

**STUDENTS' PERCEPTION OF THE PSYCHOSOCIAL ENVIRONMENT OF
CHEMISTRY CLASSROOMS IN RELATION TO ATTITUDES AND
ACADEMIC PERFORMANCE: A STUDY OF SECONDARY SCHOOLS IN
KEIYO SUB-COUNTY, KENYA**

BY

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DECLARATION

Declaration by the Student

This thesis is my original work and has not been presented for a degree in any other university.

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DEDICATION

This work is dedicated to my Mum Sadie, my Uncle John and to all those who encouraged me to fly toward my dreams.

ABSTRACT

Science educators have for long been concerned on how to improve students learning outcomes in science. Among the sciences, chemistry has been identified as an important school subject touted as a vehicle to spur scientific and technological development. The achievement in chemistry in Kenya however remains low. A continuous review of factors that influence the learning outcomes in chemistry is therefore necessary. Various research studies have shown that the perception of classroom psychosocial environment is an important determinant of student learning. This study therefore examined students' perception of the classroom psychosocial environment in relation to their attitudes and academic performance in chemistry. The study further investigated the students' perceptions of the classroom psychosocial environment by gender, class level and school type. Participants included 366 students in Form 2 and Form 4 from 10 secondary schools of different types in Keiyo sub-county. This study was guided by Lewin's Field Theory which recognizes that the environment and its interaction with an individual's characteristics are potent determinants of human behaviour. Students' perceptions of the classroom psychosocial environment were assessed using the What Is Happening In this Class? (WIHIC) questionnaire. Students' attitudes towards chemistry were collected using the Attitudes Towards Chemistry Lessons Scale (ATCLS). Academic performance in chemistry was determined by analyzing the students' scores in chemistry in their respective school. This study employed the correlational and the causal comparative research designs. A quantitative method was used. The results obtained showed that students had fairly positive attitudes towards chemistry. They also perceived their chemistry classroom psychosocial environment positively. Pearson product moment correlation revealed that the students' perception of the classroom psychosocial environment was significantly and positively associated with their attitudes and academic performance in chemistry. A t-test for independent samples showed that male and female students did not significantly differ in their perception of the classroom psychosocial environment. Similarly, Form 2 and Form 4 students did not significantly differ on all aspects of the classroom environment measured by the WIHIC. Further, one way ANOVA did not establish a statistically significant difference among boys' only, girls' only and coeducational schools in the perception of the psychosocial environment of the chemistry classroom. The findings from this study offer a diagnosis for teachers and school administrators about the various psychosocial variables in the chemistry classroom that affect learning. Effective planning and intervention measures of educational processes can therefore be initiated to optimise learning. Based on these results, it is recommended that educators seeking to improve students' attitudes and academic performance in chemistry should endeavour to improve the classroom environment factors assessed by the WIHIC.

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ABBREVIATIONS AND ACRONYMS

ATCLS	Attitude towards Chemistry Lessons Scale
CES	Classroom Environment Scale
CLEES	Classroom Learning Environment of Elementary Schools
CLEI	Chemistry Laboratory Environment Inventory
CSCEQ	Catholic School Classroom Environment Questionnaire
ILEQ	Instructional Learning Environment Questionnaire
KCSE	Kenya Certificate of Secondary Education
KNEC	Kenya National Examination Council
LEI	Learning Environment inventory
LES	Learning Environment Scale
NACOSTI	National Commission for Science, Technology and Innovation
QTI	Questionnaire on Teacher Interaction
SLEI	Science Laboratory Environment Inventory
SMASSE	Strengthening Mathematics and Science in Secondary Education
TOSRA	Test of Science Related Attitudes
WIHIC	What is Happening in this Class?

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter discusses the background to the study, statement of the problem, significance of the study, objectives of the study, research questions, the hypotheses, justification of the study, limitations of the study, scope of the study, theoretical framework, and definition of terms used in this study.

1.2 Background to the Study

A major focus of science instruction over the years has been on ways of enhancing the learning outcomes of students. Science can exert a dominant, if not decisive influence on the life of an individual as well on the developmental effort of a nation (Emovon, 1985). Within the context of science education, chemistry has been identified as an important school subject and is touted as being instrumental in the scientific and technological development of a nation (Kenya National Examination Council [KNEC], 2014). Kenya's national goals of education capture the need to focus on the development of the requisite skills, attitudes and knowledge in the sciences necessary to promote technological and industrial development. This should be by deliberately imparting these values in the youth to match global trends (Kenya Institute of Education [KIE], 2002).

A number of past studies have advocated for the establishment of conducive learning environments for students. Scott, Assoko and Driver (1992) for example, argue that effective teaching approaches which aim for students' conceptual change require learning environments that are sensitive to learners' needs, feelings, and interests.

White (1989) similarly emphasized that the context in which learning takes place must be supportive and comfortable and free from any form of repression.

These assertions have been supported by many studies conducted over the last three decades in different parts of the world which have shown significant association between student learning and the way students perceive their classroom learning environment (Fraser, 1994). These studies underscore the importance of research in classroom environments.

The field of learning environments has undergone remarkable growth, diversification and internalisation since the 1970s. Fraser (1998a) reviewed 40 past studies on classroom environments and found out that relationship between outcome measures and classroom environment perceptions have been replicated for a variety of cognitive and affective outcomes with a variety of instruments, across numerous countries and at different class levels. Research studies focusing on learning environments in Kenya are few (Koul & Fisher, 2003).

Chemistry as a subject in school is seen as having a twofold benefit to the learner namely, enabling the learner to have an open scientific mind and to equip the learner with knowledge, skills and attitudes required for further education (KIE, 2002). Court (as cited in Alwy & Schech, 2004), points out that Kenya's education policy emphasizes academic achievement as the criterion for advancement within the system.

In Kenya's secondary school curriculum, chemistry is only compulsory for students in Form 1 and Form 2, yet at Form 3 and Form 4 many students still opt to pursue it. This is in spite of the fact that chemistry has consistently ranked lowest in the national examinations among the three sciences (KNEC, 2014).

The teaching of chemistry in Kenya is in line with the objectives of secondary education which include the imparting of the necessary skills, attitudes and knowledge for the development of the self and the nation, promotion of positive environmental and health practices, the development of ability for enquiry, critical thinking and rational judgement and to build a foundation for technological and industrial development (KIE, 2002). Despite the importance of chemistry to mankind and the educators' efforts to improve its teaching and learning, the achievement of students in the subject in the country remains low.

The national mean marks in chemistry in the years 2011, 2012 and 2013 were 23.65%, 27.93% and 24.50% respectively (KNEC, 2014). Comparatively, the performance in the other two sciences biology and physics was on average higher. Table 1.1 show the national mean scores in the three sciences form 2011 to 2013.

Table 1.1: National science percentage mean scores (2011-2013 KCSE Examination)

	Year		
	2011	2012	2013
Chemistry	23.65	27.93	24.50
Biology	32.44	26.21	31.63
Physics	36.64	37.86	40.10

The performance of chemistry in Keiyo sub-county mirrors the national trends with low performance being observed (Keiyo sub-county education day planning

committee, 2014). Table 1.2 shows the chemistry percentage mean scores in the sub-county between 2011 and 2013.

Table 1.2: Keiyo Sub-County Chemistry Mean Scores (2011-2013 KCSE Examination)

	Year		
	2011	2012	2013
Mean	25.43%	24.54%	27.07%

Source: Keiyo Sub-county Education Day Planning Committee, 2014

Among the factors that have been identified as contributing to the observed low performance are poor methods of instructions, learners' largely negative or neutral attitudes towards the subject, inadequacy of laboratory experiences and a poor science background of learners (Nui & Wahome, 2006). Concerted efforts therefore need to be taken to reverse these trends. This can only be made possible through an understanding of the factors that are causal or predictive of the low achievement in chemistry. Chemistry teaching and learning can only be fruitful if the learner is willing to learn and if the teacher is motivated enough to teach using appropriate methods and resources. Emphasis should therefore be placed on the interaction between the teacher, the learner, the curriculum and the environment in which this exchange occurs (Emovon, 1985).

The Kenyan government and the Ministry of Education appreciates the magnitude of the problems bedevilling the teaching and learning of mathematics and science in the

country and have been at the forefront in funding areas in the education sector identified as pivotal in the improvement of achievement in these subjects.

In Kenya's new development blue print dubbed vision 2030 (Ministry of Planning, 2007), Kenya intends to have international ranking for her learners achievement in mathematics, science and technology. The specific strategies to achieve these will involve reforming secondary school curricula, modernising teacher training and strengthening partnership with the private sector. Further in its science, technology and innovation policy framework, the government plans to devote more resources to scientific research, technical capabilities of the workforce and in raising the quality of teaching mathematics, science and technology in schools, polytechnics and universities.

The strongest move yet by the government and the Ministry of Education together with its partners towards achieving this end has been the massive in-service programme named Strengthening Mathematics and Science in Secondary Education (SMASSE) targeting about 20,000 mathematics and science teachers. The main aim of the programme has been to equip teachers with the requisite competencies to reshape students' attitudes towards science and mathematics by enhancing appropriate classroom practices. SMASSE baseline studies reveal largely negative or neutral attitudes towards the teaching and learning of mathematics and sciences, poor teaching methods, poor content mastery by teachers and a lack of infrastructure, instructional materials and equipment to schools (Nui & Wahome, 2006). Past SMASSE impact assessment surveys of the in-service and training programme on classroom practices have indicated that teachers quality of teaching and the extent of

student participation are better after undergoing SMASSE in-service and training (Muraya, 2008).

In spite of all the efforts being put to improve the learning outcomes in science and chemistry in particular, a lot remains to be done as reflected by the dismal results at the national examination year after year (KNEC, 2014). It is therefore important and necessary to continuously review factors that cause or predict negative attitudes and low academic performance in chemistry. In this study, classroom psychosocial environment factors and their relationship with attitudes and academic performance were investigated because research has indicated that learning environment variables were the most influential predictors of student learning (Haladyna & Shaughnessy, 1982).

1.3 Statement of the Problem

Rutter, Maughan, Mortimore, Ouston and Smith (1979) contend that by the time learners finish high school, they have spent as much 15,000 hours in school. Learners therefore spend much of their formative years in school and the experiences and perceptions they have about school and in particular the classroom environment are significant. Studies on learning environments conducted in the past have provided convincing evidence that the quality of classroom environment in schools is a significant determinant of student learning (Fraser, 1994). Lawrenz (1976) argued that “one variable which might be affecting student interest is the learning environment of the science classroom. It seems likely that a student’s ‘perception of his classroom environment would affect his opinion of the course’ (p.79). He further noted that the loss of interest appears to be more pronounced in the physical sciences than in the biological sciences. Haladyna and Shaughnessy (as cited in Myers & Fouts, 1992), in

their synthesis of research further indicated that the learning environment variables were the most influential predictors of attitude toward science. In view of these observations, an investigation of classroom environments should be an integral part of our educational practices to determine the variables that have a bearing on the learning of science.

Research by Chavez (1984) and Fraser (1994, 1998b) have shown the learning environment field to be an active area of investigation. Research on this field have however been centred in western and Asian countries (Koul & Fisher, 2003). Fewer if any studies have been conducted on the relationship between learning environment and learning outcomes in chemistry in Kenya. An investigation into the environments that exist in our classrooms is therefore important since apart from other variables that influence learning outcomes, environmental variables can be mediated by educators. This will help point out the variables that are associated with learning outcomes. Since science offers a broader scope to facilitate a proper study, this study was narrowed to include chemistry only.

1.4 Purpose of the Study

This study investigated secondary school students' perception of the psychosocial environment in the chemistry classrooms in Keiyo Sub-county and its relationship with their attitudes and academic performance in chemistry. The study further examined the influence of gender, class level, and type of school on the perceptions of students of the psychosocial environment in chemistry classrooms.

1.5 Research Objectives

This study sought to pursue the following objectives.

- i) To find out the relationship between chemistry students' perception of the psychosocial environment of their classroom and their attitudes towards chemistry.
- ii) To determine the relationship between chemistry students' perception of the psychosocial environment of their classroom and their academic performance in chemistry.
- iii) To establish the influence of gender on the perception of students of the psychosocial environment of their chemistry classroom.
- iv) To determine the influence of class level on the perception of students of the psychosocial environment of their chemistry classroom.
- v) To find out the influence of school type on the perception of students of the psychosocial environment of their chemistry classroom.

1.6 Research Questions

This study sought to answer the following questions.

- i) Is there a relationship between chemistry students' perception of the psychosocial environment of their classroom and their attitudes towards chemistry?
- ii) Is there a relationship between chemistry students' perception of the psychosocial environment of their classroom and their academic performance in chemistry?
- iii) Do male and female students differ in their perception of the psychosocial environment of their chemistry classroom?

- iv) Do Form 2 and Form 4 students differ on their perception of the psychosocial environment of their chemistry classroom?
- v) Does school type influence the perception of students of the psychosocial environment of their chemistry classroom?

1.7 Null Hypotheses

- H₀₁** There is no significant relationship between chemistry students' perception of the psychosocial environment of their classroom and their attitudes towards chemistry.
- H₀₂** There is no significant relationship between chemistry students' perception of the psychosocial environment of their classroom and their academic performance in chemistry.
- H₀₃** There is no significant difference between male and female students on their perception of the psychosocial environment of their chemistry classroom.
- H₀₄** There is no significant difference between Form 2 and Form 4 learners' on their perception of the psychosocial environment of their chemistry classroom.
- H₀₅** There is no significant difference among learners in different school types on their perception of the psychosocial environment of their chemistry classroom.

1.8 Research Assumptions

- i) That classroom psychosocial environment influences learning outcomes in chemistry
- ii) The participants responded to the questionnaires without bias.

1.9 Justification of the Study

Science educator's key focus is on ways to improve the learning outcomes of students. Chemistry has been identified as an important school subject and has been touted as important in spurring scientific and technological development (KNEC, 2014). A strong chemistry curriculum should provide the opportunity for students to solve real-world problems and convey this information to others. The American Chemical Society (2012) for example states that teaching and learning of chemistry in high school should endeavour to explore the big ideas that form the backbone of chemistry, effectively and to students of diverse backgrounds. This should include adequate laboratory experiences, incorporation of technology and using assessments to improve instruction. Similarly, the Kenyan secondary school chemistry syllabus treats chemistry as a practical subject where scientific concepts, principles and skills are developed through experimental investigations in a bid to help learners realise the expected learning outcomes (KIE, 2002).

Among the three science subjects, chemistry is the worst performed nationally yet most students still opt to pursue the subject up to Form 4 level (KNEC, 2014). Understanding factors that are causal or predictive of learning outcomes in chemistry is therefore necessary.

A study of the classroom environment is important since most learning takes place here.

1.10 Significance of the Study

The findings from this study bridge the gap in the quest to find answers for the observed learning outcomes in chemistry because it offers a diagnosis for teachers and school administrators about the various variables in the chemistry classroom that

affect learning. Effective planning and intervention measures of educational processes can therefore be initiated to optimise learning. This is especially so because teachers have to a large extent the means to mediate what goes on in their classrooms. The findings from this study additionally adds to the knowledge pool in the field of learning environments and will likely provide a basis for the continued initiations of investigations in the area with a bid to improve learning outcomes in our schools.

1.11 Scope of the Study

The study was conducted in Keiyo sub-county among secondary school students to determine their perceptions of their chemistry classroom psychosocial environment and its relationship with their academic achievement and attitudes towards chemistry. The schools sampled were therefore those within the sub-county. The study also compared the students' perception of the chemistry classroom psychosocial environment with respect to gender, class level and school type.

1.12 Limitations of the Study

In considering to study the relationship between students' perception of the classroom psychosocial environment and learning outcomes, other variables that potentially influence learning outcomes in chemistry were left out. As such, findings from this study will only be applied to classroom environment in chemistry and how it relates with attitudes and academic performance.

Additionally, students and chemistry teachers' willingness to participate in this study was impeded by the need to access the chemistry academic progress records. This is because academic performance is generally used as a measure of the teachers and students' performance. This need raised the fear that the results of the study may be used to evaluate the teachers' effectiveness in class by education officials. The

assurance that the data to be collected was going to be held in confidence and to be used solely for the study helped to a large extent to allay these fears.

1.13 Theoretical Framework

The study was guided by the field theory advanced by Kurt Lewin (Mishra, 2008). Lewin's field theory attempts to approach the problem of the relationship between psychological processes and environmental characteristics in a "total way" perhaps influenced by his earlier training in the phenomenological orientation of the Gestalt school (Bonnes & Secchiaroli, 1995). Lewin postulates that every psychological event depends upon the state of the person and the environment. The famous equation of the Lewinian theory $B = f(P,E)$ points out the environment (E) interacts with personal characteristics (P) as to determine behaviour (B).

Lewin defines an individual's whole situation as their life space (LS), which he explains as the total psychological reality that determines the behaviour of the individual (Mishra, 2008). Behaviour is therefore a function of the life space expressed mathematically as $B = f(LS)$. Lewin, though affirming the importance of considering the physical characteristics of the environment however incorporates them in the psychological realm as these characteristics are perceived subjectively. This puts into perspective other underlying factors such as needs. Lewin also views the person as being differentiated from his psychological environment. This can be illustrated as follows.

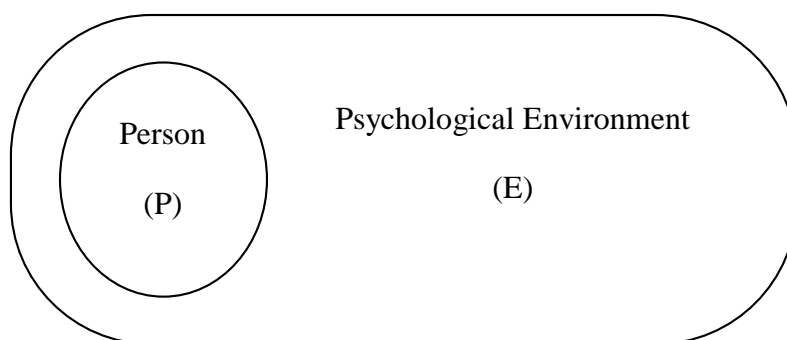


Figure1.1: Lewin's concept of life space. Source: (Bonnes & Secchiaroli, 1995).

Mishra (2008) states that Lewin's theory divides the psychological environment into different regions some with permeable boundaries which enable individuals to influence and be influenced by others. This theory was applied in this study to explain the relationship between the psychosocial environment, attitudes and academic performance in chemistry. The independent variable, the classroom psychosocial environment comprised the interaction between students and students and the teacher in the classroom, whereas attitudes and academic performance was the resultant behaviour and constituted the dependent variable.

1.14 Conceptual Framework

Various antecedent variables have been shown to have an influence on the classroom psychosocial environment (Dorman, 2002). These include gender, year level, school type and subject. In this study, the influence of gender, class level and school were investigated. This study further investigated the relationship between the perceptions of the chemistry classroom psychosocial environment with two learning outcomes: attitudes towards chemistry and academic performance in chemistry. The relationship between these variables is summarised by the Figure 1.2.

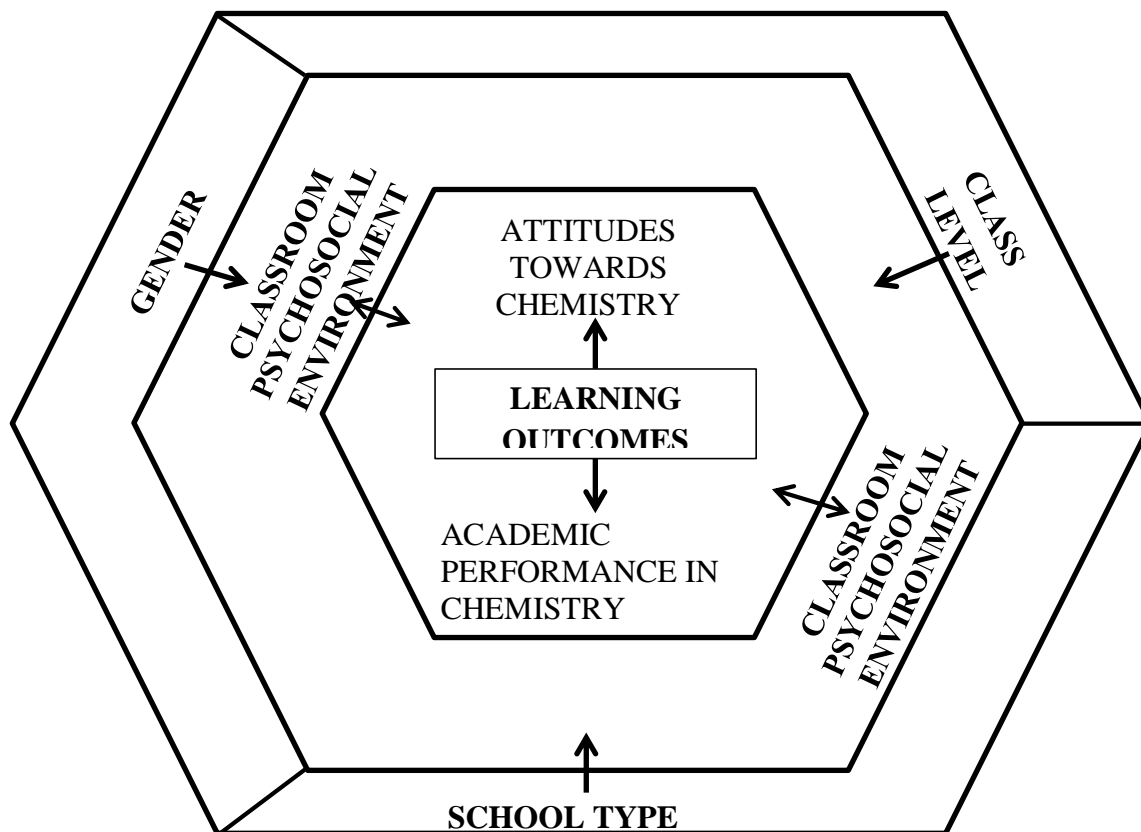


Figure 1.2: Effect of antecedent variables on classroom environment and the relationship between classroom environment and learning outcomes.

1.15 Operational Definition of Terms

The terms below were defined and operationalized as follows for this study:

Classroom psychosocial environment: This was used to describe the nature of interpersonal relationships among learners and that between the teacher and learners in the learning environment that potentially influences learning. It excluded the physical facilities.

Academic performance: This referred to an individual's score in chemistry assessment. The academic performance in chemistry was worked out by averaging a student's assessment scores for three terms preceding the study.

Attitudes: This referred to the opinion or the general feelings of a learner towards chemistry as a school subject. Attitudes were measured using the Attitudes Towards Chemistry Lessons Scale (ATCLS).

Class level: This referred to the current class year of the learner. Two class levels were considered, Form 2 and Form 4.

Gender: This referred to the classification of individuals as either male or female.

School type: This referred to the classification of schools as either single sex or co-educational.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Overview

This chapter discusses literature related to students' perceptions of classroom psychosocial environment in relation to their attitudes and academic performance in chemistry. It examines the concept of classroom psychosocial environment, historical development of classroom environment research, and influences of gender, class level and school type on students' perceptions of psychosocial environment of their chemistry classroom. It also discusses the relationship between the classroom psychosocial environment and learner attitudes and academic performance in chemistry.

2.2 Classroom Psychosocial Environment

Walberg, (1991) defines classroom psychosocial environment as “the climate or atmosphere of the class as a social group that potentially influences what students learn” (p. 255). Wilson (1996) defines it as the space or place where learners and teachers interact with each other and use a variety of tools and information in their pursuit of learning activities. Importantly, it excludes the physical learning environment in terms of classroom furniture, displays, lighting, air quality and technology. The concept of environment, as applied to educational settings, refers to the atmosphere, ambience, tone, or climate that pervades the particular setting (Dorman, 2002). Accordingly, research in this field has focussed historically on the psychosocial dimensions of the environment; those aspects of the environment that focus on human behaviour in origin or outcome (Boy & Pine, 1988).

Rutter, Maughan, Mortimore, Ouston and Smith (1979), contend that students spend up to 15,000 hours at school by the time they finish high school. Students therefore

have a large stake in what happens to them at school and their reactions to, and perceptions of, their classroom experiences are significant.

Classroom psychosocial environment is somewhat a difficult concept to describe but since the 1960s, considerable interest has been shown internationally in the conceptualisation, measurement and investigations of perceptions of psychological characteristics of the learning environment of classrooms at the elementary, secondary and higher education levels by studies mainly in Western and Asian countries (Fraser, 1994).

2.2.1 Historical Development of Learning Environment Research

Learning environment research has its roots in the work of early social psychologists. The earliest recorded classroom climate research was conducted by Thomas in the 1920s in the United States (Chavez, 1984). Thomas' work sought to characterise learning environments on the basis of observable, unambiguous actions of the participants rather than the social or emotional phenomena which could not be empirically observed.

Lewin's field theory built on Thomas' work. Lewin argued that behaviour is the result of an interaction between the person and the environment. His idea was presented as the mathematical expression $B = f(P, E)$ (Fraser, 1998a). Murray (1938) extended Lewin's work by proposing a needs-press model. Personal needs in the model refer to individuals' quest to meet their goals while environmental press refer to the external situation that aid or hinders the attainment of personal needs. He asserted that individuals would seek favourable environments and avoid unfavourable ones. Murray identified alpha press, the environment as observed by an external observer

and beta press, an individual's own perception of the environmental situation (Fraser, 1998a).

Stern, Stein and Bloom (1956) (as cited in Fraser, 1998a) expanded on Murray's beta press by suggesting that each individual had their own view of the environment and a shared view with members of a group. They called the former the private beta press while the later was termed the consensual beta press. They stated that the private beta press and the consensual beta press could differ from each other. The two additionally could differ from the alpha press.

Based on his studies of various human environments such as those in schools, prisons and homes, Moos (1979) came up with three dimensions that characterises them. They are relationship, personal development and system maintenance and change dimensions. Relationship dimensions identify the nature and intensity of personal relationships within the environment and assess the extent to which people are involved in the environment and support and help each other, personal development dimensions assess basic directions along which personal growth and self-enhancement tend to occur and system maintenance and system change dimensions involve the extent to which the environment is orderly, clear in expectations, maintains control and is responsive to change (Fraser, 1998a).

The turning point in the development of learning environment research occurred when Walberg and Moos began their seminal independent programs of research (Fraser, Aldridge & Adolphe, 2010). Walberg developed the widely used Learning Environment Inventory (LEI) as part of the Harvard Project Physics programme while Moos came up with social climate scales to measure different human environments. These included the Classroom environment scale (CES; Moos, 1979; Walberg, 1979).

These instruments facilitated the investigation of classroom environments and spurred the development and validation of more instruments for use in unique settings (Rita & Martin-Dunlop, 2011).

A strong trend in classroom environment research has been the study of associations between student outcomes and the classroom environment, investigations of the differences between students' and teachers' perceptions of classroom environments, students' actual and preferred classroom environments, use of classroom environment variables as criterion variables and a practical attempt to improve classrooms (Chua, Wong & Chen, 2009).

2.2.2 Assessment of the Learning Environments

At the onset of research into learning environments, assessment was principally carried out by low inference measures. This involved trained observers whose task was to look out for and record counts of objective explicit phenomena shown by the inhabitants of a classroom setting and to attach meaning to them (Fraser, 1986).

Chavez (1984) points out that though low inference measures are objective and verifiable, the data is "selective, inconsistent and usually incomparable with other records" (p. 3). He argues that social behavior is complex and that periodic observations and interpretations may not be sufficient to fully describe it.

In contrast to methods that rely on direct observations of explicit phenomena in the classroom, perceptual measures are now widely recognized (Fraser, 1986, 2012). Perceptual measures define the environment in terms of the students' and sometimes the teacher's subjective perception. Perceptual measures are categorized as high inference measures because they seek to attach psychological meanings to happenings in the classroom.

Fraser (1998a) states that students and teachers are at a good position to make judgments on classroom environment by virtue of being participants. They also have had a considerable amount of time to form accurate, durable impressions of the environment. Observers on the other hand have only spent a limited time in the environment and may miss out on data or deem some unimportant. Fraser adds that the use of perceptual measures have the advantage that they are economical, involve pooled judgments of all members of a classroom and consider students' experiences over many lessons. They have also been found to account for considerably more variance in student learning outcomes compared to the use of direct observations.

2.3 Classroom Environment and Attitudes toward Chemistry

Attitude is a difficult construct to define because it cannot be observed directly and happens to be multi-faceted. This isn't made any easier because terms such as interest and motivation are often used interchangeably with attitude (Ramsden, 1998). Different researchers have however attempted to define it. Salta and Tzouragraki (2004), state that an attitude is the tendency to think, feel, or act positively or negatively toward objects in our environment. According to Papanastasiou and Papanastasiou (2004), attitude as a concept represents the emotional orientation of an individual to respond favorably or unfavorably to things, people, places, events or ideas. Oskamp and Schultz (2005) are in agreement that the predisposition to respond is with respect to a given attitude object. The definitions above capture the directedness in the nature of attitudes.

There is also the contention that attitudes are learned and can influence the choices of action individuals can take. Shrigley's (1983) review of socio-psychological literature turned up five key elements that make up the concept of attitude namely;

that attitudes are learned, attitudes predict behavior, the social influence of others affect attitudes, attitudes are a readiness to respond and attitudes are evaluative with emotion being involved. This view conforms to the long held position by many social psychologists that attitudes have cognitive, affective and behavioural components (Salta & Tzougraki, 2004).

The definition of attitudes towards science has been an issue among researchers. Although Osborne, Simon and Collins (2003) decry the lack of clarity on the subject under investigation, some strides have been made towards the disambiguation of attitudes towards science. Yara (2009) for example conceives attitudes towards science as a disposition towards liking or disliking science while Osborne, Simon and Collins (2003), view attitudes towards science as being made up of sub-constructs which together add up to make up attitudes towards science. Fraser's (1981) Test of Science Related Attitudes (TOSRA) scale perhaps best captures the proposition by Osborne et al. (2003) that attitudes towards science has sub-constructs because the scale has seven attitude factors.

Cheung (2007) asserts that it is important for students to develop positive attitudes towards science lessons for two main reasons. Firstly, research has confirmed that attitudes are related with academic achievement. Weinburgh's (1995) meta-analysis of research on attitudes towards science between 1970 and 1971 for example concluded that attitude can account for 25-30% of variance in academic achievement. Papanastasiou and Zembylas (2004) also reached the same conclusion reporting a high correlation between positive attitudes and achievement in science. A study in Kenya by Amunga, Amadalo and Musera (2010), found that negative attitudes towards school chemistry led to poor performance while positive attitudes led to good performance in the subject.

The other reason why it is important to develop students' positive attitudes toward science lessons taught in schools is that attitudes predict behaviour (Cheung, 2007). Koballa (1988), states that students' actions reflect their feelings toward objects and issues. Mager, (1968) argues that students with a positive attitude toward a subject are more likely to want to extend their learning even after the direct influence of the teacher has ended.

Numerous studies on attitudes towards science have been documented. Ramsden (1998) reviewed a number of them and concluded that:

1. Science is considered to be difficult and not relevant to the lives of most people.
2. Science is supposed to cause social and environmental problems.
3. Science is more attractive to males than females.
4. The interest in science decreases over the years of secondary schooling.
5. The more negative views are associated with the physical sciences rather than biological sciences.

Research in science education has highlighted a number of factors that influence student's attitudes towards science. Anwer, Iqbal and Harrison (2012) in their review of various studies identified gender, parental education, classroom environment, home environment, socio-economic status, class level, peer group, quality of instruction, maturity and motivation. A general agreement, however, is that gender seems to have the greatest significance. Besides gender, Haladyna and Shaughnessy's (1982) synthesis of research indicated that the learning environment variables were the most influential predictors of attitude toward science. They recommended that because we cannot do much to change student variables, science educators should concentrate on

examining the teacher and learning environment variables, which are under the control of the teacher.

A number of studies have established a positive correlation between the classroom environment and attitudes towards science across many countries. These include Turkey (Telli, Cakiroglu & den Brok, 2006), Australia (Rawnsley & Fisher, 1998; McRobbie & Fraser, 1993), USA (Wolf & Fraser, 2007) India (Koul & Fisher, 2003) Philippines (Rivera & Ganaden, 2000) Canada (Smith & Ezeife, 2010) and Vietnam (Tran, 2012).

Smith and Ezeife (2010) used the WIHIC and TOSRA scales to study the relationship between perceptions of classroom environment and attitudes among class nine applied science students in Canada. They found a significant positive correlation between the adoption of scientific attitudes and the classroom environment measures of investigation, equity, cooperation, teacher support, task orientation and involvement.

Telli et al., (2006) also using the WIHIC and the TOSRA scales to determine Turkish secondary education students perceptions of their classroom learning environment and their attitudes towards biology found positive correlations between all the classroom environment scales and attitude scales. Notably high correlations were those between involvement and investigation with the attitude scales of enjoyment and leisure. Students' cohesiveness was found to be least related with the attitude scales.

In a study of associations between student outcomes and psychosocial science environment among senior high school chemistry students in Australia using the Science Laboratory Environment Inventory (SLEI) and four attitudinal measures called Attitude to laboratory learning, Nature of chemistry knowledge, cooperative

learning and adoption of laboratory attitudes, McRobbie and Fraser (1993), found a strong link between the science laboratory scale of integration of laboratory work and theory lesson with enhanced attitude outcomes.

Rawnsley and Fisher (1998) investigated the learning environments in mathematics classrooms and their associations with students' attitudes and learning found that students developed more positive attitudes towards the subject in classes with more teacher support, more equity, investigations, strong leadership, helping friendly behaviour and where more emphasis on understanding was underscored.

A study in the Philippines by Rivera and Ganaden, (2000) on high school students and using the Learning Environment Scale (LES) and an Attitude towards Chemistry Scale found all the seven classroom environment factors to be significantly and positively correlated with the attitude factors. The LES dimensions include students' interest, teacher support, fairness and clarity of rule and tasks in the classroom, teacher encouragement, student participation, classroom ventilation and classroom space. The attitude factors are liking for and competence in chemistry and perceptions and beliefs about chemistry. They established that fairness and clarity of rule and tasks had the highest positive correlation with perceptions and beliefs about chemistry. They also concluded that students' preferred more teacher support as this factor correlated highly with attitude factors compared to classroom space.

Six of the WIHIC scales namely, teacher support, involvement, investigation, task orientation, cooperation and equity were found to be significant independent predictors of students' attitudes in a study by Wolf and Fraser, (2007) using an attitude scale modified from TOSRA's Enjoyment of Science Lessons Scale. The study targeted middle school physical science students in the USA. All the classroom

environment scales were positively correlated with attitudes except cooperation. They suggested that cooperation in class could lead to an unequally shared workload leading to negative attitudes towards the class.

Similarly Tran, (2012) in a study of the link between perceptions of classroom environment and self-esteem and attitudes among class nine lower secondary schools students in Vietnam found out that satisfaction with mathematics learning and a cohesive classroom environment was associated with a positive self-esteem and attitudes towards mathematics. The study also revealed that a competitive rather than a cooperative environment favoured negative self-esteem and attitudes towards mathematics.

Koul and Fisher (2003) in a study of science classrooms learning environment in India using the WIHIC and an attitude towards scientific inquiry scale established that all the classroom environment scales were positively correlated with the attitudes to science classroom. They further concluded that the scales Investigation, Task Orientation and equity were independent predictors of students' attitudes towards science lessons.

Allen and Fraser, (2007) in her study of parent and student perceptions of the science learning environment and its influence on student outcomes reports that the WIHIC scales of involvement, task orientation and investigation correlated positively with student enjoyment of science lessons. They also found a connection between investigation with attitude to scientific inquiry. The study targeted Grades 9-11 students in the USA and utilised modified versions of WIHIC and TOSRA scales.

The above studies show that classroom environment factors are connected to a large extent with students' attitudes towards various subject areas. What is lacking in the

current literature is a link with the chemistry classroom in Kenya. This study also sought to contribute to the previous studies that specifically addressed the chemistry classroom environment.

2.4 Classroom Environment and Academic Performance in Chemistry

Stakeholders in Kenya's education system attach immense importance to academic performance. This is mainly because good performance guarantees one's progression into tertiary institutions and competitive career opportunities. Although Kenya's education curriculum emphasizes wholesome education, academic achievement remains the main criterion for admission into tertiary institutions.

Perceptions of the classroom environment have consistently been shown to be associated with students' learning outcomes. Haertel, Walberg and Haertel (1981) in a meta-analysis of previous research examined 734 correlations from 12 studies on 823 classrooms in eight subject areas found significant correlations between classroom environment and learning outcomes. The outcomes include cognitive, affective and behavioural dimensions. Specifically the outcomes were positively associated with cohesiveness, satisfaction, task difficulty, formality, goal orientation, democracy and environment. They were negatively associated with friction, cliqueness, apathy, disorganisation and favouritism.

Wahyudi and Treagust (2004) examined the associations between learning environments and students' outcomes in science classes in Indonesian lower secondary schools. Learning environment perceptions were gathered using a modified version of the WIHIC questionnaire from 1400 students. Performance was reflected by scores in the national examinations. The study revealed significant associations between achievement in science and the learning environment dimensions of student

cohesiveness, task orientation, and cooperation. The study especially singled out cooperation as being a strong predictor of students' cognitive achievement.

A similar study by Chionh and Fraser (2009) to investigate the relationship between classroom environment and achievement, attitudes and self-esteem in geography and mathematics. Student cohesiveness and task orientation was found to be related with scores in geography, while student cohesiveness, task orientation and equity were found to be related to achievement in mathematics. Classroom environment perceptions was collected using the WIHIC questionnaire while results in the Singapore-Cambridge General Certificate of Education ordinary Level Examination was to rate achievement in mathematics and geography.

Baek and Choi (2002) in Korea found academic achievement in English to be positively related to the classroom environment dimensions of involvement, task orientation, affiliation, competition, order and organisation, rule clarity and teacher control. Their study used a revised version of the CES questionnaire that was then translated to Korean.

A study by Rivera and Ganaden (2000) in the Philippines found the LES environment scales of students' interest, teacher support, student participation, teacher encouragement, fairness and clarity of rule and tasks in the classroom and classroom ventilation to be positively related to achievement in chemistry.

Although different research variables and different instruments have been used to study environment-achievement associations in different subjects, evidence support the potency of the environment in helping to predict achievement outcomes.

2.5 Determinants of Classroom Environment

Researchers in the past have used various determinants of classroom environment as dependent variables with the aim of identifying how they relate with various classroom environment dimensions.

The various determinants include: teacher personality, class size, class level, subject matter, the nature of the school-level environment, the type of school, ethnic, linguistic and cultural differences, as well as age and sex differences (Fraser, 1994), and school membership, attendance, time spent doing homework, students' academic expectations, course class, and course content (Huang, 2003).

Because this study also sought to investigate the influence of gender, class level and school type on the classroom environment, a review of literature on past research of these factors are discussed in the next section.

2.5.1 Influence of Gender on Perception of Classroom Environment

A large number of studies across many countries, using different classroom environment questionnaires and at different class levels have established a connection between gender and classroom environment dimensions.

Huang (2003), in a study to investigate antecedents to psychosocial environment with 644 seventh class pupils in middle school classrooms in Taiwan and using a scale that combined the WIHIC, CES and the Instructional Learning Environment Questionnaire (ILEQ) found out that girls perceived their classroom environment more positively than boys did. Notably the girls viewed themselves as being more involved, affiliated, and cooperative in the classroom than boys. They also perceived more teacher support and did more research to investigate problems than boys.

In Singapore, Wong and Fraser (1997) assessed chemistry laboratory classrooms using the SLEI. The sample consisted of 1,592 tenth class students from 56 intact classrooms in 28 randomly selected co-educational schools. Mean scores obtained by females and males on the actual and preferred scales of the SLEI showed females scored significantly higher in both cases. This suggested that females had more positive perceptions of their science laboratory classroom environment than their male counterparts. In another study in Singapore using the Chemistry Laboratory Environment Inventory (CLEI) to investigate gender differences in the perceptions of chemistry laboratory classroom environments, Quek, Wong and Fraser (2001) found out that girls perceived their learning environment just as favourably if not more favourably than boys.

In Zimbabwe Shadreck (2012) conducted a study among 1728 junior secondary schools students using the WIHIC scale to investigate their perceptions of their classroom environment and attitudes towards science. The study revealed that girls generally held more positive perceptions of their classroom environment in science than did the boys. Girls particularly rated cohesiveness, task orientation, cooperation and equity as being higher in their classroom environment. Boys on the other hand perceived more involvement, teacher support and investigation.

Fraser, Aldridge and Adolphe (2010) in a cross-national study of secondary science classrooms in Australia and Indonesia using a modified version of the WIHIC found out that female students perceived significantly more cohesiveness and equity than did male students. The sample consisted of 18 matched pairs of within-class sex means in Indonesia and another 18 matched pairs of within-class sex means in Australia.

Gender differences in classroom environment perceptions have been investigated by many other researchers. These include Ogbuehi and Fraser (2007) in USA, Fraser, Giddings and McRobbie (1995) in Australia, Majeed, Fraser and Aldridge (2002) in Brunei, Fraser & Chionh (2000) in Singapore, Koul and Fisher (2003) in India, Wahyudi and Treagust (2004) in Indonesia and Dorman (1987) in Australia. Generally, most studies have shown female students having a more favourable view of their classroom environments. Some studies have however found that boys perceived some aspects of their environment more favourably than girls do.

A study by Kim, Fisher and Fraser (2000) however contradicts this general view. Using the WIHIC and the Questionnaire on Teacher Interaction (QTI), they investigated the nature of classroom environment and teacher interpersonal behaviour in Korea. The participants were 543 students from 12 different Korean schools. The study found out that boy's perceived their learning environments and their teacher's interpersonal behaviour more favourably than girls. The schools sampled in the study were single sex schools only.

Similarly, Hoang (2008) found out that boys consistently reported slightly more positive perceptions of classroom environment than girls. His study had sought to establish effects of class level, gender and ethnicity on and learning environment in mathematics in high school using the WIHIC questionnaire in Los Angeles high schools.

Further, other studies have found no significant difference in boys' and girls' perception of the classroom environment. Khalil and Saar (2009) using the Classroom Learning Environment of Elementary Schools (CLEES) questionnaire found no such differences with class 5 and 6 elementary students in Arab middle schools.

2.5.2 Influence of Class Level on Perception of the Classroom Environment

The influence of class on classroom environment has been researched with varying findings. Randhawa and Michayluk (1975) on a study of learning environments in urban and rural class 8 and class 11 mathematics, science, social studies and English classrooms in Canadian schools showed that as class increased, students positive perceptions of the classroom environment decreased. They proposed that students became more critical of their social environment as they grow older.

In one of the few relatively recent studies on the effect of class on classroom environment, Cheng (1999) reported the use of CES to differentiate the perception of classroom environment between junior and senior forms in Hong Kong high schools. Significant class level differences were found between the junior and senior class levels. The senior class levels perceived more teacher support, task orientation, and order and organization, but reduced levels of affiliation, rule clarity, and teacher control. These differences were more pronounced in the high performing school compared to low performing schools.

Hoang (2008) investigated the effect of class level, gender, and ethnicity on attitude and learning environment in mathematics in Los Angeles. The sample consisted of 600 Grade 9 and 10 mathematics students in 30 classes in one high school. Data on classroom environment was collected using the WIHIC questionnaire. The study revealed that student cohesiveness and equity increased between Grade 9 and 10 while perception of teacher support and task orientation declined.

Dorman (1999) found out that Grade 12 students perceived higher levels of interactions, but lowers of teacher control compared to Grade 9 students using the personal form of the Catholic School Classroom Environment Questionnaire

(CSCEQ) in Australia. The study showed that as class increased cooperation increased but task orientation and teacher control decreased.

Mucherah (2008) in her examination of classroom climate and student goal structures in high school biology classrooms in one boys' only and one girls' only school in Kenya using the Classroom Climate Questionnaire found out that learners' perception of the classroom environment were different based on their class level. Eleventh graders perceived their classrooms to be higher in teacher support, task focus, competition, rule strictness and innovation compared to tenth graders.

As can be seen, the findings from various studies cited in this study on the influence of class level on classroom environment are at best mixed. This study assessed Form 2 and Form 4 students for their perceptions the classroom environment.

2.5.3 Influence of School Type on Perception of Classroom Environment

Schools can be categorized into various groups on the basis of such factors as location (urban or rural school), its catchment area (county or national school), the gender of the students it admits (single sex or coeducational school), the bodies that sponsor it (religious sponsored or government sponsored) or the curriculum it offers. A number of studies seeking to link school type to classroom learning environment have been conducted.

Rivera and Ganaden (2000), in a study to investigate the variations in the dimensions of chemistry classroom environment using the researcher made Learning Environment Scale (LES) in the Philippines found out that students in private and public schools differed in their perceptions of all the factors of the classroom environment scale. On the whole, students in private schools showed significantly better or more positive classroom environment than those in public schools.

Opolot-Okurut (2010) compared mathematics students' perceptions of the classroom environment in high performing and low performing schools using the WIHIC questionnaire. He concluded that students in the high performing schools perceived their learning environments more favourably with respect to task orientation and cooperation while those in low performing schools perceived more of teacher support and involvement in their classrooms. Students in both schools however perceived near equal levels of equity.

Wahyudi and Treagust (2004) found differences in science classroom learning environments between urban and rural lower secondary schools in Indonesia. Their study using the actual form of the WIHIC questionnaire revealed that students in rural schools experienced a less positive classroom environment than their counterparts in urban schools. Students in rural schools had less favourable perceptions for all the scales of the WIHIC compared to students in suburban and urban areas. A similar study carried out in Zimbabwe among junior secondary schools students and using the WIHIC noted that students in urban schools consistently scored highly for all classroom environment factors compared to students in rural schools (Shadreck, 2012).

Dorman (1999) in a study to validate the CSCEQ found out that catholic girls' schools had more positive classroom environments than those in catholic boys' and coeducational schools. Students in Girls' schools perceived higher student affiliation, cooperation, order and organisation, and individualisation. The sample consisted of 1,317 students from 52 religious education classes in 17 Australian catholic high schools.

Baek and Choi (2002) conducted a study to investigate the relationship between classroom environment and students' academic achievement in Korea using the CES questionnaire and a sample of 1,012 tenth and 11th graders. The results showed that the classroom environments in boys' only schools' were highest on affiliation, rule clarity, and innovation. On the contrary girls' only schools were lowest on affiliation, rule clarity and innovation but highest on task orientation and involvement. Coeducational schools scored close to the mean of the single gender schools. Notably, the perceptions of the affiliation scale differ from Dorman's (1999) findings.

A Kenyan study by Mucherah (2008), in two single sex boarding schools (one for boys and the other for girls) to investigate the relationship between classroom climate and student goal structures in high school Biology classes using the Classroom Climate Questionnaire showed that the students in the two schools differed on their perceptions of their biology classroom environment except on teacher support and competition. Boys perceived a greater level of involvement, affiliation, task focus, order and organisation, rule clarity and rule strictness. Girls on the other hand perceived their classroom activities to be highly innovative. The study consisted of 891 Form 2 and Form 3 students.

2.6 Summary

Classroom learning environment research has undergone remarkable development since its inception over half a century ago. From its roots in western countries, the study has spread to Asian and now African countries. Various methods of conceptualising and assessing the learning environment now exist. Notably, numerous instruments that have been found to be reliable and valid have been developed and are available for assessing the learning environment. Most of the instruments can measure

students', teachers' and sometimes parents' perceptions of the experienced and the preferred classroom environment. They can also be used distinguish between sub-groups in the classroom through the use of a personal form or the collective views of all members of a class by use of the class form.

Students' perception of the classroom environment from the foregoing discussion is an important consideration for all educators because numerous studies have established that they are linked with a variety of learning outcomes such as attitudes and cognitive achievement. Educators consequently need to pay attention to various determinants of the classroom environment such as gender, class level, and school type and introduce interventions that can help create a conducive environment as part of the broader quest to attain educational goals.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 Overview

This chapter discusses the research method, research design, target population, the study sample, sampling procedure, research instruments, validity and reliability, pilot study, data collection and data analysis procedures.

3.2 Research Design

This study adopted causal-comparative and correlational research designs. Causal-comparative research design attempts to establish a cause for or consequences of differences between groups. The independent variable is not under the control of the researcher (Fraenkel & Wallen, 2009). This design was chosen because the independent variables could not be manipulated and the phenomena under investigation had already occurred. This design was used to examine the influence of class level, school type, and gender on chemistry students' perception of psychosocial environment in their classrooms.

Correlational research design attempts to determine relationships between two or more variables. It is suitable in collecting more than one type of information from the sample when the intention is to describe and compare them (Fraenkel & Wallen, 2009). The designs are non-experimental because they deal with relationships among non-manipulated variables to analyse their relationships (Best & Kahn, 1993). This design was useful in exploring the relationships between the perception of the psychosocial environment of chemistry classrooms with attitudes towards chemistry and academic performance in chemistry.

3.3 Research Method

A quantitative method was employed in this study. The quantitative method involves techniques and measures that produce discreet numerical or quantifiable data (Mugenda & Mugenda, 2003). In this study, the use of questionnaires and record analysis was used to source for numerical data. Quantitative method is advantageous in that it is suitable for testing hypothesis and minimising research bias.

3.4 Geographical Location of the Study

The study was carried out in Keiyo sub-county. Keiyo sub-county is part of Elgeyo-Marakwet County. The geographical location of the study was chosen because the academic performance in chemistry was observed to be low (Keiyo Sub-county Education Day Planning Committee, 2014). It also has the characteristics desired for the study. Further, no study on learning environments has been done in the sub-county.

3.5 Research Population

The research population comprised all Form 2 and Form 4 chemistry students in all the secondary schools in Keiyo sub-county. Form 2 students are in their second year of secondary education whereas form 4 students are in their fourth and final year of secondary education. The sub-county has 21 secondary schools. There are three girls' only schools and three boys' only schools. The rest are co-educational. The research population was approximately 3,500 students.

3.6 The Study Sample and Sampling Procedure

Multi-stage sampling was used to select the participants in the study. First, the schools were stratified into boys' only, girls' only and co-educational schools. Two co-educational schools were in the process of phasing out students of one gender while

one other had no students at Form 4 level. These three schools were therefore omitted from the sampling frame. Schools in each stratum were then randomly selected by drawing lots to make up the sample. Table 3.1 shows the composition of the sampled schools.

Table 3.1: Breakdown of sampled schools

	School Category			Total
	Boys' Only Schools	Girls' only Schools	Co-educational Schools	
Total Number of schools	3	3	12	18
Sampled Schools	2	2	6	10

In the schools chosen, two class levels, Form 2 and Form 4 were purposively selected to take part in the study. This consideration provided for the study of the influence of class level on the students' perceptions of the psychosocial environment in a chemistry classroom. The two class levels represented lower and upper forms respectively. Students in each of the selected level have been in school longer and so have experienced the variables being examined longer. In schools with more than one stream per form, at least one stream was randomly selected by drawing lots. In single sex schools, participating students in each class were randomly selected while disproportionate stratified random sampling was used to select students in coeducational schools to ensure all groups were equitably represented. Krejcie and Morgan (1970) sample size table was used to determine the sample size. The composition of the participants is shown in the Table 3.2.

Table 3.2: Composition of sampled students

Gender	Class Level	School Category			Total
		Boys' Only School	Girls only Schools	Co-educational Schools	
Boys	Form 2	39	-	43	82
	Form 4	58	-	50	108
Girls	Form 2	-	43	56	99
	Form 4	-	43	34	77
	Total	97	86	183	366

3.7 Pilot Study

A pilot study is important in figuring out beforehand problems or issues a researcher may encounter in the actual study. It also facilitates an insight into issues such as validity, reliability, ethics, representation and researcher health and safety (Marshall & Rossman, 2001). A pilot study was carried out between 30th June and 4th July 2014 in Form 2 and Form 4 classes in one girls' only school, one boys' only school and in one co-educational school in Keiyo Sub-county. These schools were not involved in the main study. A total of 63 students in six classrooms responded to the two instruments: the WIHIC and the ATCLS. The instruments were found to have acceptable validity and reliability. The students' chemistry scores were sourced from their progress records in the respective schools. The pilot study helped to refine the instruments used in the main study by ensuring the language used in the instruments was appropriate. The time required to complete the instruments was also noted.

3.7.1 Validity

Kothari (2004) defines validity as the degree to which an instrument measures what it is supposed to measure. Prior to the study, three teachers who have in the past served

as chemistry examiners for the Kenya National Examinations Council were requested to look at the questions in the two questionnaires (the WIHIC and the ATCLS) and to point out questions which may be confusing or carry different meanings from what was intended. In their view “checks in with me” in item 15 of the WIHIC meant arrives with me. Checks in with me was therefore replaced with “moves about the class to talk with me”. “Seldom” as a measure of the frequency of classroom events occurring was replaced with rarely because it was felt that students were less familiar with the word.

The WIHIC and ATCLS scale intercorrelations (mean correlation of a scale with the other scales) were also calculated to measure each scale’s discriminant validity. The results are displayed in Table 3.3.

Table 3.3: WIHIC’s Discriminant Validity (Mean correlation of a scale with other scales)

	Discriminant validity
Student Cohesiveness	.44
Teacher Support	.38
Involvement	.43
Investigation	.47
Task Orientation	.45
Cooperation	.47
Equity	.48

The mean correlations of one scale with the other scales for the WIHIC were all positively correlated and ranged from 0.38 to 0.48. These values are sufficiently small to suggest that each scale of the WIHIC measures distinct aspects of the classroom environment but with some degree of overlap with other scales.

The mean correlations of each scale of the ATCLS were also positively correlated with the other scales and were small enough to suggest that each scale measured distinct aspects of the attitudes towards chemistry. The results are shown in Table 3.4.

Table 3.4: ATCLS's Discriminant Validity (Mean correlation of a scale with other scales)

Scale	Discriminant validity (Mean correlation of a scale with other scales)
Liking for chemistry theory lessons	.42
Liking for chemistry laboratory work	.38
Evaluative beliefs about school chemistry	.39
Behavioural tendencies to learn chemistry	.49

3.7.2 Reliability

Creswell (2009) states that reliability refers to whether scores to items on an instrument are internally consistent, stable over time and whether there was consistency in test administration and scoring. In this study, the scores obtained from one item were correlated with scores obtained from other items within the same scale in the instrument to determine their internal consistency. Cronbach's alpha coefficient was calculated to determine the degree of correlation among items in a scale. An alpha value of .70 and above is considered an adequate measure of internal consistency (Bland & Altman, 1997).

The reliability coefficients (α) for the different items of the WIHIC ranged from .70 to .80. The lowest reliability coefficient (.70) was obtained for the Task Orientation scale and the highest (.80) for the Investigation scale. The reliabilities of the various scales are shown in Table 3.5.

Table 3.5: WIHIC Scales Internal Consistency (Cronbach Alpha Reliability)

Scale	Alpha Reliability (α)
Student Cohesiveness	.71
Teacher Support	.76
Involvement	.78
Investigation	.80
Task Orientation	.70
Cooperation	.77
Equity	.76

The results obtained compares well with those from similar studies in different countries (Dorman, 2003).

The reliability coefficients for the different ATCLS scales ranged from .71 to .76. The lowest reliability coefficient (.71) was obtained for the Evaluative beliefs about school chemistry scale and the highest (.76) for the Liking for chemistry theory lessons scale. The reliabilities are displayed in Table 3.6.

Table 3.6: ATCLS Scales Internal Consistency (Cronbach Alpha Reliability)

Scale	Alpha Reliability (α)
Liking for chemistry theory lessons	.76
Liking for chemistry laboratory work	.71
Evaluative beliefs about school chemistry	.71
Behavioural tendencies to learn chemistry	.73

The results being consistently above .70 indicates the ATCLS is a reliable tool.

3.8 Data Collection Instruments

Two questionnaires, the WIHIC and the ATCLS were used to collect data in this study. Student scores in chemistry was obtained from progress records in the schools where data was collected

3.8.1 What Is Happening In this Class? (WIHIC) questionnaire

The WIHIC questionnaire was used in this study to assess the perceptions of the psychosocial environment of the chemistry classroom. It was developed by Fraser, McRobbie and Fisher (1996) by “combining modified versions of the most salient scales from a wide range of existing questionnaires with additional scales that accommodate contemporary educational concerns (for example equity and constructivism)” (Fraser, 1998b, p. 13). The WIHIC has therefore made the study of learning environments economical. The WIHIC comprises 7 scales with 8 items each.

The WIHIC has been extensively used in many countries where it has been shown to be valid and reliable. The countries include: Zimbabwe (Shadreck, 2012), Uganda (Opolot-Okurut, 2010), Turkey (den Brok, Telli, Cakiroglu, Taconis & Tekkaya, 2010), Canada (Smith & Ezeife, 2010), USA (Rita & Martin-Dunlop, 2011), Australia and Indonesia (Fraser & Aldridge & Adolphe, 2010), India (Koul & Fisher, 2003), Singapore (Fraser & Chionh, 2000) and Taiwan (Aldridge & Fraser, 2000). Dorman (2003) in a study to validate the WIHIC cross nationally in Australia, the United Kingdom and Canada showed its reliability (Cronbach’s alpha) to be above .70 when the student was used as the unit of analysis and above .85 at the class level. Exploratory and confirmatory factor analyses showed factor loadings above .40 within the scales and lower loadings on other scales.

The WIHIC scale has also been used to assess various subjects including science (Shadreck, 2012; Fraser & Aldridge & Adolphe, 2010; Koul & Fisher, 2003), mathematics, (Opolot-Okurut, 2010; Dorman & Adams, 2004), chemistry (Wong & Fraser, 1997; Rivera & Ganaden, 2000), biology (den Brok, et al., 2010; Rita & Martin-Dunlop, 2011) and mathematics and geography (Chionh & Fraser, 2009).

The seven WIHIC scales are Student cohesiveness, Teacher support, Involvement, Investigation, Task Orientation, Cooperation, and Equity. Student Cohesiveness, Teacher Support and Involvement fall under Moos relationship dimension. Investigation, Task Orientation and Cooperation are grouped under Moos personal development dimensions while Equity is categorised under the system maintenance and change dimensions.

The WIHIC has been translated into Chinese for use in Taiwan (Aldridge & Fraser, 2000) and into Korean for use in Korea (Kim, Fisher, & Fraser, 2000).

The WIHIC questionnaire is usually administered in a class which typically consists of 20-30 students. The items on a WIHIC questionnaire are responded to on a five point Likert scale of Almost Never, Seldom, Sometimes, Often and Almost Always. The total score for a particular score is the sum of the circled numbers for the eight items belonging to that scale. Omitted or incorrectly answered items are given a score of 3. The higher the scale score, the more a classroom score occurs in that dimension (Khine, 2001).

A distinctive feature of most learning environment questionnaires is the existence of personal and class forms and actual and preferred forms of the same instrument.

Fraser and Tobin (1991) noted that classrooms had groups of students named target students who were more involved in classroom discussions than other students. These target students were found to enjoy more favourable perceptions of the classroom environment than those who were less involved. Earlier classroom environment instruments were unable to differentiate between sub-groups in the classroom because they were designed to source the shared views of the class as a whole.

The distinction between personal and class forms of the WIHIC questionnaire allows for the collection of views of individual students and the shared views of the class respectively. The personal and class forms of the questionnaire is consistent with Stern, Stein and Bloom's (1956) concept of private beta press and consensual beta press. The personal form of the WIHIC questionnaire was used in this study.

Most learning environment questionnaires have a form to measure the experienced classroom environment and another form to assess an ideal or preferred classroom environment. The preferred forms are concerned with goals and value orientations and measure perceptions of the classroom environment ideally liked or preferred. Though the wording for the two forms are similar, slightly different instructions for answering each are used (Fraser, 1998b).

Actual and personal forms are useful for improving classroom environments. This is done by bridging the gap in the variation between observed classroom environments dimensions with those preferred by students. The actual form of the WIHIC questionnaire was used in this study.

3.8.2 Attitudes Towards Chemistry Lesson Scale

A number of instruments have been constructed to measure attitudes towards science and among those receiving considerable attention in science education is the TOSRA

developed by Fraser (Cheung, 2007). The TOSRA is a 70 item Likert type instrument categorised into seven scales. The seven scales include social implications of science, normality of scientists, attitude to scientific inquiry, adoption of scientific attitudes, enjoyment of science lessons, leisure interest in science and career interest in science (Cheung, 2007). The scale is however lengthy and requires more time to administer, lacks multidimensionality and is not grounded on theory.

The Attitude Towards Chemistry Lessons Scale (ATCLS) was used for this study. The instrument has been modified from the enjoyment scale of the TOSRA for use to evaluate school chemistry. It has four scales with three items each. The scales are Liking for chemistry theory work, Liking for chemistry laboratory lessons, Evaluative beliefs about school chemistry and behavioural tendencies to learn chemistry (Cheung, 2007).

3.9 Research Variables

The independent variables for this study were classroom psychosocial environment, gender, class level, and school type. The dependent variables were chemistry classroom psychosocial environment, attitudes toward chemistry and academic performance in chemistry.

3.10 Data Analysis

Statistical analyses were carried out to examine the reliability and validity of the data collection instruments, to investigate the associations between the student outcomes (academic performance and attitudes) and the various scales of the WIHIC, and to examine the differences in the students' perception of the learning environment with respect to gender, class level and school type. The Statistical Package for the Social Sciences (Version 17) was used to analyse the students' responses.

Pearson product moment correlation was used to determine relationships between the factors in the WIHIC scale and academic performance and attitudes towards chemistry. A t-test for independent samples was used to compare the differences in the students' perception of the classroom psychosocial environment by gender and class level. Differences in the perceptions of students in different school types for WIHIC factors was analysed using one way ANOVA. Statistical inference was carried out at 0.05 level of significance.

3.11 Administration of the Instruments

A research permit was obtained from the National Commission for Science, Technology and Innovation (NACOSTI) to enable the researcher to collect data from various participants. Further clearance to conduct research in the sub-county was sought from the county commissioner and the county director of education, Elgeyo-Marakwet County and the respective head teachers and chemistry teachers in the various schools.

Two data collection instruments were used to source data. The WIHIC questionnaire was used to obtain data on the perception of students of their psychosocial environment in a chemistry classroom. ATCLS was used to obtain data on the attitudes of learners towards chemistry. The two questionnaires were administered to the participants by the researcher in the selected classrooms. The respondents were given clear instructions which were on the first page of the instruments before they started to answer the questions. Adequate time was allowed for the participants to complete the instruments before they were collected.

Academic performance of students in chemistry was based on their average scores in chemistry assessment over the preceding three terms. This was obtained from the

progress records in the respective schools. Since the different schools sit different exams, the scores were standardised to Z- scores to allow for comparisons.

3.12 Ethical Considerations

Each participant's right to privacy was respected. The participants were not required to write their names on the questionnaires. The questionnaires were however coded using the participant's admission number to enable the researcher to associate the mean chemistry score with the right participant.

Participants were asked to read and sign the Informed Consent Letter before participation in the study. The participants, chemistry teachers and the school administration were assured that the information they divulged would not be used for purposes other than those stated.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Overview

This chapter details the data analyses, results and findings from the study. Data were collected using two questionnaires: the WIHIC to gather the students' perceptions of the psychosocial environment of chemistry classrooms and the ATCLS to collect the students' attitudes towards chemistry. An average score in chemistry from three preceding terms was obtained for each participant by referring to the students' progress records. The results were then standardised to Z-scores.

In all, data was collected from 366 students in 10 secondary school classrooms in Keiyo sub-county. The demographics of the participants is presented in Table 4.1.

Table 4.1: Demographics of the Participants by Gender, Class (Form) and School Type

Form	Gender			
	Girls		Boys	
	Single Sex	Coeducational	Single Sex	Coeducational
2	43	56	39	43
4	43	34	58	50
Total	86	90	97	93

The data collected were then used to analyse the students' perception of the psychosocial environment of chemistry classrooms in relation to attitudes and academic performance. Finally, the possible influences of gender, class level and school type on chemistry classroom psychosocial environment was analysed. The data were analysed using SPSS (Version 17.0).

4.2 Means and Standard Deviations of the WIHIC and ATCLS Scales

The students' means and standard deviations on each of the WIHIC scales is presented in Table 4.2.

Table 4.2: Means and Standard Deviations for each Scale of the WIHIC

WIHIC Scale	Mean	Standard Deviation
Student Cohesiveness	4.07	0.53
Teacher Support	3.51	0.69
Involvement	3.26	0.70
Investigation	3.55	0.74
Task Orientation	4.20	0.53
Cooperation	3.94	0.64
Equity	3.93	0.66
Mean for the WIHIC questionnaire	3.78	

The mean scores for the WIHIC scales ranged from 3.26 to 4.20 with an average of 3.78. The mean scores above suggest a fairly positive chemistry classroom psychosocial environment. The students perceived task orientation, cohesiveness, and cooperation most positively. The standard deviation for all the scales is small suggesting that the variation in the students' perceptions is small. The low means observed for teacher support and involvement may be partly explained by the large number of students per class. Teachers would therefore generally have limited time to attend to each learner. Conversely, each learner may also not get the opportunity to be involved in class activities. The high mean for task orientation may be explained by the high premium stakeholders in the education sector attach on academic achievement.

Descriptive analysis of the attitude questionnaire revealed the results displayed in Table 4.3.

Table 4.3: Means and Standard Deviations for each Scale of the ATCLS

ATCLS Scales	Mean	Standard deviation
Liking for chemistry theory lessons	3.54	0.91
Liking for chemistry laboratory lessons	4.19	0.75
Evaluative beliefs about school chemistry	3.92	0.84
Behavioural tendencies to learn chemistry	4.01	0.81
Mean for the attitude questionnaire	3.92	

The means ranged from 3.54 for the liking for chemistry lessons scale to 4.19 for the Liking for chemistry laboratory lessons. The mean for the attitude questionnaire was 3.915. These suggest that students generally have positive attitudes towards school chemistry. The small standard deviation (below 1.0) in each scale suggests there was not a large diversity in the students' attitudes towards chemistry. These findings differ from those of Nui and Wahome (2006) and Ramsden (1998) who found out that students generally had neutral or negative attitudes towards science. The positive attitudes recorded in this study could be the result of the deliberate retraining of teachers over the years through SMASSE.

Each of the sampled schools and class levels sat different exams and so meaningful comparisons of their academic performance could not be carried out. Scores from each school and class level were therefore standardised into Z-scores to provide a uniform yardstick for comparing the associations between academic performance and perceptions of the chemistry classroom psychosocial environment.

4.3 Relationship between Classroom Psychosocial Environment and Attitudes toward Chemistry

Research Question 1

The research question 1 stated that: Is there a relationship between chemistry students' perception of the psychosocial environment of their classroom and their attitudes towards chemistry? To answer this question, a null hypothesis was formulated that: There is no significant relationship between chemistry students' perception of the psychosocial environment of their classroom and their attitudes towards chemistry.

To test this hypothesis, the participants were asked to respond to items in the WIHIC which measured their perception of the chemistry classroom psychosocial environment. They were also asked to respond to items in ATCLS which measured their attitudes towards chemistry. Their responses to the two instruments were scored and correlated using the Pearson product moment correlation. The results of the correlation are reported in Table 4.4.

Table 4.4: Simple Correlation between Perceptions of the Chemistry Classroom Psychosocial Environment and Attitudes towards Chemistry

Measure	1	2
1. WIHIC	-	.33**
2. ATCLS	.33**	-
<i>M</i>	3.78	3.92
<i>SD</i>	0.47	0.63

** $p \leq 0.001$

n=366

The result of simple correlation analysis shows a statistically significant positive association between the perceptions of the chemistry classroom psychosocial environment and attitudes towards chemistry, $r(364) = .329$, $p < .001$. Further analysis revealed that perceptions for each scale of the WIHIC were significantly and positively correlated with each scale of the ATCLS as reported in Table 4.5.

Table 4.5: Simple Correlation (r) for Associations between Scales of the WIHIC and those of the ATCLS.

	Liking for chemistry theory lessons	Liking for chemistry laboratory lessons	Evaluative beliefs about school chemistry	Behavioural tendencies to learn chemistry
Student Cohesiveness	.22**	.38**	.17**	.17**
Teacher Support	.26**	.28**	.14**	.15**
Involvement	.24**	.13*	.21**	.16**
Investigation	.30**	.19**	.27**	.23**
Task Orientation	.17**	.10	.21**	.18**
Cooperation	.12*	.29**	.19**	.27**
Equity	.29**	.19**	.24**	.18**

* $p \leq .05$, ** $p \leq 0.001$
n=366

4.4 Relationship between Classroom Psychosocial Environment and Academic Performance in Chemistry

Research Question 2

The research question 2 stated that: Is there a relationship between chemistry students' perception of the psychosocial environment of their classroom and their academic performance in chemistry. To answer this question, a null hypothesis was

formulated that: There is no significant relationship between chemistry students' perception of the psychosocial environment of their classroom and their academic performance in chemistry.

To test this hypothesis, the participants were asked to respond to items in the WIHIC which measured their perception of the chemistry classroom psychosocial environment. An average score in chemistry was calculated from scores of three preceding terms. These were obtained from the respective schools' progress records and served as a measure of academic performance in chemistry. The responses to the WIHIC items were scored and correlated with standardized chemistry scores using Pearson product moment correlation. The results of the correlation are reported in Table 4.6.

Table 4.6: Simple Correlation between Perceptions of the Chemistry Classroom Psychosocial Environment and Academic Performance in Chemistry

Measure	1	2
1. Perceptions of Classroom Psychosocial Environment	-	.16**
2. Standardised Chemistry Scores	.16**	-
M	3.78	0
SD	0.47	1

**** $p \leq 0.001$**
n=366

The result of simple correlation analysis showed that perceptions of the classroom psychosocial environment are positively and significantly related with academic performance in chemistry, $r(364) = .155, p = .003$. Further analysis was conducted to explore the relationship between the various WIHIC scales and academic performance. The results are displayed in Table 4.7.

Table 4.7: Simple Correlation (r) between WIHIC Scales and Academic Performance in Chemistry

WIHIC Scale	Average Score in Chemistry
Student Cohesiveness	.12*
Teacher Support	.15**
Involvement	.13*
Investigation	.15**
Task Orientation	.06
Cooperation	.04
Equity	.12*

* $p \leq .05$, ** $p \leq 0.001$

n=366

The results of simple correlation analysis show that 5 out of the 7 correlations are statistically significant. Results show that Student Cohesiveness, Teacher Support, Involvement, Investigation and Equity are significantly and positively correlated with the students' academic performance in chemistry. Task orientation and cooperation were found not to be correlated with academic performance in chemistry.

4.5 Influence of Gender on the Chemistry Classroom Psychosocial Environment

Research Question 3

The research question 3 stated as follows: Do male and female students differ in their perception of the psychosocial environment of their chemistry classroom? To answer this question, a null hypothesis was formulated and read as follows: There is no significant difference between male and female students on their perception of the psychosocial environment of their chemistry classroom.

To test this hypothesis, the participants were asked to indicate their gender on the WIHIC questionnaire. They were further asked to respond to items on the instrument to measure their perceptions of the chemistry classroom psychosocial environment. Their mean scores on the perception of the chemistry classroom psychosocial environment were calculated and are reported in Table 4.8.

Table 4.8: Mean Scores on the Perceptions of Chemistry Classroom Psychosocial Environment by Gender

Perceptions of Chemistry Classroom Psychosocial Environment			
Gender	<i>n</i>	<i>M</i>	<i>SD</i>
Male	190	210.89	26.21
Female	176	212.47	26.06
Total	366	211.68	26.14

A t-test for independent samples was conducted to find out whether or not there was a significance difference in the mean scores of male and female participants in their perceptions of the chemistry classroom psychosocial environment. The results of the analysis showed that there was no statistically significant difference between the two mean scores, $t(362) = -.577, p = .564$. It was concluded that male and female students do not differ in their perception of the chemistry classroom psychosocial environment.

4.6 Influence of Class Level on Chemistry Classroom Psychosocial Environment

Research Question 4

The research question 4 stated that: Do Form 2 and Form 4 students differ on their perception of the psychosocial environment of their chemistry classroom? To answer this research question, the following null hypothesis was formulated: There is no

significant difference between Form 2 and Form 4 learners' on their perception of the psychosocial environment of their chemistry classroom.

To test this hypothesis, the participants were asked to indicate their class level on the WIHIC questionnaire. They were further asked to respond to items on the instrument to measure their perceptions of the chemistry classroom psychosocial environment. Their mean scores on the perception of the chemistry classroom psychosocial environment were calculated and are reported in Table 4.9.

Table 4.9: Mean Scores on the Perceptions of Chemistry Classroom Psychosocial Environment by Class Level

Class Level	<i>n</i>	Perceptions of Chemistry Classroom Psychosocial Environment	
		<i>M</i>	<i>SD</i>
Form 2	181	213.41	26.02
Form 4	185	209.93	26.16
Total	366	211.67	26.09

A t-test for independent samples was conducted to find out whether or not there was a significance difference in the mean scores of Form 2 and Form 4 participants in their perceptions of the chemistry classroom psychosocial environment. The results of the analysis showed that there was no statistically significant difference between the two mean scores, $t(364) = 1.277$, $p = 0.202$. It was concluded that Form 2 and Form 4 students do not differ in their perception of the chemistry classroom psychosocial environment.

4.7 Influence of school Type on the Chemistry Classroom Psychosocial Environment

Research Question 5

The research question 5 stated as follow: does school type influence the perception of students of the psychosocial environment of their chemistry classroom? To answer this question, a null hypothesis was formulated that: There is no significant difference among learners in different school types on their perception of the psychosocial environment of their chemistry classroom.

To test this hypothesis, participants were asked to indicate their school type on the WIHIC questionnaire. They were further asked to respond to the items in this questionnaire to measure their perceptions of the chemistry classroom psychosocial environment. Their mean scores for the perception of the chemistry classroom psychosocial environment were calculated and are reported in Table 4.10.

Table 4.10: Mean Scores on the Perceptions of Chemistry Classroom Psychosocial Environment by School Type

School Type	<i>n</i>	Perceptions of Chemistry Classroom Psychosocial Environment	
		<i>M</i>	<i>SD</i>
Boys' Only	97	213.94	21.99
Girls' Only	86	210.06	26.72
Coeducational	183	211.19	27.84
Total	366	211.73	25.64

A one way between subjects ANOVA was conducted to find out whether or not there was a significance difference in the mean scores of participants in boys' only schools,

girls' only schools and in coeducational schools in their perceptions of the chemistry classroom psychosocial environment. The results of the analysis showed that there was no statistically significant difference between the three mean scores, $F(2,363) = 0.559, p = 0.572$. It was concluded that participants in boys' only schools, girls' only schools, and in coeducational schools do not differ in their perception of the chemistry classroom psychosocial environment.

4.8 Summary of Findings

This study set out to investigate the perception of students of the psychosocial environment of their chemistry classroom in relation to attitudes and academic performance. It also sought to examine the influence of gender, class level and school type on the psychosocial environment of chemistry classrooms. The main findings from this study are as follows: perception of the chemistry classroom psychosocial environment is significantly and positively correlated with the attitudes toward chemistry. Perception of the chemistry classroom psychosocial environment was also found to be associated with academic performance in chemistry. Further, male and female students and students in Form 2 and Form 4 were not significantly different in their perceptions of all the measured aspects of the classroom environment. Lastly, students' perception of the chemistry classroom psychosocial environment was not significantly different in the three types of schools studied.

CHAPTER FIVE

DISCUSSION, CONCLUSION, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

5.1 Overview

This chapter presents a summary of the study, discussion of the findings, conclusion and recommendations based on the study findings.

5.2 Summary of the Study

The purpose of this study was to investigate students' perception of their chemistry classroom psychosocial environment in secondary schools in Keiyo Sub-county and to establish if this was related with academic performance and attitudes towards chemistry. The study also examined the influence of gender, class level and type of school on the perceptions of students of the psychosocial environment of chemistry classrooms.

The study of learning environments stems from the work of early psychologists who made attempts to characterize various human environments like schools, prisons and homes and is directly linked to the work of Moos (1979) and Walberg (1991) who came up with different scales to measure human environments. The assessment of classroom environments has shifted over the years from methods that rely on direct observation to those that measure the participants' subjective perceptual responses (Fraser, 1996). A number of reliable and valid questionnaires are available to assess the classroom environment. This study employed the WIHIC questionnaire to assess the students' perception of the chemistry classroom environment. This instrument combines scales from a wide range of questionnaires and includes dimensions that

incorporate contemporary issues in education. It was also found to be suitable for use with secondary school students (Fraser, 1998b).

Review of literature showed that the classroom environment is related to and can predict various learning outcomes such as academic performance, attitudes, academic efficacy and motivation. Prior studies have also used classroom environment factors as dependent variables. Classroom environment has been shown to vary with such factors as school type, gender, class level, and subject area. Studies have also been carried out to assess the actual and preferred classroom environment and the perceptions of students and teachers of the classroom environment using both the student and the class as the unit of analysis (Dorman, 2002).

Causal comparative and correlation designs were used in the study. A quantitative approach was used in data collection and involved the use of two questionnaires, the WIHIC and the ATCLS. Students' average score in chemistry was obtained from their progress records. The research population comprised all Form 2 and Form 4 students. Stratified random sampling was used to select schools which participated in the study. Form 2 and Form 4 class levels were purposively sampled. The two levels allowed for the comparison of perceptions of classroom environment across class levels. At least a third of the classrooms and students were included in the study. In all, 366 participants from 21 classrooms in 10 secondary schools were involved in the study.

Tests carried out confirmed the instruments used as having sound psychometric properties. All the items in the two questionnaires used had a Cronbach alpha reliability coefficient above 0.7 (Bland & Altman, 1997). Data collected were analysed using means, standard deviations, Pearson product moment correlation, independent t- tests and one way ANOVA.

5.3 Discussion of the findings

The study found out that perception of the chemistry classroom environment and attitudes towards chemistry were significantly and positively correlated, $r(364) = .329$, $p < .001$. The results also revealed that perceptions for each scale of the WIHIC were significantly and positively correlated with each scale of the ATCLS. These findings are consistent with findings from previous research (for example Koul & Fisher, 2006; Smith & Ezeife, 2010; Telli et al., 2006; Wolf & Fraser, 2007) which found most classroom environment factors and attitude factors to be positively correlated.

Consequently, in classes where students perceive a high level of cohesion, classes in which teachers are supportive, classes in which students are involved in classroom activities, classes that frequently use investigative methods, classes in which learners remain on assigned tasks, classes in which members are cooperative and classes that operate equitably, have students that show a more positive attitude towards chemistry. The positive outlook on chemistry would include a liking for both chemistry theory and practical lessons, a feeling that chemistry is an important subject to learn and a mindset to be willing to do more to internalize chemistry concepts.

Educators should therefore aspire to improve aspects of the classroom environment defined by the WIHIC in order to foster students' attitudes towards chemistry. It is apparent from this study that a friendly and supportive classroom environment, where the teacher is helpful and fair in his or her treatment of all the students favours the development of liking for chemistry as a school subject and the motivation to learn it. Teachers can therefore play a pivotal role in ensuring that all students are involved in class tasks in spite of the large class sizes. Additionally, emphasis should be placed on

the development of various practical skills, inquiry competencies and problem solving skills to prepare learners adequately for future challenges in the subject.

The perceptions of the chemistry classroom psychosocial environment and academic performance in chemistry were also found to be significantly related, $r(364) = .155$, $p = .003$. Specifically, student cohesiveness, teacher support, involvement in class tasks, investigation skills and equity in the classroom were found to be related academic performance in chemistry. Only task orientation and cooperation did not correlate with academic performance. These findings largely replicate research in various subject areas which have shown significant associations between learning environment factors and academic performance. These include Wayhudi and Treagust (2004), who found out that student cohesiveness was positively and significantly related to academic achievement in science, Chionh and Fraser (2009) who established a link between student cohesiveness, task orientation, and equity on academic performance in mathematics, and Baek and Choi (2002) who found student involvement, teachers control and task orientation to be related to academic performance in English. Similarly, Ganaden and Rivera (2000) found association between teacher support and academic achievement in chemistry. Notable in this study is the lack of a relationship between task orientation and cooperation with academic performance. In the Kenyan education set up, teachers are particularly keen and strict on completion of tasks and failure by students to complete them is severely punished (Human Rights Watch, 1999). Students may therefore be mechanically solving tasks without really bothering to understand them in order to meet deadlines. This may explain the lack of association between task orientation and academic performance. The non-significant relationship between cooperation and academic

performance may be attributed to the competitive nature of most classrooms. Students therefore find it a contradiction to cooperate and compete at the same time.

Male and female students did not significantly differ in their perceptions of the chemistry classroom psychosocial environment, $t(362) = -.577, p = .564$. The finding from this study agrees with that of Khalil and Saar (2009) who found no difference in the perceptions of the learning environment by male and female students. This finding however differs from many prior studies that have generally shown female students as perceiving their learning environment more favourably than their male counterparts (Huang, 2003; Wong & Fraser, 1997; Quek et al., 2001). It also differs with findings with studies (for example Shadreck, 2012; Wayhudi & Treagust, 2004) which have determined that male students perceived higher teacher support than female students.

This finding contrast with most past studies which have consistently shown girls to have more positive perceptions of the classroom environment. This similarity in the perceptions of the chemistry classroom psychosocial environment between the genders can be explained by the fact that male and female students would have interacted for long by the time they get to secondary school. This is because most primary schools are coeducational and therefore opportunities for shared experiences are ample. This observation can also be the result of the clamour for equal opportunities in learning for both male and female students. Additionally, the presence of role models and mentors now means females students, who for long have been perceived to be weaker in the sciences, have someone to look up to and thus the positive view to their chemistry learning environment.

There were no significant differences between students in Form 2 and Form 4 in their perceptions of all the measured aspects of the classroom environment, $t(364) = 1.277$, $p = 0.202$. Past studies have reported mixed results on the influence of class level on the classroom environment.

This observation differs from those found in previous research studies. Studies reviewed turned up mixed results. Randhawa and Michayluk (1975) for example noted that as class increased, students perceived the classroom environment less positively. This was in their study of learning environments in urban and rural Grade 8 and Grade 11 mathematics, science, social studies and English classrooms in Canadian schools. Other studies have reported an increase in the perception of certain aspects of the classroom environment and a decrease in others with increase in the class level (for example Cheng, 2009; Hoang, 2008; Dorman, 1999; Mucherah, 2008). In these studies, such interpersonal aspects as cohesiveness, cooperation, teacher support and order and organisation were generally perceived more favourably by students in higher classes. This could be because of the longer duration of interaction among students and their teachers. The decrease in the perception of factors such as teacher control could be attributed to the fact that students in higher classes are more mature and are growing towards independence.

The non-significant differences in the perceptions of the classroom environment across class levels in this study suggests that schools create situations that ensure homogeneity across class levels. Most of the students who participated in the study board in their schools. Most therefore spend at least 9 months together, interacting in places such as the dormitory, in clubs and societies and out in the field of play. Further, these students are taught by the same teachers throughout the school year.

This interaction outside the classroom present opportunities to share experiences with peers and to influence and shape each other's views.

Lastly, students in the various school types did not significantly differ in their perceptions of their chemistry classroom psychosocial environment, $F(2,363) = 0.559, p = 0.572$. This finding implies that single sex and coeducational schools in the area of the study create fairly similar learning situations, provide similar experiences, present similar opportunities for their learners and demand similar expectations from their students. Results from a number of studies have concluded that the classroom environment differs from one type of school to another. Significant differences have been found between private and public schools (Rivera & Ganaden, 2000), low performing and high performing schools (Opolot-Okurut, 2010), urban and rural schools (Shadreck, 2012; Wahyudi & Treagust, 2004) and between single gender and coeducational schools (Dorman, 1999; Baek & Choi, 2002; Mucherah, 2008). The findings in this study therefore differ from these studies.

The similarity in the learning situations is evidenced by the presence of activities that brings about uniformity in what different schools do. These include a joint county examination for all students in all class levels. Schools also get to learn best practices through benchmarking sessions with other schools. Further, the creation of a sub-county teacher resource centre means teachers get to benefit from shared resources which they in turn expose to their students in the various schools. The ongoing retraining of science teachers through the SMASSE project has also contributed in the homogeneity observed in classrooms in different schools in the county because science teachers get to share best practices in the respective subjects.

5.4 Conclusion

This study investigated the perceptions of students of the psychosocial environment of chemistry classrooms in relation to attitudes and academic performance. The study further looked at the influences of gender, class level and school type on the psychosocial environment of chemistry classrooms. Two instruments, the WIHIC to collect perceptions of the psychosocial environment of the chemistry classrooms and the ATCLS to collect attitudes towards chemistry were used in this study. The two instruments were found to be valid and reliable.

Findings from the study indicate that the perceptions classroom psychosocial environment is associated with attitudes and academic performance in chemistry. The study found no differences in the perceptions of the psychosocial environment of chemistry classrooms with respect to gender, class level and school type.

This study, like many before it, has established associations between classroom environment factors and attitudes as well as academic performance. Educators can therefore adjust aspects of the classroom environment that maximise student learning. This study further contributes to the field of classroom learning environment research because it extends the assessment to the chemistry classrooms in Keiyo sub-county.

5.5 Recommendations

Based on the findings of this study, the following recommendations are made.

1. Chemistry teachers should strive to enhance the classroom environment variables which are under their control to optimise learning. This should include being responsive to students' needs, providing opportunities for

students to be involved in classroom activities and ensuring that students in their classrooms are treated equitably.

2. Students should be encouraged to foster a cohesive, cooperative, and task oriented environments in their classrooms. These classroom environment factors measured by the WIHIC have been shown to influence learning outcomes.
3. Many research studies have shown gender, class level and school type to have an influence on the classroom environment. This study did not find such influence. It is recommended that further studies be done so as to explain this difference.

5.6 Suggestions for further Research

Findings from this study have revealed the association between various chemistry classroom environment factors with attitudes and academic performance in chemistry. Gender and school type has also been shown to influence particular classroom environment variables. This study is the first of its kind in the Sub-county and in order to fully appreciate the interaction of the various variables, the following suggestions for future research are made.

1. To replicate the present study with some changes like using different class levels, using different categories of schools such as national and county schools and using a bigger sample.
2. To combine both quantitative and qualitative approaches in studies. The qualitative probes will help explain the quantitative findings.
3. To assess both the actual and the preferred environment of learners and to compare them.

4. To compare the teachers and students' perception of the classroom environment.
5. To assess the classroom environments of other subjects.
6. To establish the relationship between classroom environment with other affective outcomes such as academic efficacy.

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APPENDICES

Appendix 1: What Is Happening In This Class? (WIHIC) Questionnaire

This survey contains statements about practices which could take place in a chemistry class. You will be asked how often each practice takes place. There are no 'right' or 'wrong' answers.

Your opinion is what is wanted. Think about how well each statement describes what this class is like for you. Draw a circle around:

1 if the practice takes place **Almost Never**

2 if the practice takes place **Rarely**

3 if the practice takes place **Sometimes**

4 if the practice takes place **Often**

5 if the practice takes place **Almost Always**

STUDENT COHESIVENESS	Almost Never	Rarely	Some- times	Often	Almost Always
1. I make friendships among students in this class.	1	2	3	4	5
2. I know other students in this class.	1	2	3	4	5
3. I am friendly to members of this class.	1	2	3	4	5
4. Members of the class are my friends.	1	2	3	4	5
5. I work well with other class members.	1	2	3	4	5
6. I help other class members who are having trouble with their work.	1	2	3	4	5
7. Students in this class like me.	1	2	3	4	5
8. In this class, I get help from other students.	1	2	3	4	5
TEACHER SUPPORT	Almost Never	Rarely	Some- times	Often	Almost Always
9. The teacher takes a personal interest in me.	1	2	3	4	5
10. The teacher goes out of his/her way to help me.	1	2	3	4	5
11. The teacher considers my feelings.	1	2	3	4	5
12. The teacher helps me when I have trouble with the work.	1	2	3	4	5
13. The teacher talks with me.	1	2	3	4	5
14. The teacher is interested in my problems.	1	2	3	4	5
15. The teacher moves about the class to talk with me.	1	2	3	4	5
16. The teacher's questions help me to understand.	1	2	3	4	5
INVOLVEMENT	Almost Never	Rarely	Some- times	Often	Almost Always

17. I discuss ideas in class.	1	2	3	4	5
18. I give my opinions during class discussions.	1	2	3	4	5
19. The teacher asks me questions.	1	2	3	4	5
20. My ideas and suggestions are used during classroom discussions.	1	2	3	4	5
21. I ask the teacher questions.	1	2	3	4	5
22. I explain my ideas to other students.	1	2	3	4	5
23. Students discuss with me how to go about solving problems.	1	2	3	4	5
24. I am asked to explain how I solve problems.	1	2	3	4	5
INVESTIGATION	Almost Never	Rarely	Some- times	Often	Almost Always
25. I carry out investigations to test my ideas.	1	2	3	4	5
26. I am asked to think about the evidence for statements.	1	2	3	4	5
27. I carry out investigations to answer questions coming from discussions.	1	2	3	4	5
28. I explain the meaning of statements, diagrams and graphs.	1	2	3	4	5
29. I carry out investigations to answer questions which puzzle me.	1	2	3	4	5
30. I carry out investigations to answer the teacher's questions.	1	2	3	4	5
31. I find out answers to questions by doing investigations.	1	2	3	4	5

32. I solve problems by using information obtained from my own investigations.	1	2	3	4	5
TASK ORIENTATION	Almost Never	Rarely	Some- times	Often	Almost Always
33. Getting a certain amount of work done is important to me.	1	2	3	4	5
34. I do as much as I set out to do.	1	2	3	4	5
35. I know the goals for this class.	1	2	3	4	5
36. I am ready to start this class on time.	1	2	3	4	5
37. I know what I am trying to accomplish in this class.	1	2	3	4	5
38. I pay attention during this class.	1	2	3	4	5
39. I try to understand the work in this class.	1	2	3	4	5
40. I know how much work I have to do.	1	2	3	4	5
COOPERATION	Almost Never	Rarely	Some- times	Often	Almost Always
41. I cooperate with other students when doing assignment work.	1	2	3	4	5
42. I share my books and resources with other students when doing assignments.	1	2	3	4	5
43. When I work in groups in this class, there is teamwork.	1	2	3	4	5
44. I work with other students during practicals.	1	2	3	4	5
45. I learn from other students in this class.	1	2	3	4	5

46. I work with other students in this class	1	2	3	4	5
47. I cooperate with other students on class activities.	1	2	3	4	5
48. Students work with me to achieve class goals.	1	2	3	4	5
EQUITY	Almost Never	Rarely	Some- times	Often	Almost Always
49. The teacher gives as much attention to my questions as to other students' questions.	1	2	3	4	5
50. I get the same amount of help from the teacher as do other students.	1	2	3	4	5
51. I have the same amount of say in this class as other students.	1	2	3	4	5
52. I am treated the same as other students in this class.	1	2	3	4	5
53. I receive the same encouragement from the teacher as other students do.	1	2	3	4	5
54. I get the same opportunity to contribute to class discussions as other students.	1	2	3	4	5
55. My work receives as much praise as other students' work.	1	2	3	4	5
56. I get the same opportunity to answer questions as other students.	1	2	3	4	5

Appendix 2: Attitude Toward Chemistry Lessons SCALE (ATCLS)

Tick the statement that you think best represents your view of chemistry as a school subject.

Use the Key below as a guide.

1. Strongly Disagree (SD)
2. Disagree (D)
3. Uncertain (U)
4. Agree (A)
5. Strongly Agree (SA)

LIKING FOR CHEMISTRY THEORY LESSONS

SD D U A SA

1	I like chemistry more than any other school subject					
2	Chemistry lessons are interesting.					
3	Chemistry is one of my favourite subjects.					

LIKING FOR CHEMISTRY LABORATORY WORK

SD D U A SA

4	I like to do chemistry experiments.					
5	When I am working in the chemistry laboratory, I feel I am doing something important.					
6	Doing chemistry experiments in school is fun.					

EVALUATIVE BELIEFS ABOUT SCHOOL CHEMISTRY

SD D U A SA

7	Chemistry is useful for solving everyday problems.					
8	People must understand chemistry because it affects their lives.					
9	Chemistry is one of the most important subjects for people to study					

BEHAVIOURAL TENDENCIES TO LEARN CHEMISTRY**SD****D****U****A****SA**

10	I am willing to spend more time reading chemistry books					
11	I like trying to solve new problems in chemistry.					
12	If I had a chance, I would do a project in chemistry.					

Appendix 3: Student Consent Form

JULY 2014

Dear participant,

My name is Rutto Hillary and I am currently studying for a Master of Philosophy degree at Moi University. I wish to request for your consent to participate in a student based research to examine the relationship between chemistry students' perception of classroom psychosocial environment and their academic performance and attitudes towards the subject.

The study will also examine the influence of class level, school type, and gender on chemistry students' perception of classroom psychosocial environment.

The study will employ two questionnaires and an analysis of chemistry progress records to collect data.

Participation in this study will be beneficial in establishing the factors that influence the psychosocial environment in a chemistry classroom and those that cause or predict academic performance and attitudes in chemistry. The findings from this study will likely provide the basis for the improvement of the learning environment to enhance the learning outcomes in chemistry.

Participation in this study is entirely voluntary. You may refuse to participate or may withdraw from participation at any time. The information you divulge will be held in confidence. If you agree to participate, please sign below.

Date _____ / _____

/ _____

Signature of Participant

**Appendix 4: Scale Descriptions and Example of Items of the WIHIC
Questionnaire**

Scale	Description	Item
Student Cohesiveness.	Extent to which students are friendly and supportive of each other.	I make friendships among students in this class.
Teacher Support	Extent to which the teacher helps, befriends, and is interested in students.	The teacher takes a personal interest in me.
Involvement	Extent to which students have attentive interest, participate in class and are involved with other students in assessing the viability of new ideas.	I discuss ideas in class.
Investigation	Extent to which there is emphasis on the skills and of inquiry and their use in problem solving and investigation.	I carry out investigations to test my ideas.
Task Orientation	Extent to which it is important to complete planned activities and stay on the subject matter.	Getting a certain amount of work done is important.
Cooperation	Extent to which students cooperate with each other during activities.	I cooperate with other students when doing assignment work.
Equity	Extent to which the teacher treats students equally, including distributing praise, question distribution and opportunities to be included in discussions	The teacher gives as much attention to my questions as to other students' questions.

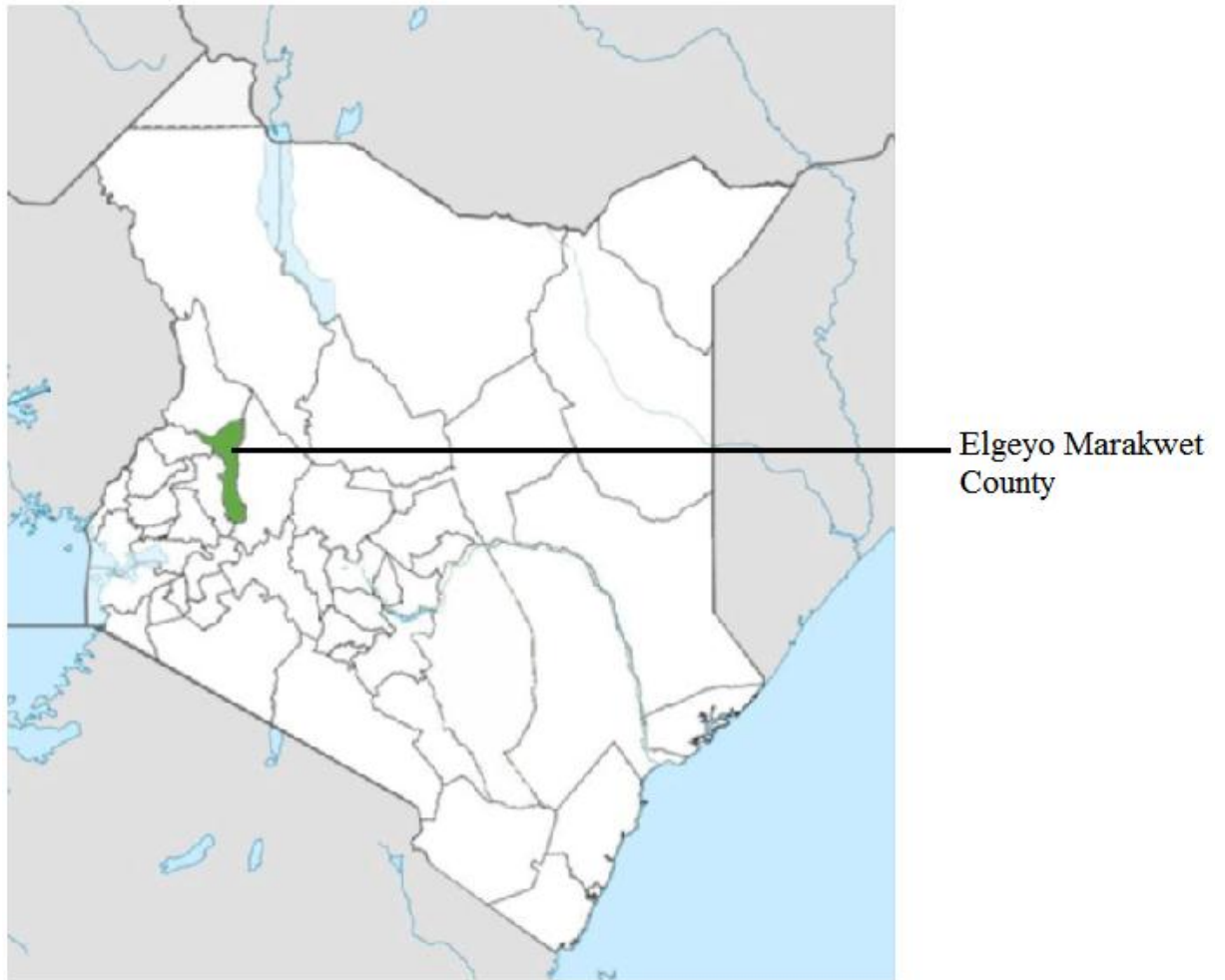
Source: Khine (2001, p.56)

Appendix 5: Krejcie and Morgan Sample Size Table

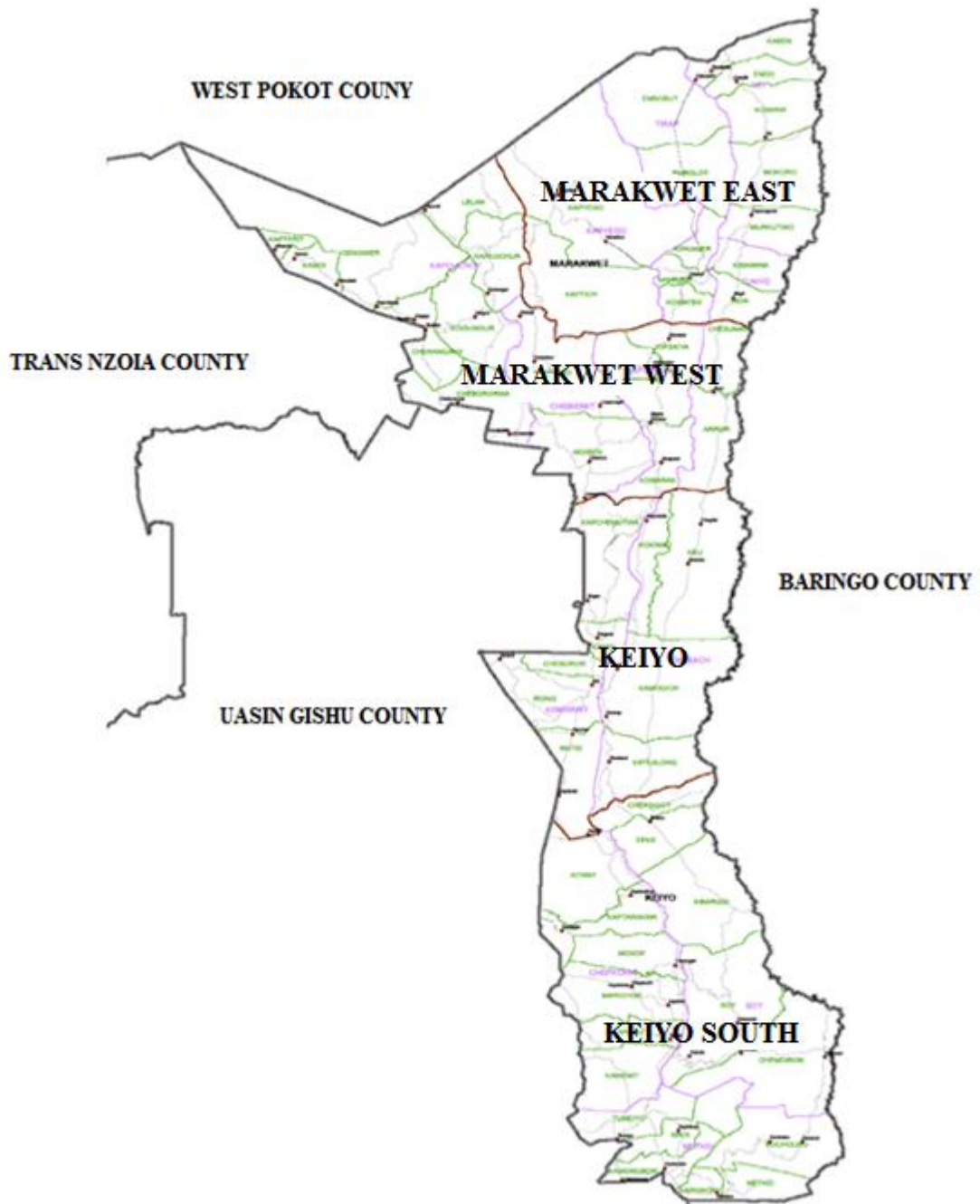
N-----n	N-----n	N-----n	N-----n	N-----n
10-----10	100-----80	280-----162	800-----260	2800-----338
15-----14	110-----86	290-----165	850-----265	3000-----341
20-----19	120-----92	300-----169	900-----269	3500-----346
25-----24	130-----97	320-----175	950-----274	4000-----351
30-----28	140-----103	340-----181	1000-----278	4500-----354
35-----32	150-----108	360-----186	1100-----285	5000-----357
40-----36	160-----113	380-----191	1200-----291	6000-----361
45-----40	170-----118	400-----196	1300-----297	7000-----364
50-----44	180-----123	420-----201	1400-----302	8000-----367
55-----48	190-----127	440-----205	1500-----306	9000-----368
60-----52	200-----132	460-----210	1600-----310	10000-----370
65-----56	210-----136	480-----214	1700-----313	15000-----375
70-----59	220-----140	500-----217	1800-----317	20000-----377
75-----63	230-----144	550-----226	1900-----320	30000-----379
80-----66	240-----148	600-----234	2000-----322	40000-----380
85-----70	250-----152	650-----242	2200-----327	50000-----381
90-----73	260-----155	700-----248	2400-----331	75000-----382
95-----76	270-----159	750-----254	2600-----335	100000-----384

Source: Krejcie and Morgan (1970)

Where N= Population size, and n= sample size required.

Appendix 6: Map of Kenya Showing Elgeyo Marakwet County

Source: https://en.wikipedia.org/wiki/Elgeyo-Marakwet_County

Appendix 7: Map of Elgeyo Marakwet Showing Keiyo Sub-County

Source: https://en.wikipedia.org/wiki/Elgeyo-Marakwet_County

Appendix 8: Secondary Schools in Keiyo Sub-County

Coeducational schools	Boys' only Schools	Girls' Only Schools
1. Anin secondary school	1. Tambach high school	1. A.I.C. secondary school - Kessup
2. Kessup mixed day secondary school	2. St. Patricks' high school -Iten	2. Sing'ore secondary school
3. Kaptum secondary school	3. Kipsoen Secondary school	3. St. Alphonsus secondary school - Mutei
4. Kabulwo secondary school		
5. Kapchelaal secondary school		
6. Kibendo secondary school		
7. Korkitony secondary school		
8. Kimuron secondary school		
9. Bugar secondary school		
10. Chebonet secondary school		
11. Chelingwa secondary school		
12. Kapkoi secondary school		
13. Kapkessum Secondary School		
14. Sergoit Secondary School		
15. St. Peters, Iten Mixed Day Secondary School		

Appendix 9: Research Permit

THIS IS TO CERTIFY THAT:

MR. HILLARY KIPNGETICH RUTTO
of MOI UNIVERSITY, 0-30700 Iten, has
been permitted to conduct research in
Elgeyo-Marakwet County
on the topic: STUDENTS' PERCEPTION
OF THE PSYCHOSOCIAL ENVIRONMENT
OF CHEMISTRY CLASSROOMS IN
RELATION TO ATTITUDES AND
ACADEMIC PERFORMANCE: A STUDY OF
SUB-COUNTY
for the period ending:
3rd June, 2015

Permit No : NACOSTI/P/14/2660/2104
Date Of Issue : 27th June, 2014
Fee Received : ksh 1,000

[Handwritten Signature]
Secretary
National Commission for Science,
Technology & Innovation

[Handwritten Signature]
Applicant's
Signature