lacked the pragmatic ideas required to comprehend the sciences. As a result, the null hypothesis was shown to be false.

The findings of this study concurred with Chan's (2020) observation that everyone is the beneficiary of God's free gifts. Thus, in a passive way, God's glory fell upon those who received it in their lives. The outcomes also agreed with Ruschenpohler (2019) findings, which indicated that a person's religious beliefs greatly and significantly influence the decisions they make in life. Harris (2021) recognized that the integration of faith-based learning was seen as the duty of educators and educational institutions, who saw teachers as active Christian skill providers and students as passive learners. This was in reference to the teaching approach used by lecturers or professors.

In a similar vein, Richard (2018) proposed a tentative approach to connect academic competencies with Christian principles. The approach discouraged indoctrination while promoting pupils' logical independence and critical thinking. Three educational processes were included in the initial model that was proposed: Three main areas were recognized by the students: 1) conflict: they recognized the difficulties separating Christian faith from scientific ideas; 2) creativity: they disproved stereotypes and made faith and abilities seem hard; and 3) commitment: they combined social beliefs with their own creative solutions to overcome obstacles.

When connecting the discipline's topic knowledge with Christian beliefs, the two methods previously discussed were designed to address the issues faced by both the teacher who serves as the knowledge provider and the students, who are less engaged learners. According to Oladejo (2021), being a lover rather than a thinker is what makes a human being fundamentally unique. This comprehension of the fundamental nature of humanity proposed that education be viewed as a formation in which the aspirations and hearts of both teachers and pupils were directed toward the contours of human development. Aiming to recruit not only the head but also the intellect, heart, and every other element of the human body, the entire process required the faculty to develop teaching and learning techniques that were faithfully consistent with the shape of Christian activities.

The study's findings from the three student groups according to their religious affiliations disagreed with those of Eskola (2020), who contended that Jewish persecution may have compelled the wisdom teachers to embrace a new eschatological dualism that maintained that faith was ultimately determined by abiding by the law and covenantal selection. Therefore, although predestination was crucial to comprehending science, it was not fate.

**5.7 Chapter Summary**

The focus of this chapter was on the presentation, analysis, and interpretation of research findings. The primary focus of the analysis was the study's objectives and independent variables, which included establishing a relationship between cultural beliefs and secondary school students' chemistry performance and investigating potential associations between cultural practices, traditions, and religion and students' chemistry performance. The summary, conclusions, consequences, suggestions, and opportunities for additional research are all included in the following chapter (chapter 6).

# CHAPTER SIX

# SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

## 6.1 Introduction

An overview of the study's findings, suggestions based on the conclusions, and deductions drawn from the data are given in this chapter. A consideration of the ramifications and suggestions for possible research subjects are also included.

## 6.2 Summary of Research Findings

To fulfill the goals of the study, the results were condensed. The following conclusions from the study were summed up in accordance with the goals of the investigation.

The first objective of this study was to determine the relationship between students' performance in chemistry in secondary schools in Samburu County and cultural beliefs. The students' cultural beliefs and their chemistry performance did not show any statistically significant correlation. This showed that the relationship between students' performance in chemistry and their cultural beliefs was not statistically significant. This was explained by the fact that students accepted the null hypothesis because they were unable to see how cultural beliefs related to chemistry performance.

The study's second objective was to determine how cultural behaviors and students' chemistry performance relate to one another. The variables had a substantial linear association, according to the results. This was explained by the pupils' ability to relate their cultural practices to the modern sciences, particularly chemistry. Consequently, the null hypothesis was disproved.

Determining the relationship between students' chemistry performance and their cultural practices was the third objective of the study. The study's findings demonstrated a connection between cultural traditions and students' chemistry ability. The main reasons were that cultural practices encouraged students' development of scientific knowledge and critical thinking skills, which are essential for studying the sciences, according to the interview data. As a result, the null hypothesis was rejected.

The fourth objective of the study was to determine whether or not students' religious beliefs affected their performance in chemistry. The results of the analysis showed that the variables had a statistically significant linear connection. This was ascribed to the students' curiosity for the sciences and their ability to comprehend the connections between the various elements. Thus, it was demonstrated that the null hypothesis was untrue hence being rejected.

### 6.3 Conclusions

Based on the study's findings, the following conclusions were made:

**i.** There was no statistically significant link found between students' performance in chemistry and their cultural beliefs. This indicated that there was no discernible linear association between students' performance in chemistry and cultural views.

**ii.** There was a statistically significant link found between cultural practices and students' chemistry performance. This indicated that there was a substantial linear association between cultural practices and students' chemistry performance.

**iii.** There was a statistically significant link found between students' performance in chemistry and cultural practices. This indicated that there was a substantial correlation between students' performance in chemistry and cultural practices.

**iv.** There was a statistically significant link found between students' performance in chemistry and their religious beliefs. This indicated that there was a substantial linear link between students' performance in chemistry and religion.

### 6.4 Implications of the Study

The results of this investigation could be used to draw a variety of conclusions. The findings suggested that:

**i).** There was no correlation between students' chemistry performance and cultural beliefs. The findings lacked statistical significance, and there was no correlation between the factors. As a result, cultural beliefs had no effect on students' chemistry performance.

**ii).** There was a positive correlation between cultural behaviors and students' chemistry performance. The findings demonstrated a statistically significant relationship between the factors. This resulted from students' ability to relate scientific findings to their cultural practices through modern science interpretation. As a result, there were negative effects on pupils' performance in chemistry, which led to subpar learning outcomes.

**iii).** There was a correlation between students' chemistry performance and cultural practices. The findings demonstrated a statistically significant relationship between the factors. This was due to the fact that it supported students' critical thinking and scientific skill development, both of which are essential for comprehending chemical ideas.

**iv).** There was a positive correlation between students' performance in chemistry and their religion. The findings demonstrated a statistically significant relationship between the factors. This resulted in low performance on chemistry exams since religion lacked the scientific abilities that pupils needed to comprehend chemical subjects.

### 6.5 Recommendations

Based on the study's findings, the following suggestions were made:

**(i).** Given that the study's findings showed no correlation between cultural beliefs and students' performance in chemistry, what steps should be taken to stop gender and performance gaps in chemistry from developing early in the formal educational process? It has been demonstrated that cultural views about chemical performance appear to "increase" during schooling. Accordingly, early action is required to decrease cultural ideas that are known to cause gender disparities in chemistry performance. It would be ideal to incorporate techniques that lessen the detrimental impact of cultural beliefs on students' performance in chemistry into the curriculum as well as the pre- and service training.

**(ii)**. However, educators should take note of the fact that it would seem reasonable to suggest that parents, teachers, and students be informed about the fact that, despite the fact that both genders seemed to have gender-typical attitudes toward chemistry, there was insufficient data to support the presumption that males and girls could not excel in the sciences at the same levels. To elaborate, it would be foolish to implement distinct instructional strategies for males and girls in the classroom in an attempt to lessen the impact of cultural norms on students' chemistry performance.

**(iii).** When creating the chemistry exam questions, the Kenya National Examinations Council (KNEC) and other testing organizations ought to consider the fact that the nation's cultural customs vary widely.

**(iv).** The Kenya Institute of Curriculum Development (KICD), authors of chemistry textbooks, and chemistry instructors should create chemistry textbooks free of any religious prejudice or typical behavior.

### 6.6 Areas for Further Research

The study's conclusions suggested that a few cultural variables may have an impact on how well pupils performed in chemistry. Consequently, encouraging pupils' comprehension of chemical principles. There were, nevertheless, certain points that called for more research. Among them were the following:

**(a).** It is important to research the relationship between teachers' cultural understanding of science and their pupils' performance in chemistry.

**(b).** The study focused on the connection between students' performance in chemistry and cultural variables. In order to ascertain whether these criteria were associated with students' performance and the overall quality of education, a study of this kind ought to be conducted at middle-level colleges and universities.

**(c).** Cultural aspects should be investigated in secondary school to ascertain how they affect students' performance in other science classes including Physics, Biology, and Agriculture.

**(d).** The impacts discovered may mostly represent the circumstances in the county, as the sample respondents were chosen from a limited number of public and private secondary schools in Samburu County, in the Rift Valley region. Therefore, it's possible that the results don't apply to all secondary schools in Kenya. Therefore, in order to provide a more accurate and comprehensive overall image of the entire country, this study needs to be repeated in other parts of Kenya. This will make it easier to make decisions about how cultural variables relate to students' chemistry performance.

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# APPENDICES

## APPENDIX 1:

## Students' Chemistry Performance Test (SCPT)

**BACKGROUND INFORMATION**

**Date:__________________________________________________________________**

**Time: 30 Mins.**

**Serial No_______________________________________________________________**

Gender:_______________________________________________Male (   ) Female (   )

Religion_____________________ Christian (  ), Muslim (   ), Hindu (   ), Others (   )

Class/Form:_____________________________________________________________

Name of the School:____________________________________________________

School Category______________________ Girls (  ), Boys (   ), Co- educational (   )

Sub-County: _________________________________Samburu North (   ), Central (   )

**INSTRUCTIONS**

The following questions aim to ascertain how well Form Three pupils performed in the following areas of chemistry: the Mole concept, Organic chemistry I, and Nitrogen and its compounds.

There are **thirty marks** in all for this question paper.

Kindly complete all the questions in the designated spaces.

Before composing your response, carefully review the question to make sure you understand it.

1. In order to determine whether an unknown material is an acid, what colors are seen on both blue and red litmus paper? (2mks)

2. Identify the brown material that results from the reaction of iron sheets or nails with water or moisture in the presence of air. (1 mk)

3. Compose the chemical formula for the creation of the brown material mentioned in the previous question. (2mks)

4. State one local use of the Red-ore in your community and write its chemical formula. (2mks)

5. Stinging Nettle is a common weed in our farms and grazing fields. Name one local use of the weed to your community and write the chemical formula of the ion/s with high percentage in its contents. (2mks)

6. Explain why sodium hydrogen carbonate ($NaHCO_{3\,(aq)}$) solution is usually applied to the part of the body stung by the bee or wasp? (1mk)

7. Classify bones, feathers, hooves and hair as both organic and inorganic substances and give a reason for your answer. (2mks)

8. Blood, milk and meat contains proteins. What are the main chemical elements contained in proteins only but not in lipids and carbohydrates? (1mk)

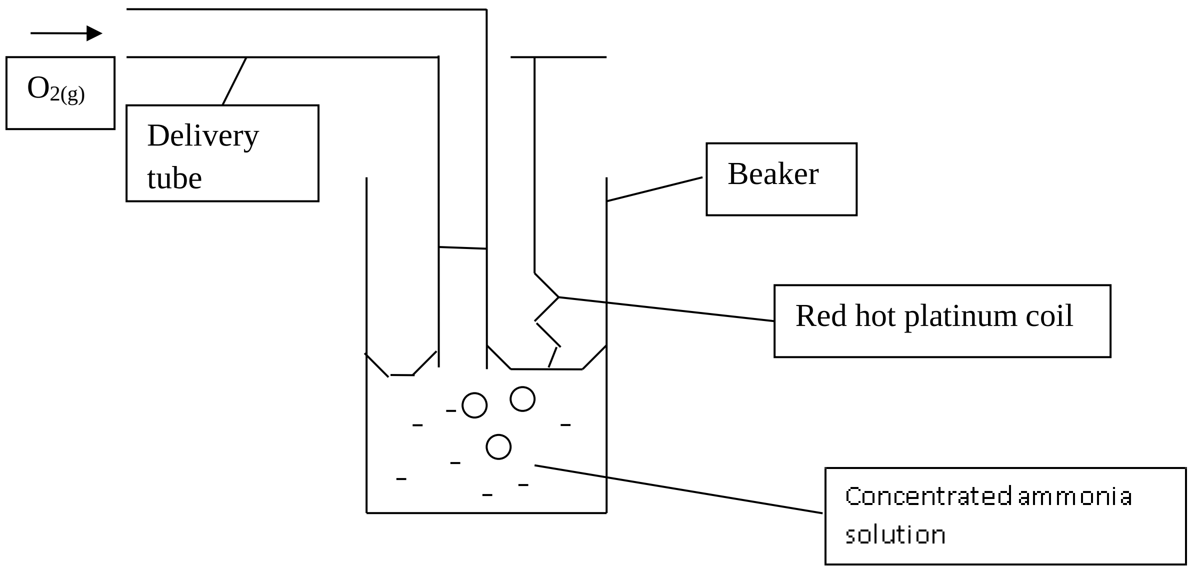
9. Fermented mixture of maize flour and millet or sorghum forms an alcohol and carbon (IV) oxide gas as the main products. Name the alcohol formed and write its molecular formula. (2mks)

10. Locally, smoke has been used for preserving food. What are the active chemical ingredients of smoke used for this process? (1mk)

11. Citrus fruit juices have a sour taste. Name the chemical compound making the citrus fruit juices have a sour taste. (1mk)

12. Honey has a sweet taste due to having simple sugars. Name one simple sugar commonly found in honey, sugarcane juice and write down its molecular formula. (2mks)

13. Examine **figure 1** below and utilize it to provide an answer to the following query.




Describe the findings from the platinum wire that was heated. (2mks)

14. Locals plaster the walls and floors of traditional huts using a mixture of earth and fresh cow dung. Justify the inclusion of fresh cow dung in the combination. (2mks).

15. Identify the class of chemical compounds found in cow dung or manure that give the appearance of healthy, dark green plant leaves. (1 mk).

16. Record the chemical formula of the gaseous urine component that allows dogs to mark their territory. (1 mk).

17. List the two uses for the gas that is most prevalent in the air. (3mks).

18. Give a brief explanation of how soot is formed from wood. (2mks).

**END**

**I Appreciate Your Cooperation**.

## APPENDIX II:

### Students' Cultural Beliefs and Practices Questionnaire (SCBPQ)

**Date:____________________________________________**

**Time: 40 Mins.**

**Serial No:________________________________________**

**INSTRUCTIONS**

The purpose of the following questions is to determine whether cultural beliefs and practices have an impact on Samburu County students' chemistry performance. After being chosen for information submission, you are required to check (√) the boxes next to five (5), four (4), three (3), two (2), or one (1) to indicate how much you agree, on a scale of 1 to 5. The questionnaire is divided into two main sections, each with twelve closed-ended questions. If there is any doubt about a question, it is recommended that you approach the researcher to clarify it. The information you have given is confidential and will only be used for the purposes of this study. These are the questions with a rating scale that are used.

**BACKGROUND INFORMATION**

Age: ____________________________________________________________Years

Gender________________________________________________Female ( ), Male ( )

Religion:_________________________Christian ( ), Muslim ( ), Hindu ( ), Others ( )

Class/Form:____________________________________________________________

Name of the School:_____________________________________________________

School Category:___________________________Girls ( ), Boys ( ), Co-educational ( )

Sub-County:_____________________________________Samburu North ( ), Central ( )

**PART ONE**

**Cultural Beliefs**

Regarding how each of the following cultural ideas relates to your chemical performance, how much do you agree with them?

| | RATING SCALE: | | | | |
|---|---|---|---|---|---|
| | **(5)** | **(4)** | **(3)** | **(2)** | **(1)** |
| 1. When someone travels and a black Cat cross in front is an indication of a bad luck. | ( ) | ( ) | ( ) | ( ) | ( ) |

| | | | | | |
|---|---|---|---|---|---|
| 2. An Owl making noise near a homestead very early in the morning or late in the evening is an indication that one of the family member will die. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 3. Someone giving birth to a mutant is an indication of a curse from the family or very close relative. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 4. Rainbow means rain will not fall. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 5. Rain falls and Sun shines, means the Hyena is giving birth. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 6. Brightness of the moon is an indication that rain will not fall. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 7. Using a hand to collect rain water can cause thunderstorm to strike. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 8. Wearing a red colour material when raining can cause thunderstorm to strike. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 9. Standing at the doorpost when raining can cause thunderstorm to strike. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 10. The presence of whirlwind is an indication of evil spirit. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 11. Heavy and Stormy rain that causes damages is an indication of the wrath of God to man. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 12. When Lake/river flows over the bank is an indication that the goddess of the lake/river is angry. | ( ) | ( ) | ( ) | ( ) | ( ) |

## PART TWO

## Cultural Practices

To what extent do the following cultural behaviors impact your chemistry performance?

**RATING SCALE:**

| | (5) | (4) | (3) | (2) | (1) |
|---|---|---|---|---|---|
| 13. Traditional initiations. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 14. Traditional ceremonies. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 15. Myth and Rituals. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 16. Mourning rituals during and after the burial of a deceased member of the family. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 17. Child birth rituals. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 18. Practices of food preservation using honey. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 19. Shaving of hair from the heads when a family member dies. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 20. Cultural uses of Salts. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 21. Cultural uses of Smoke. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 22. Libations. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 23. The Tattooing processes. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 24. Burning of sacrifices. | ( ) | ( ) | ( ) | ( ) | ( ) |

**END**

**I Appreciate Your Cooperation.**

## APPENDIX III:

### Students' Religion Questionnaire (SRQ)

**Date:**________________________________________

**Time: 20 Mins.**

**Serial No:**____________________________________

**INSTRUCTIONS**

The purpose of the following questions is to determine whether students' religious views and their chemistry performance are related in Samburu County. After being chosen for information submission, you are required to check (√) the boxes next to five (5), four (4), three (3), two (2), or one (1) to indicate how much you agree, on a scale of 1 to 5. The questionnaire's main body consists of twelve closed-ended questions. If there is any doubt about a question, it is recommended that you approach the researcher to clarify it. The information you have given is confidential and will only be used for the purposes of this study. These are the questions with a rating scale that are used.

**BACKGROUND INFORMATION**

Age: __________________________________________________________Years

Gender:_____________________________________________Female ( ), Male ( )

Religion:_______________________Christian ( ), Muslim ( ), Hindu ( ), Others ( )

Class/Form:__________________________________________________________

Name of the School:__________________________________________________

School Category:_________________________Girls ( ), Boys ( ), Co-educational ( )

Sub-County:__________________________________Samburu North ( ), Central ( )

**PART ONE**

**Students' Religion**

How much do you agree with each of the following religious observances in connection to how well you performed in chemistry?

**RATING SCALE:**

| | **(5)** | **(4)** | **(3)** | **(2)** | **(1)** |
|---|---|---|---|---|---|
| 1. My religion does not prevent my performance in | ( ) | ( ) | ( ) | ( ) | ( ) |

| | | | | | |
|---|---|---|---|---|---|
| chemistry. | | | | | |
| 2. Religious beliefs have connection with students' performance in chemistry. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 3. Non-religious beliefs have no connection with students' performance in chemistry. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 4. Religious Worship affect students' performance in chemistry. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 5. Non-religious Worship do not affect students' performance in chemistry. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 6. Religion forms the basic foundation for students' performance in chemistry. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 7. Performance in chemistry is not connected to students' religion. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 8. Good performers in chemistry do not perform well in religious studies. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 9. Religion is a key tool for best performance in chemistry. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 10. Exam questions in chemistry are easier than religious questions. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 11. Religion promote students' performance in chemistry. | ( ) | ( ) | ( ) | ( ) | ( ) |
| 12. Religion does not promote students' performance in chemistry. | ( ) | ( ) | ( ) | ( ) | ( ) |

**END**

**Thank You for Your Cooperation**

## APPENDIX IV:

### Students' Cultural Traditions Interview Schedule (SCTIS)

**Date of the Interview**:________________________________________

**Time: START:________________________END_________________**

**Serial No:____________________________________________________**

**INTRODUCTION**

Greetings, I am ____________________________________

The purpose of the following questions is to see whether Samburu County students' chemistry scores are correlated with their cultural practices. You have been chosen to provide information about the issue, so please answer all of the questions truthfully. I want to reassure you that your answers will remain confidential, be utilized just for this study, and be unrelated to you in the future. You are one among the many students in the County whom I will be interviewing. You speak for other students, thus your comments are significant.

**BACKGROUND INFORMATION**

Age:_____________________________________________________________________Years

Gender:_____________________________________________________Female ( ), Male ( )

Religion:______________________________Christian ( ), Muslim ( ), Hindu ( ), Others ( )

Class/Form:_____________________________________________________________________

Name of the School:_____________________________________________________________

School Category:_______________________________Girls ( ), Boys ( ), Co-educational ( )

Sub-County:________________________________________Samburu North ( ), Central ( )

### Students' Cultural Traditions

1. Do cultural customs affect how well you succeed in chemistry? a). Yes, b). No.

2. Provide a suitable justification for the response you provided in point 1 above.

   i. ………………………………………………………………………………
   ii. ………………………………………………………………………………
   iii. ………………………………………………………………………………
   iv. ………………………………………………………………………………

3. To what extent do the following cultural customs impact your chemistry performance?

| | Very much; | Much; | Some; | Little; | Very little. |
|---|---|---|---|---|---|
| a). Folklore, | | | | | |
| b). Magic, | | | | | |
| c). Customs. | | | | | |

4. i). Do you practice **Traditional Norms**?

a). Yes, b). No.

ii). Give appropriate reason(s) for the answer you have given in 4; (i), above.

i. ------------------------------------------------------------------------------------

ii. ------------------------------------------------------------------------------------

iii. ------------------------------------------------------------------------------------

iv. ------------------------------------------------------------------------------------

iii). What are some of those common **Traditional Norms** which are related to your performance in chemistry?

i. ------------------------------------------------------------------------------------

ii. ------------------------------------------------------------------------------------

iii. ------------------------------------------------------------------------------------

iv. ------------------------------------------------------------------------------------

5. i. Do your belief in your community **Cultural Traditions**?

a). Yes, b). No.

ii). What are some of those **Cultural Traditions** which are related to your performance in chemistry?

6. Do **Traditional Taboos** relate to your performance in chemistry?
   a). Yes, b). No.

7. Give appropriate reason(s) for the answer you have given in 6 above.
   i. ------------------------------------------------------------------------------------
   ii. ------------------------------------------------------------------------------------
   iii. ------------------------------------------------------------------------------------
   iv. ------------------------------------------------------------------------------------

8. i). Does **Moranism** relate to your performance in chemistry?
   a). Yes, b). No.

   ii). Give appropriate reason(s) for the answer you have given in 8; (i), above.
   i. ----------------------------------------------------------------------------------
   ii. ---------------------------------------------------------------------------------
   iii. ---------------------------------------------------------------------------------
   iv. ---------------------------------------------------------------------------------

9. Which are the most well accepted **Traditional laws** apply to your performance in chemistry?

10. i) How does your performance in chemistry relate to **culturally accepted gender roles?**

a). Yes, b). No.

ii). Give appropriate reason(s) for the answer you have given in 10; (i), above.
   i. ----------------------------------------------------------------------------------
   ii. ----------------------------------------------------------------------------------
   iii. ----------------------------------------------------------------------------------
   iv. ----------------------------------------------------------------------------------

11. In our societies, **child labour and early marriage** are customary behaviours. To what extent does each practice apply to your chemistry performance?

| | Very much; Much; Some; Little; Very little. |
|---|---|
| (i). Child labour, | |
| (ii).Early-Marriage. | |

12. i). How do your chemistry performance and **cultural traditions** relate to each other?

a). Yes, b). No.

ii). What are some of the **most effective strategies** that secondary schools can employ to control the connection between students' performance in chemistry and their cultural traditions?

**END**

**Thank You for Your Cooperation**

## APPENDIX V:

### Sample Size Determination

The sample size (n) was calculated using the Kothari (2004) method of calculating sample size from a finite or given population.

$$n = \frac{Z^2PqN}{(N-1)\ e^2+Z^2Pq}$$

Where: -

n = Required Sample Size,

Z = Value of Standard Variate =1.96@ 95% Cl,

N = The given Population Size (N = 1,238),

e = Acceptable Error and Degree of Accuracy (= 0.05),

P = Proportionate target population with particular characteristics (P = 0.141),

q = 1- P = 0.859.

Therefore: -

$$n = \frac{1.96^2 \text{ X } 0.141\text{X } 0.859\text{X } 1,238}{(1,237)\ 0.05^2 + (1.96^2\text{X } 0.141\text{X } 0.859)} = 161.806.$$

A convenient approximation of 162 students and 10% of the 1,238 students who were allowed for attrition were chosen, for a total of **286** students, given that the study's lowest sample size was n = 161.806.

## APPENDIX VI:

## Chi-Square Critical/Probability (P) Values

| df | 0.995 | 0.99 | 0.975 | 0.95 | 0.90 | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | --- | --- | 0.001 | 0.004 | 0.016 | 2.706 | 3.841 | 5.024 | 6.635 | 7.879 |
| 2 | 0.010 | 0.020 | 0.051 | 0.103 | 0.211 | 4.605 | 5.991 | 7.378 | 9.210 | 10.597 |
| 3 | 0.072 | 0.115 | 0.216 | 0.352 | 0.584 | 6.251 | 7.815 | 9.348 | 11.345 | 12.838 |
| 4 | 0.207 | 0.297 | 0.484 | 0.711 | 1.064 | 7.779 | 9.488 | 11.143 | 13.277 | 14.860 |
| 5 | 0.412 | 0.554 | 0.831 | 1.145 | 1.610 | 9.236 | 11.070 | 12.833 | 15.086 | 16.750 |
| 6 | 0.676 | 0.872 | 1.237 | 1.635 | 2.204 | 10.645 | 12.592 | 14.449 | 16.812 | 18.548 |
| 7 | 0.989 | 1.239 | 1.690 | 2.167 | 2.833 | 12.017 | 14.067 | 16.013 | 18.475 | 20.278 |
| 8 | 1.344 | 1.646 | 2.180 | 2.733 | 3.490 | 13.362 | 15.507 | 17.535 | 20.090 | 21.955 |
| 9 | 1.735 | 2.088 | 2.700 | 3.325 | 4.168 | 14.684 | 16.919 | 19.023 | 21.666 | 23.589 |
| 10 | 2.156 | 2.558 | 3.247 | 3.940 | 4.865 | 15.987 | 18.307 | 20.483 | 23.209 | 25.188 |
| 11 | 2.603 | 3.053 | 3.816 | 4.575 | 5.578 | 17.275 | 19.675 | 21.920 | 24.725 | 26.757 |
| 12 | 3.074 | 3.571 | 4.404 | 5.226 | 6.304 | 18.549 | 21.026 | 23.337 | 26.217 | 28.300 |
| 13 | 3.565 | 4.107 | 5.009 | 5.892 | 7.042 | 19.812 | 22.362 | 24.736 | 27.688 | 29.819 |
| 14 | 4.075 | 4.660 | 5.629 | 6.571 | 7.790 | 21.064 | 23.685 | 26.119 | 29.141 | 31.319 |
| 15 | 4.601 | 5.229 | 6.262 | 7.261 | 8.547 | 22.307 | 24.996 | 27.488 | 30.578 | 32.801 |
| 16 | 5.142 | 5.812 | 6.908 | 7.962 | 9.312 | 23.542 | 26.296 | 28.845 | 32.000 | 34.267 |
| 17 | 5.697 | 6.408 | 7.564 | 8.672 | 10.085 | 24.769 | 27.587 | 30.191 | 33.409 | 35.718 |
| 18 | 6.265 | 7.015 | 8.231 | 9.390 | 10.865 | 25.989 | 28.869 | 31.526 | 34.805 | 37.156 |
| 19 | 6.844 | 7.633 | 8.907 | 10.117 | 11.651 | 27.204 | 30.144 | 32.852 | 36.191 | 38.582 |
| 20 | 7.434 | 8.260 | 9.591 | 10.851 | 12.443 | 28.412 | 31.410 | 34.170 | 37.566 | 39.997 |
| 21 | 8.034 | 8.897 | 10.283 | 11.591 | 13.240 | 29.615 | 32.671 | 35.479 | 38.932 | 41.401 |
| 22 | 8.643 | 9.542 | 10.982 | 12.338 | 14.041 | 30.813 | 33.924 | 36.781 | 40.289 | 42.796 |
| 23 | 9.260 | 10.196 | 11.689 | 13.091 | 14.848 | 32.007 | 35.172 | 38.076 | 41.638 | 44.181 |
| 24 | 9.886 | 10.856 | 12.401 | 13.848 | 15.659 | 33.196 | 36.415 | 39.364 | 42.980 | 45.559 |
| 25 | 10.520 | 11.524 | 13.120 | 14.611 | 16.473 | 34.382 | 37.652 | 40.646 | 44.314 | 46.928 |
| 26 | 11.160 | 12.198 | 13.844 | 15.379 | 17.292 | 35.563 | 38.885 | 41.923 | 45.642 | 48.290 |
| 27 | 11.808 | 12.879 | 14.573 | 16.151 | 18.114 | 36.741 | 40.113 | 43.195 | 46.963 | 49.645 |
| 28 | 12.461 | 13.565 | 15.308 | 16.928 | 18.939 | 37.916 | 41.337 | 44.461 | 48.278 | 50.993 |
| 29 | 13.121 | 14.256 | 16.047 | 17.708 | 19.768 | 39.087 | 42.557 | 45.722 | 49.588 | 52.336 |
| 30 | 13.787 | 14.953 | 16.791 | 18.493 | 20.599 | 40.256 | 43.773 | 46.979 | 50.892 | 53.672 |
| 40 | 20.707 | 22.164 | 24.433 | 26.509 | 29.051 | 51.805 | 55.758 | 59.342 | 63.691 | 66.766 |
| 50 | 27.991 | 29.707 | 32.357 | 34.764 | 37.689 | 63.167 | 67.505 | 71.420 | 76.154 | 79.490 |
| 60 | 35.534 | 37.485 | 40.482 | 43.188 | 46.459 | 74.397 | 79.082 | 83.298 | 88.379 | 91.952 |
| 70 | 43.275 | 45.442 | 48.758 | 51.739 | 55.329 | 85.527 | 90.531 | 95.023 | 100.425 | 104.215 |
| 80 | 51.172 | 53.540 | 57.153 | 60.391 | 64.278 | 96.578 | 101.879 | 106.629 | 112.329 | 116.321 |
| 90 | 59.196 | 61.754 | 65.647 | 69.126 | 73.291 | 107.565 | 113.145 | 118.136 | 124.116 | 128.299 |
| 100 | 67.328 | 70.065 | 74.222 | 77.929 | 82.358 | 118.498 | 124.342 | 129.561 | 135.807 | 140.169 |

## APPENDIX VII:

## Form Three Students Sampled per School and Gender

| School | F.3. Students Enrolment | | | |
|---|---|---|---|---|
| | **Girls** | **No. Sampled** | **Boys** | **No. Sampled** |
| a. Baragoi Girls | 85 | 33 | ------------ | --------------- |
| b. AIC Moi Girls | 100 | 38 | ------------- | --------------- |
| c. Samburu Mixed | 39 | 14 | 49 | 19 |
| d. Good Shepherd Boys | ---------- | -------------- | 70 | 27 |
| e. Nyiro Boys | ------------ | ----------------- | 122 | 47 |
| f. Bishop Perlo Girls | 33 | 13 | -------------- | ---------------- |
| g. Maralal Mixed | 15 | 06 | 54 | 21 |
| h. Ng'ari Mixed | 25 | 10 | 60 | 23 |
| i. Baragoi Boys | ------------ | ------------------ | 90 | 35 |
| **Total** | **297** | **114** | **445** | **172** |

Source: School Class Registers, 2023

## APPENDIX VIII:

**Form Three Students Sampled per School and Gender-Specific Interview Schedule**

| School | F.3. Students Enrolment | | | |
|---|---|---|---|---|
| | Girls | No. Sampled | Boys | No. Sampled |
| 1. Baragoi Girls | 85 | 03 | ------------ | --------------- |
| 2. AIC Moi Girls | 100 | 04 | ------------- | --------------- |
| 3. Samburu Mixed | 39 | 02 | 49 | 02 |
| 4. Good Shepherd Boys | ------------- | ------------------ | 70 | 03 |
| 5. Nyiro Boys | ------------- | ------------------ | 122 | 05 |
| 6. Bishop Perlo Girls | 33 | 01 | -------------- | ---------------- |
| 7. Maralal Mixed | 15 | 01 | 54 | 02 |
| 8. Ng'ari Mixed | 25 | 01 | 60 | 02 |
| 9. Baragoi Boys | ------------- | ------------------ | 90 | 04 |
| **Total** | **297** | **12** | **445** | **18** |

Source: School Class Registers, 2023

## APPENDIX IX:

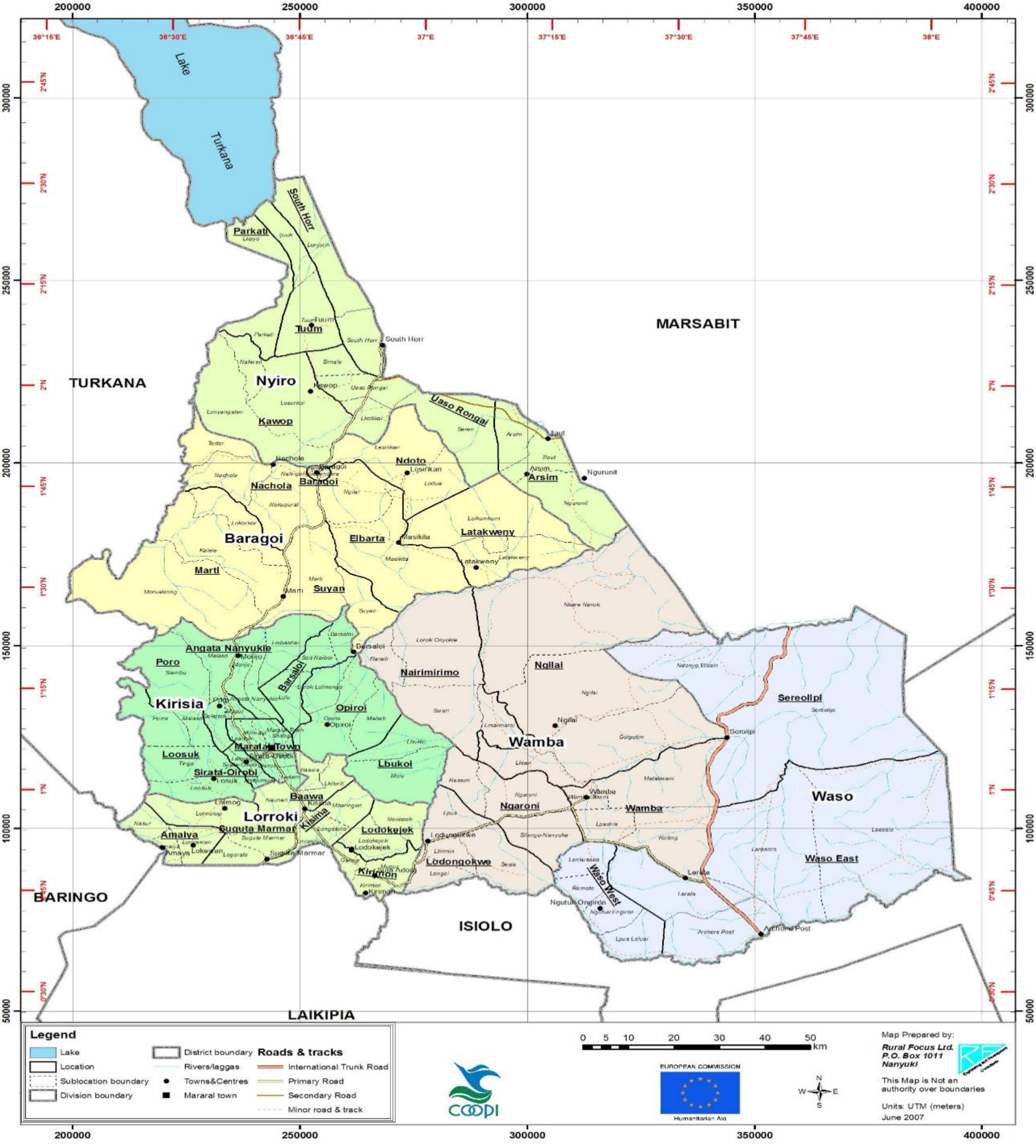
**High Schools' Student Population per School in Samburu County, Kenya, 2023**

| Schools | Enrolment (F. 1 - 4), | F.3. |
|---|---|---|
| **1.** KISIMA GIRLS | **435** | **109** |
| **2.** MARALAL BOYS | **655** | **164** |
| **3.** AIC MOI GIRLS | **465** | **116** |
| **4.** KIRISIA BOYS | **565** | **141** |
| **5.** BISHOP PERLO GIRLS | **230** | **058** |
| **6.** GOOD SHEPHERD BOYS | **235** | **059** |
| **7.** SAMBURU MIXED | **235** | **059** |
| **8.** BARAGOI BOYS | **413** | **103** |
| **9.** MARALAL MIXED | **217** | **054** |
| **10.** BARAGOI GIRLS | **221** | **055** |
| **11.** NG'ARI MIXED | **235** | **059** |
| **12.** MWANGAZA MIXED | **245** | **061** |
| **13.** ST. THERESAS GIRLS | **235** | **059** |
| **14.** NYIRO BOYS | **325** | **081** |
| **15.** KISIMA MIXED | **240** | **060** |
| **TOTAL** | **4,951** | **1,238** |

Source: Samburu County D.E. Office, 2023

## APPENDIX X:

### Map of Study Area




Source: Samburu County Education Office, 2023

## APPENDIX XI:

## Informed Consent Form

**Title of Study:** Relationship between Cultural Factors and Secondary School Students' Performance in Chemistry in Samburu County, Kenya

**Principal Investigator**

Lomonyang Ekwam,

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P.O. BOX 536 – 20115, EGERTON,

Mobile phone: +254-720-237-664/ +254726791465.

Email: lomonyangekwam@yahoo.com / ekwamlomonyang@gmail.com

**Purpose of Study**

It is requested of you to participate in a research project. It is crucial that you comprehend the purpose of the research and what it entails before choosing to take part in it. If there is anything unclear or if you require further information, please ask the researcher after carefully reading the accompanying material. The aim of this research is to ascertain the correlation between cultural factors and the chemistry performance of Samburu County secondary school students. The study will also look into the connection between students' performance in chemistry and cultural beliefs, practices, traditions, and religion. It is hoped that actions will be done to enhance students' performance in chemistry as part of the requirements for the award of the Doctor of Philosophy (PhD) degree by Egerton University, based on the results of this study.

**Study Procedures**

First, the researcher will get in touch with the principals of the schools and ask Form Three Chemistry students to complete the exam items, complete questionnaires, and agree to an interview schedule.

**Risks**

This study has a reasonable lack of predictable dangers. If there are any dangers associated with employing any of the study's techniques, suitable precautions will be made to reduce them. These could include you opting out of participating at any moment and refusing to respond to any or all of the questions.

**Benefits**

There is nothing that you will immediately earn by participating in this study. Still, we hope that this study's results will contribute to a better understanding of the relationship between cultural factors and the performance of chemistry students in secondary schools around the country. Furthermore, by lessening the negative effects of cultural influences on students' chemistry performance, the study aims to further knowledge on the relationship between cultural factors and students' chemistry performance. Finally, the results of this study will ensure that secondary school students around the country do better in chemistry.

**Confidentiality**

The researcher shall take all appropriate measures, such as the following, to safeguard your privacy:

• Assigning code names or numbers to participants, which will show up on all research notes and records.

• Preserving notes, transcripts of interviews, and any other data that can be used to identify participants in a password-protected file that is kept on the researcher's personal computer.

The information provided by participants will remain private until the researcher is required by law to disclose particular instances. These episodes may involve abuse incidents as well as any other unfavorable exposure of the individuals to any risk, including harm to their bodies or minds.

**Contact Information**

You can get in touch with the researcher, whose details are on the first page, if you have any queries at all regarding this study or if taking part in it has any negative impact on you. For any inquiries about your rights as a study participant or concerns that you feel uncomfortable discussing with the primary investigator, please get in touch with the Egerton University Ethical Review Board via phone at +254-775-015388 or email at eurec@egerton.ac.ke.

**Voluntary Participation**

It is voluntary for you to participate in this study. You are free to choose whether or not to participate in this study. Should you choose to participate in this research, a consent form will need to be signed. You are still able to withdraw your consent at any moment and for any reason once you sign the consent form. If you decide to withdraw from this study, it won't have an impact on your relationship if any with the researcher. Your data will be erased or returned to you if you leave the research before all data collection is finished.

**Consent**

---

I have studied the material, taken the time to understand it, and had the chance to ask questions. I am aware that participation is completely voluntary and that I can end it whenever I want, for any reason, and for free. I am aware that a copy of this permission form will be provided to me. I willingly consent to participate in this research.

Participant’s signature___________________ Date______

Investigator's signature __________________ Date ______

Do not hesitate to get in touch with the following if you have any questions or need any clarification: -

1. My personal contact: Lomonyang Ekwam, Mobile No. 0720237664/ 0726791465, Email: lomonyangekwam@yahoo.com / ekwamlomonyang@gmail.com
2. Prof. F. N. Keraro (Supervisor), Mobile No. 0721375678, Email: fkeraro@egerton.ac.ke, CIEM; Egerton University.
3. Dr. J. K. Ng’eno (Supervisor), Mobile No. 0722440053, Email: jkngeno@egerton.ac.ke, CIEM; Egerton University.

## APPENDIX XII:

## Research Authorization License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 584922

Date of Issue: 09/August/2021

**RESEARCH LICENSE**

This is to Certify that Mr.. LOMONYANG EKWAM of Egerton University, has been licensed to conduct research in Samburu on the topic: Relationship between cultural factors and secondary school students' achievement in Chemistry in Samburu County, Kenya. for the period ending : 09/August/2022.

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584922

Applicant Identification Number

Director General

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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## APPENDIX XIII:

### Research Clearance License

### THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

**CONDITIONS**

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## APPENDIX XIV: Published Article I

**RELATIONSHIP BETWEEN CULTURAL BELIEFS AND STUDENTS' ACHIEVEMENT IN CHEMISTRY**

GPH INTERNATIONAL JOURNAL OF EDUCATIONAL RESEARCH
OPEN ACCESS www.gphjournal.org

10.5281/zenodo.8189803 Vol. 06 Issue 07 July - Manuscript ID:

# RELATIONSHIP BETWEEN CULTURAL BELIEFS AND SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN CHEMISTRY IN SAMBURU COUNTY, KENYA

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ABSTRACT

African Societies have a relatively rich body of Indigenous Knowledge. This is embodied in the Continent's Indigenous Knowledge Systems. This knowledge has been used by the African people for thousands of years to solve their specific problems. According to Kenya National Examination Council reports, secondary school students' achievement in chemistry has been persistently poor. This has been attributed to many factors including cultural beliefs. However, it is not clear how cultural beliefs are related to students' achievement in chemistry. The current concern in Samburu County among parents and other education stakeholders is that, students' achievement in chemistry is poor and is likely to be affected by cultural beliefs that have a bearing on chemistry. This study was designed to investigate the relationship between cultural beliefs and secondary school students' achievement in chemistry in Samburu County. Descriptive Correlational survey research design was used. The target population was all the secondary school chemistry students in Samburu County. The accessible population was all the Form Three chemistry students in the County in the year 2022. Cluster sampling was used to select nine secondary schools as sampling units and this included both public and private schools. Stratified and simple random sampling was used to select a sample of 286 students. Two instruments were used for data collection namely: Students' Chemistry Achievement Test (SCAT) and Students' Cultural Beliefs Questionnaire (SCBQ). The instruments were validated by five experts in educational research. The reliability coefficient of SCAT was estimated using Guttman's Lambda (λ6) formula. This yielded a reliability coefficient of 0.80. Cronbach's Alpha Coefficient (α) was used to estimate reliability coefficient of SCBQ. This yielded reliability coefficients of 0.85. The data collected was analyzed using both descriptive and inferential statistics. Simple Linear Regression was used to establish the relationships between the different variables in the study. All statistical tests of significance were conducted at a coefficient level of alpha (α) equal to 0.05 with the help of Statistical Package for Social Sciences (SPSS) version 23.0 for windows. There was no statistically significant relationship between Cultural Beliefs and students' achievement in chemistry. The findings, however, indicate that there was a gender difference in achievement in chemistry in favour of boys. It is recommended that the Ministry of Education should initiate in-service courses for science teachers to equip them with requisite skills to enhance their effectiveness in teaching of chemistry and science subjects as a whole. The findings of this study would benefit chemistry teachers, curriculum developers, teacher educators and policy makers in addressing necessary interventions to facilitate meaningful learning of chemistry and thus improve students' achievement in the subject in secondary schools in Kenya.

KEYWORDS: Relationship, Cultural Beliefs, Students' Achievement, Chemistry

**APPENDIX XV:**

**Published Article II**

# Gender Differences in Secondary School Students' Achievement in Chemistry in Samburu County, Kenya

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**Abstract**

*The purpose of this study was to investigate the gender differences in secondary school students' achievement in chemistry. In addition, the study sought to identify the factors that contribute to gender differences in chemistry achievement in order to enhance the provision of equal opportunities for the learning of chemistry and all other sciences in general to both boys and girls. Cross-Sectional study design under the descriptive survey research was used. The target population of the study comprised of all the secondary school chemistry students in both public and private secondary schools in Samburu County. The accessible population were all the form three chemistry students in the county. A sample of 286 students was selected from a population of 1,238 using stratified and simple random sampling techniques. Students' Chemistry Achievement Test (SCAT) and Students' Gender Interview Schedule (SGIS) were used to collect data. The data collected was analyzed using both descriptive and inferential statistics. The statistics derived included the analysis of percentages, mean, standard deviation, students' T-Test scores and Chi-Square Test ($x^2$ test) used to establish the relationship between culturally accepted gender roles and achievement in chemistry. The findings show that there was a statistically significant gender difference in chemistry achievement in favour of boys. As a result, boys' schools performed better than both girls' and co-educational schools. Boys had a high affinity and interest towards chemistry than girls. Also, the culturally accepted gender roles had an effect on chemistry achievement. It is recommended that the Ministry of Education should initiate in-service programmes for teachers in science courses emphasizing on relevant scientific skills to empower teachers to provide learning opportunities that would reduce the gender differences and the effect of cultural factors known to enhance gender differences in the learning and achievement in chemistry. Curriculum developers and policy makers need to develop curriculum materials that would help to reduce the gender gap in learning and achievement.*

**Keywords:** Gender Differences, Students' Achievement, Chemistry