EFFECT OF MOTIVATIONAL STRATEGIES ON THE LEARNERS’ PERFORMANCE IN SECONDARY SCHOOL CHEMISTRY IN THIKA- EAST DISTRICT, KIAMBU COUNTY, KENYA

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE MASTER OF EDUCATION (SCIENCE EDUCATION) IN THE SCHOOL OF EDUCATION OF KENYATTA UNIVERSITY

JULY 2017
DECLARATION

This thesis is my original work and has not been presented for examination in any other study program of an institution or university. It has been complemented by referenced works duly acknowledged. Where text, data or table have been borrowed from other works- including the internet, the sources are specifically accredited through referencing in accordance with the antipiracy regulations.

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DEDICATION

I dedicate this thesis to my beloved parents, Mr. Anthony Muratha and Mrs. Teresiah Muratha for their priceless love, care and support.
ACKNOWLEDGEMENT

Such work as this is produced with several people’s input. I am therefore indebted to a number of people whose assistance and co-operation made the production of this work possible. I am especially grateful to my supervisors Prof. Twoli Nicholas and Dr. Waweru Gichuhi for their advice, guidance and suggestions which made the writing of this thesis possible.

I’m equally grateful to principals and teachers of Chemistry of Thika- East District in Kiambu County for sparing their time and co-operating with me during the study. Also, I wish to appreciate the students who did the pre-test and post-test.

Finally, I wish to thank Mr. Anthony Muratha Nganga for his support, encouragement and love that he has given me all through.
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# ACRONYMS AND ABBREVIATIONS

<table>
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<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
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<tr>
<td>A&lt;sub&gt;1&lt;/sub&gt;</td>
<td>One mark for the answer</td>
</tr>
<tr>
<td>ALT</td>
<td>Academic Learning Time</td>
</tr>
<tr>
<td>KCSE</td>
<td>Kenya Certificate of Secondary Education</td>
</tr>
<tr>
<td>KNEC</td>
<td>Kenya National Examinations Council</td>
</tr>
<tr>
<td>m&lt;sub&gt;1/2&lt;/sub&gt;</td>
<td>Half of a mark</td>
</tr>
<tr>
<td>m&lt;sub&gt;1&lt;/sub&gt;</td>
<td>One mark</td>
</tr>
<tr>
<td>n</td>
<td>number of respondents</td>
</tr>
<tr>
<td>NACOSTI</td>
<td>National Commission for Science, Technology and Innovation</td>
</tr>
<tr>
<td>RAM</td>
<td>Relative Autonomous Motivation</td>
</tr>
<tr>
<td>SAS</td>
<td>Statistical Analysis System</td>
</tr>
<tr>
<td>SDT</td>
<td>Self Determination Theory</td>
</tr>
<tr>
<td>SMASSE</td>
<td>Strengthening Mathematics and Science in Secondary Education</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
</tr>
<tr>
<td>TSC</td>
<td>Teachers Service Commission</td>
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</table>
ABSTRACT

For learning to take place it requires an active participation of a learner and an instructor. For active participation, motivation is an essential element especially in science subjects which are perceived as difficult by most learners. A student may be intrinsically or extrinsically motivated. This study focused on five motivational strategies that may enhance and sustain intrinsic motivation of learners so as to improve conceptualisation, increase initiation and persistence, sustain interest, active participation and consequently lead to a better performance of learners in Chemistry. The purpose of the study was therefore to assess the effect of motivational strategies used during instruction on the student’s performance in secondary school Chemistry. The study was guided by the following objectives: To explore the motivational strategies that were used during instruction of Chemistry; to find the relationship between use of motivational strategies and students’ performance in Chemistry; to find out whether there existed a significant difference between the effect motivational strategies on the performance of boys and girls and to determine the challenges teachers of Chemistry faced when attempting to motivate learners. The motivational strategies under consideration were; feedback, content relevance, nature of learning environment, performance standards and learning goals. The research was carried out within the framework of self-determination theory. The study used quasi-experimental research design. The target population were form two students and Chemistry teachers from public secondary schools in Thika- East District. Random sampling was used to sample ten public mixed secondary schools from the target population for the research. Data was collected using interview schedules, observation schedules and written chemistry tests. Piloting was done to determine reliability and validity of the research instruments. Data was analysed using Micro-Soft Excel, SPSS, SAS and presented by use of tables and figures to enhance clarity. The key findings of the research were that, the mostly used motivational strategy used by teachers of Chemistry promoted extrinsic motivation, use of motivational strategies led to a better performance of learners in secondary school chemistry and there was no significant difference on effect of motivational strategies on the performance of boys and girls in secondary school Chemistry. The study resulted in the conclusion that use of motivational strategies leads to a better performance of learners in secondary school Chemistry. The researcher recommended that there is need to sensitise teachers of Chemistry on the importance of learner’s intrinsic motivation and how it can be enhanced and sustained.
CHAPTER ONE
INTRODUCTION AND BACKGROUND TO THE STUDY

1.0 Introduction
This chapter provides an introduction and background information to the research. Specifically the following areas are discussed: background information to the study; statement of the problem; purpose of the study; research questions; theoretical framework as well as conceptual framework.

1.1 Background Information to the Study
Chemistry is one of the sciences that are offered in secondary schools. The skills and knowledge gained is very useful in many areas of people’s lives, for example, controlling environmental pollution and production of a variety of drugs. For that reason Chemistry is compulsory in form 1 and form 2 for basic knowledge and as an elective subject for form 3 students. As noted by Twoli (2006), a few areas where chemistry knowledge is important include: Food production and preservation, contribution towards better health, for example, production of a variety of drugs; enhancement of life, for example, production of plastics and synthetic clothes; large scale industries, for example, in production of cosmetics, in detergent industries and petroleum refining plants and career opportunities since it can enable a learner to pursue a science- based career, for example, in pharmacy, engineering or teaching.

In spite of its usefulness in people’s lives, students’ performance in Chemistry in KCSE is the lowest compared to other sciences as shown in Table 1.1.
Table 1.1: Students’ Percentage Mean Scores in Three Science Subjects in the Years 2009-2013 KCSE Examination in Kenya.

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject</td>
<td>Mean score (%)</td>
<td>Mean score (%)</td>
<td>Mean score (%)</td>
<td>Mean score (%)</td>
<td>Mean score (%)</td>
</tr>
<tr>
<td>Biology</td>
<td>27.20</td>
<td>29.23</td>
<td>32.44</td>
<td>26.21</td>
<td>31.64</td>
</tr>
<tr>
<td>Chemistry</td>
<td>19.13</td>
<td>24.91</td>
<td>23.66</td>
<td>27.93</td>
<td>24.23</td>
</tr>
<tr>
<td>Physics</td>
<td>31.33</td>
<td>35.13</td>
<td>36.64</td>
<td>37.87</td>
<td>40.11</td>
</tr>
</tbody>
</table>

Source: KNEC (2009-2013)

From Table 1.1, it is clear that Chemistry was the lowest performed science in the years under consideration except in the year 2012. The performance in chemistry when compared to the other two sciences is also the lowest in Thika-East District as shown in Table 1.2.

Table 1.2: Students’ Percentage Mean Score in Three Science Subjects in the Years 2010-2014 KCSE in Thika-East District.

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects</td>
<td>Mean score (%)</td>
<td>Mean score (%)</td>
<td>Mean score (%)</td>
<td>Mean score (%)</td>
<td>Mean score (%)</td>
</tr>
<tr>
<td>Biology</td>
<td>29.67</td>
<td>29.5</td>
<td>20.75</td>
<td>31.75</td>
<td>30.15</td>
</tr>
<tr>
<td>Chemistry</td>
<td>24.58</td>
<td>25.42</td>
<td>15.63</td>
<td>25.17</td>
<td>20.5</td>
</tr>
<tr>
<td>Physics</td>
<td>29.83</td>
<td>30.33</td>
<td>21.90</td>
<td>30.42</td>
<td>33.78</td>
</tr>
</tbody>
</table>


Chemistry at secondary school level consists of concrete topics such as solubility of salts and nitrogen and its compounds as well as abstract topics such as structure of the atom and the periodic table and structure and bonding. As observed by Twoli (2006), in a learning environment of Chemistry not all concepts are considered to be at the same level of comprehension. Some are generally viewed by students as ‘difficult’ topics such as structure and while others as ‘easy’ topics such as simple classification of substances (types of mixtures and their separation). Going by the
KNEC reports released in the years 2009-2013 to explain various weaknesses that candidates exhibit when answering questions and according to Twoli (2006), the following characteristics stand out to describe a difficult topic:

a) Abstract in nature. These are topics in which concrete experiences such as experiments cannot be used, for example “structure and bonding” and “structure of the atom and the periodic table”.

b) Topics with large concept maps. Such concepts have a wide range of inter-relationships which have to be clearly understood if one has to apply in or interpret them correctly in a variety of situations, for example, the mole concept.

c) Topics requiring a lot of mathematical applications. Mathematical ability is a problem to many students, this is exhibited by the low mathematics mean score in KCSE (KNEC 2009-2013) and this weakness tends to be transferred to chemistry topics which demand mathematical applications, for example, mole concept and energy changes in physical and chemical processes.

When teaching Chemistry therefore, it is necessary that the teacher alleviates these difficulties. One way this can be done is by use of motivational strategies during instruction that ensures that the learner persists in the face of difficulty and puts effort.

A high achievement in Chemistry can be determined by many factors, some of which can be related to teachers, others to students and also school administration. Some of the factors that are learner related include; learners’ cognitive ability, interest, effort, attitude towards the subject and learner’s motivation. The school administration provides physical and financial resources as well as a supportive and conducive working/learning environment. The teacher facilitates learning and for
him/her to do this, he/she has to; have a good mastery of the subject matter, use appropriate instructional techniques as well as consistently motivate learners.

Motivation can be defined as the reasons underlying behaviour (Guay, Ratelle and Boivin, 2010). According to Cherry (2010) motivation is that drive which makes an individual set a goal, initiate and maintain behaviours which lead to the attainment of the set goal. Motivation is all about putting effort, staying focused to a certain goal and persisting in the face of difficulty, that is, all aspects of activation and intention. The two types of motivation are intrinsic and extrinsic motivation. Deci and Ryan (2000) give the difference between the two types of motivation. Intrinsic motivation refers to doing an activity which an individual finds naturally interesting and enjoyable while extrinsic motivation involves performance of an activity so as to get a separable outcome. As Deci, Koestner and Ryan (1999) points out, an activity done by a person who is intrinsically motivated is energised and sustained by the inherent satisfaction that comes from performing the activity. It is clearly seen in behaviours such as play, exploration and challenge-seeking. On contrary, extrinsic motivation is governed by reinforcement contingencies. Student intrinsic motivation has to do with student desires to participate in the learning process. It also concerns the reasons or goals that underlie their involvement in academic activities. Ryan and Connell (1990) suggest that the learning outcomes of intrinsic motivation are better than those obtained under extrinsic motivation. This is because a student who is intrinsically motivated is going to complete a certain task even when it is challenging such as the difficult topics in chemistry, retain concepts learnt better and confidently handle unfamiliar learning situations.

`
Effects of motivation in education on student’s learning and attitude towards subject matter are several. These include: Motivation determines the specific goal towards which learners strive (Maehr and Meyer, 1997 and Pintrinch, 1993). The choices students make are affected by how motivated they are, for instance, motivation determines whether a learner spend his/ her evening doing a Chemistry assignment or watching a movie. Secondly, it makes a learner increase the amount of effort and energy in learning activities so as to achieve the set goals (Csikszentmihalyi and Nakumura, 1989; Maehr, 1984; Pintrinch, 1993). Thirdly, a motivated student is more initiative and persistent in learning activities. Learners will actually begin a task, if they want to, and will continue working at it to completion even when they occasionally fail or are disappointed along the way (Larson, 2000 and Maehr, 1984)). Generally therefore, motivation leads to more academic learning time (ALT). According to Caldwell, Hutt and Graeber(1982) and Berliner(1984) ALT is the amount of time spent by a student doing academic work and doing it successfully. Fourthly, motivation affects cognitive processes. What a learner pays attention to and how effectively they process any information is affected by motivation (Eccles and Wigfield, 1985 and Pintrinch and Schunk, 1996)). For example, students who are motivated make a deliberate effort to learn Chemistry meaningfully and consider how they would make it useful in their own lives. Finally, it improves performance. Since motivation determines specific goals, increases the amount of effort and energy expended on a learning activity and affects cognitive processes then it leads to an enhanced performance. Motivated students learn and perform well in academics and are often high achievers (Uguroglu, Schiller and Walberg, 1987)).
1.2 Statement of the Problem

In spite of all its usefulness in the society, Chemistry continues to be the worst performed school science subject as seen in Table 1.1. This means that there would be shortage of man-power in Chemistry based careers such as doctors and engineers, poor food production and preservation skills and sub-standard products from large scale industries which use the knowledge and skills gained from chemistry. Various efforts that have been put in place to improve this situation include; seminars and workshops for Chemistry teachers to familiarise them with the effective instructional modes, KNEC reports which alert on weaknesses in Chemistry that need to be given attention, embracing of modern technology in instruction to diversify teaching techniques, introduction of micro-kits for practical lessons, SMASSE, establishment of science clubs in schools and science and engineering fairs for learners. Irrespective of the effort put in improving learners’ performance in Chemistry, it seems not to improve. Some scholars (Borg and Shapiro, (1996); Ward and Bordner, (1993); Ziegert, (2000)) have suggested that one root of the problem and some possible but neglected perspective of learning Chemistry might be related to learners’ motivation. Very few studies have been done on Chemistry learners’ motivation in Kenya. This research therefore, focused on ways that motivation and particularly intrinsic motivation of learners would be enhanced and sustained so as to improve conceptualisation, increase initiation and diligence, sustain interest, active participation and consequently lead to a better achievement in Chemistry.
1.3.0 Purpose of the Study

The purpose of this study was to assess the effect of motivational strategies on the learner’s performance in secondary school Chemistry in Thika- East district, Kiambu County, Kenya.

1.3.1 Objectives of the Study

The study was guided by the following three objectives:

a) To explore the motivational strategies which are used during instruction of Chemistry.

b) To determine the challenges teachers of Chemistry encounter when motivating learners.

c) To find the relationship between use of motivational strategies and students’ performance in secondary school Chemistry.

d) To find out whether use of motivational strategies affected the performance of one gender more than the other.

1.3.2 Research Questions

The research sought to answer the following questions:

a) Which motivational strategies are used to motivate Chemistry students?

b) Is there a significant difference in Chemistry performance between learners taught conventionally and those taught in classes where the motivational strategies are employed?

c) Is there a significant difference between the effect of motivational strategies on Chemistry performance of boys and that of girls?
d) Which challenges do Chemistry teachers encounter when employing motivational strategies during instruction?

1.4 Hypotheses

The study also sought to test the following hypotheses:

Ho₁: There is no significant relationship between use of motivational strategies and learner’s performance in secondary school Chemistry.

Ho₂: There is no significant difference between the effect of motivational strategies on the performance of boys and girls in Chemistry.

1.5 Significance of the Study

The findings of this study assisted in bringing to light the importance of motivational strategies which support intrinsic motivation. This is useful to educational quality assurance officers on assessing the quality and quantity of motivational strategies used in schools. Secondly, the research identified some of the problems teachers of Chemistry face when employing motivational strategies and hence policy makers will come up with possible solutions to solve these problems. Thirdly, it will improve the quality of training teachers because the study recommended possible ways of dealing with difficulties associated with use of motivational strategies.

1.6 Limitation of the Study

The study involved only 10 mixed public district secondary schools from Thika-East district. This limited generalisation of results from the study to only other
district secondary schools which actually form the bulk of Kenyan secondary schools.

1.7 Delimitation of the Study

The study focused on five motivational strategies only that promote intrinsic motivation. This is because intrinsically motivated learners engage more in learning activities, conceptualise content better and end up performing better than those who are extrinsically motivated (Deci, Lens and Vanteenkiste, (2006))

1.8 Theoretical framework

The research was carried out within the framework of self-determination theory. Self-determination theory (SDT) was initially developed by Deci and Ryan (1975). It is an approach of human motivation and personality development and behavioural self-regulation based on the study of people’s inherent growth tendencies and innate psychological needs that are the basis for self-motivation and personality integration as well as for the conditions that foster those positive processes. The three needs have through research been found out to be the needs for competence (Harter, (1978) and White, (1963)), relatedness (Baumester and Leary, (1995) and Reis, (1994)), and autonomy (De’ Charms, (1968) and Deci, (1975)).

Need for competence is an inherent desire to master skills and understand concepts (White, (1963)). When a person feels competent then his/her intrinsic motivation flourishishes. Engaging in an activity that is optimally challenging fulfils the need to feel competent consequently promoting intrinsic motivation (Deci and Ryan, (1992) and Grolnick et. al, (2002)). Having academic work slightly above the students’ skill level makes them work on it more, feel proud and joyful when they perform it
successfully and hence boost their intrinsic motivation (Harter, 1978) and McMullin and Steffen, 1982). The teacher should therefore administer an optimally challenging assignment so that the learners put effort. This leads to success and is paramount in developing intrinsic motivation which promotes achievement (Skinner, 1996).

Research by Fischer (1978) and Ryan (1982) have shown that, feelings of competence alone will not promote intrinsic motivation if not accompanied by a sense of autonomy. According to SDT, learners not only need to feel competent but also need to feel that their success or behaviour is self-determined/autonomous for intrinsic motivation to flourish. Learners feel self-determined/autonomous when they perceive their behaviour to be internally controlled or self-regulated. This is fostered by allowing learners to make their own choices in their actions where possible and to set learning goals instead of being controlled or pressured (de Charms, 1968 and Deci and Ryan, 1985).

SDT hypothesises that, learning environments with a sense of sense of security and relatedness flourishes intrinsic motivation. Ryan and Grolnick (1986) carried out a research and found out that, learners who experienced their teachers as uncaring and cold had a lower intrinsic motivation. There is need for learners to feel secure in their learning environment and connectedness as this leads them to seek out mastery of concepts and consequently promoting a sense of competence.

According to self-determination theory, if the three universal psychological needs are met then people function and perform optimally. Therefore, classroom environment should meet these needs by use motivational strategies which enhance and sustain self-determination of learners. These are learners; setting their own
goals and making choices, seeing the relevance and importance of Chemistry, learning in an accommodative and inclusive environment, getting immediate and appropriate feedback as well as knowing what is expected of them during the lesson (clear performance standards). This study therefore, purposes to assess the effect of the five motivational strategies on the learner’s performance in secondary school Chemistry.

1.9 Conceptual Framework

The conceptual framework is useful in a research as it gives the relationship between variables in the study shown graphically or diagrammatically (Mugenda and Mugenda, (1999)). The relationships between variables in this study are as shown in the Figure 1.1.

![Conceptual Framework of the Study](image)

**Figure 1.1 Conceptual Framework of the Study**

*Adopted from John Latham (1997)*
This conceptual framework shows that if teachers would use the motivational strategies when instructing learners in Chemistry then, it would enhance, improve and sustain intrinsic motivation in learners which would lead to a better performance in Chemistry. A student with high intrinsic motivation will perform an assignment persistently even if it is challenging (Gottfried, (1985) and Schunk, (1991)), and will not need any type of reward or incentive to initiate or complete a task (Deci, (1975) and Woolfolk and Holy, (1990)). The intrinsically motivated learner will complete a chosen task and be motivated by the challenging nature of Chemistry content. The student is also more likely to retain concepts learned and feel confident about tackling unfamiliar learning situations.

The motivational strategies under this study were learners; setting learning goals, being given immediate feedback, being aware of relevance of content, being aware of clear performance standards and learning in an accommodative and inclusive learning environment.

Performance in chemistry is not only affected by teacher’s ability to motivate learners but also other intervening variables which include; availability of resources, learners’ cognitive ability as well as support from the administration.
DEFINITION OF TERMS

**Autonomy**  A feeling of being in control of one’s behaviour or actions.

**Compulsory subject**  A subject that all learners must study at a certain level of education.

**County**  An administrative unit that is a tier of devolution and is next to national government.

**County school**  A secondary school which admits 20 percent of its students from the district it is situated in and the rest from the county.

**District school**  A secondary school which admits students from the district it is situated in.

**Elective subject**  A subject a learner can choose to study or not at a certain level of education.

**Extrinsic motivation**  A tendency to engage in an activity in order to obtain a reward, for recognition or to avoid a punishment external to the activity itself.

**Intrinsic motivation**  A tendency to engage in an activity for its own sake or out of interest.

**Mixed school**  A school where boys and girls learn together.

**Motivation**  The attribute that moves us to do or not to do something or a process whereby a goal oriented behaviour is initiated and sustained.

**Motivational strategy**  A way a teacher would use to motivate learners.
National school  A secondary school that admits 20 percent of its students from the county it is located in and the rest from all the other counties in the country on equitable basis.

Private schools  These are secondary schools which are developed, equipped and provided with staff from private funds from individuals, religious organisations, etc. These schools may be profit-making or non-profit making.

Public schools  These are secondary schools which are developed, equipped and provided with staff from public funds by government, parents and community.

Self-determination  Ability to make decisions of one’s own acts or states without external compulsions

Self-regulation  Individuals’ ability to understand and control their behaviour.
CHAPTER TWO
REVIEW OF RELATED LITERATURE

2.0 Introduction

The most important goal in education is for the learners to gain knowledge and skills. Making the knowledge and skills that learners gain purposeful and meaningful to them is another important goal as it ensures the information and knowledge is retained useful throughout their lives (Ryan, (2002)). To achieve these goals, it is essential that the learners are motivated to learn. It is therefore necessary, that the teacher motivates learners to learn Chemistry. This chapter considers a few areas related to motivation. These include; motivational strategies and motivation and academic performance.

2.1 Motivational Strategies

There are several ways that would be used to enhance and sustain intrinsic motivation of learners at secondary school level but this study concentrated on five of them. These were learners; setting their learning goals, getting immediate feedback, being aware of relevance of Chemistry, learning in an inclusive and accommodative classrooms and being aware of clear performance standards. These motivational strategies are discussed below.

2.1.0 Setting of Learning Goals

Students should be encouraged to set goals which are short- term and realistic n learn ways to work toward their set goals (Schunk and Miller, (2002) and Tollefson, (2000)). Students become increasingly responsible of their own learning when they are allowed to take part in making choices (Connell and Wellborn, (1991); D’ Ailly,
According to Schunk and Miller (2002), when learners set their own learning goals then they are more willing to put effort, learn that effort and ability contribute to success, improve academic skills and develop self-efficacy.

Learning goals, also known as task-focused goals by Anderman and Maecher (1994), focuses on gaining new skills and knowledge even if failure occurs during the process. Emphasising mastery of concepts and skills encourages students to focus on being successful rather than just avoiding failure (Covington, 2002). Covington (2002) outlines an approach learners would use to choose a grade known as “grade-choice arrangement”. In this approach students choose any grade depending on their ability. When a student aims for a higher target, he/she works harder and consequently performs better. Learners do not compete against one another but their set targets and hence each feels successful. Covington (2002) found out that students learning under “grade-choice arrangement approach” were more competent and had a higher level of motivation than those who competed against each other. Teachers should however not allow learners to set targets in Chemistry that allow them to minimise effort or avoid failure but they should set challenging goals so that they increase their effort (Ryan, 2002). According to Elliot and Dweck (1998), students using learning goals see failure as an indicator to change their learning strategy and increase their effort. The increased effort often enables the students with learning goals to improve their performance.

Teachers should teach students how to deal with inevitable disappointments that come when learners do not perform as they had hoped. They can be encouraged to learn from their mistakes and failures and be taught ways of dealing with
disappointments and negative emotions that would interfere with learning. (Elias, Blum and Schuler, (1997)).

2.1.1 Relevance and Application of Chemistry Content

When the teacher points out the relevance of chemistry content, it increases the learners’ self-determination to learn (Assor, Kaplan and Roth, (2007)). Learners are most probably going to value the material they are learning and be motivated to study it if it is of personal interest to them. In a certain study by Covington and Mueller (2001), students enjoyed studying a topic that was of interest to them even when they failed. For intrinsic motivation to flourish, the teacher should make learning activities to be relevant to students’ lives. Strategies include using local examples, teaching with events in news, using several teaching aids and relating Chemistry content with the student’s immediate environment and daily activities (Brozo, (2005)).

When students view course material or learning material to be personally relevant they develop task value (Eccles and Wigfield, (2002)). Task value provides interpretation for why content (in our case Chemistry) is interesting, important or useful. Learners should understand the importance of learning Chemistry and determine whether the content support their personal and professional goals. Identifying a connection between studying Chemistry and learners’ personal goals makes a student to be motivated to learn it, increase their effort leading to a better performance (Walker, Greene and Mansell, (2006)).
2.1.2 Importance of Immediate Feedback

When students are given feedback by their teachers pointing out that they performed well as a result of increased effort, learners become highly motivated and experience greater self-determination (Schunk and Miller, 2002). Telling learners to work harder after a poor performance may lower their intrinsic motivation especially when they feel they are doing their best (Tollefson, 2000). Students should be provided with precise feedback about the exact skills they have acquired or need to acquire so as to perform well in Chemistry, for example, the teacher should tell students exactly why they failed a certain question and how they would have done it to get it correctly.

Feedback can be informational or controlling. Informational feedback informs the learner of his/her competence and enhances their intrinsic motivation (Deci and Ryan, 2006). Controlling feedback on the other hand are threats, directives, statements which demean a learner and it diminishes intrinsic motivation. Negative comments should be on performance and should not dehumanise, embarrass or humiliate the performer. The teacher’s comments whether written or verbal should encourage the student to learn and not to demean or demoralise as observed by Ginot.

I have come to frightening conclusion that I am the decisive element in the classroom......... As a teacher, I possess tremendous power to make a child’s life miserable or joyous. I can be a tool of torture or an instrument of inspiration. I can humiliate or humour, hurt or heal. In all situations, it’s my response that decides whether a crisis will be escalated or de-escalated or a child humanised or dehumanised....... (Ginot(1976): 92).

It is also necessary for students to be praised when they do well and show improvement. The praise should be specific, that is, it should tell learners that their
performance was good and for which learning processes or skills they are being praised for (Bandura, (1997) and Schunk, (1994)). Students use feedback and praise given by teachers and peers to mould how they conceive about their competences as well as making decisions pertaining academic activities.

2.1.3 Learning Environment

The motivational strategies may not be useful for students if the learning environment is not conducive for learning. “Learning is mediated by social environment in which the learners interact with their instructor and their peers” (National Research Council, (2006)). For effective learning to take place, students should be in control of their own learning and also feel comfortable to express themselves in the classroom.

To ensure inclusiveness, where every learner participates in the learning of Chemistry, then teachers should support autonomy. This means that students’ perspectives are acknowledged, learners are taking initiative in solving problems, included in decision making and are allowed to be innovative (Koestner, Ryan, Berneiri and Hott, (1994). Boggiano (1988) did a research and found out that when students viewed themselves as being in control of their own learning, they exceedingly preferred a task even when it was challenging. It is necessary that learners are given an optimally challenging task to work on their own.

The class ought to be accommodative to all learners. They should feel secure and relatedness, that is, a sense of belonging and connectedness among learners in a class. When the students feel they relate well with each other their intrinsic motivation flourishes (Ryan and Deci, (2000)). Students who connect with others and
are secure in their learning environment will seek to master concepts and this promotes their sense of competence. Students’ intrinsic motivation for academic tasks and activities may develop if they are modelled or valued by people with whom they experience an attachment to (Deci and Ryan, (2006)). Many students, for instance, may be motivated to learn Chemistry if they felt “bonded” with a teacher who always shows them the value of studying Chemistry. Learners who believed their teacher to be uncaring as well as cold had lower intrinsic motivation (Ryan and Grolnick, (1986)). The motivation of girls is reported to be more positively affected by relatedness than that of boys. A research showed that the relationship of girls with their teachers is closer than that of boys with theirs (Howes, Phillipsen and Peisner-Feinberg, (2000); Valeski and Stipek, (2001)).

2.1.4 Performance Standards

Students learn they can succeed if they achieve specific standards of performance (Amos, (1992); Pintrinch and De Groot, (1990); Seidel, Perencech and Kett, (2005)). Therefore, teachers are supposed to state specific performance requirements at the start of Chemistry lessons. Students should know exactly what is expected of them, that is, which key areas and skills in a topic they need to understand to perform well, where possible the learner should be guided on how a concept is usually evaluated and how they would be assisted in the learning of information or skills. In the topic “structure of the atom and the periodic table” for example, the learners should know how to identify different isotopes, how to write formula of compounds, write correct balanced equations and how to draw various structures of atoms. When students are able to meet the set performance expectations, teachers would show them how the
specific performance requirements are connected to their learning goals and the skills that they would require to be successful in Chemistry.

The performance expectations that are set should ensure that the work does not exceed learners’ cognitive ability and that the learner has a chance of been successful in it. Chemistry content should be arranged from simple to complex, known to unknown to ensure a level of success for learners at initial stages (Mastropieri and Scruggs, (2000)). When a student fails in a given task and does not meet the set performance standards, he/she should be allowed to repeat it and be guided on how to do it well. This can be achieved by assisting the learner divide a task into small sections which he/she can purpose to complete one at a time. When the learners find that a task can be completed a feeling of success is imbued in them.

2.2 Motivation and Academic Performance

Several studies have been conducted on effect of motivation on academic performance. In all of these studies it is claimed that motivation is important in learning but the concepts used to explain how and why differ from one study to another. A few are as discussed below.

Shari B. Obrentz (2012) conducted a study entitled “Predictors of science success: the impact of motivation and learning strategies on college chemistry performance.” The predictors of science success in this study were self-efficacy, effort-regulation, assessment anxiety and previous achievement. The research found out that, levels of motivation changed with significant decreases in self-efficacy and increases in personal relevance and assessment anxiety which consequently influenced the performance in science.
Kursurkar et. al (2012) carried out a research on “How motivation affects academic performance: a structural equation modelling analysis.” The aim was to determine whether Relative Autonomous motivation (RAM, a measure of balance between autonomous motivation and controlled motivation) affects academic performance through a good study strategy and higher study effort. Students were selected via two different systems namely qualitative and weighted lottery selection. The study found out that, high RAM positively affected good strategy and study effort, which in turn positively affected academic performance in form of grade-point averages.

Afolekemi and Adebisi (2008) did a research entitled “Impact of teachers’ motivational indices on science students’ academic performance in Nigerian Secondary Schools.” The impact of science teacher’s motivation on science students’ academic performance in Senior Secondary schools in Ondo and Ekiti states of Nigeria was studied. The study revealed that; there was significant relationship between regular payment of science teachers’ allowances and academic performance of sciences.

2.3 Summary of the Literature Review

In summary, the following has been found to enhance and sustain intrinsic motivation of learners to learn and consequently lead to a better academic performance by learners. Firstly, students should be encouraged to set learning goals as well as making choices in the class. This makes learners more responsible of their learning, put more effort, improve academic skills and promotes autonomy. Secondly, students become self- determined in their learning when they see the relevance of the content as well as its application in their day to day lives. Therefore, the relevance and application of Chemistry content should be pointed out. Thirdly,
feedback given to the students should be immediate and appropriate. In case of failure, the learner should be given precise information about the precise skills or knowledge that they need to acquire to improve and be successful. Also the performance standard should be clear, that is, students should know what is expected of them and what support will be available for them if they need help learning the information or the skills. Finally, the learning environment should be inclusive where every learner participates in the learning of Chemistry. The class should be accommodative such that every learner feels secure, relatedness and cared for.

2.4 The Gap

From the reviewed literature, each motivational strategy and motivation of learners in general is expected to lead to improved academic performance of learners. This research however, sought to find out which effect the motivational strategies, when used together, would have specifically on learners’ performance in secondary school Chemistry.
CHAPTER THREE
RESEARCH METHODOLOGY

3.0 Introduction
This chapter outlines how data was collected to facilitate answering of research questions. More specifically the chapter includes a description of the following key areas; the research design, target population, sampling procedure and sample size, research instruments, pilot study, reliability and validity of research instruments, data collection procedures and mode of data analysis.

3.1 The Research Design
The research adopted a quasi-experimental design. The design was used to gather quantitative data to determine the effect of motivational strategies during instruction on the learner’s performance in secondary school Chemistry.

Table 3.1: Quasi-experimental Research Design

<table>
<thead>
<tr>
<th>R_1</th>
<th>O_1</th>
<th>X</th>
<th>O_3</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_2</td>
<td>O_2</td>
<td>X</td>
<td>O_4</td>
</tr>
</tbody>
</table>

Key
- O_1 and O_2: Pre-test
- O_3 and O_4: Post-test
- X: Treatment
- X: No treatment
- R_1: Experimental group
- R_2: Control group
The research process followed the stages shown in the Figure 3.1.

**Figure 3.1 Research Process for the Study**
3.2 Locale of the Study
This research was carried out in Thika-East District, Kiambu County in Kenya. This was due to various reasons:

a) No research has been done on effect of motivational strategies on the learners’ performance in secondary school Chemistry in this District previously.
b) Students’ performance in Chemistry in this District is also the lowest compared to that in other science subjects as shown in Table 1.2.

3.3 Target Population
The target population was the form two students and Chemistry teachers from public secondary schools in Thika-East District, Kiambu County in Kenya. Form two students were preferred for this study because they were appropriately adapted to the school environment and were familiar with their teachers. Form one students were not suitable because they were considered to be very new to the school and again not very familiar with their teacher. Schools would not allow form four students to be used in research since they are busy preparing for KCSE examinations. The topic “structure of the atom and the periodic table” which was used in this study is only taught in form two and hence Form three students would also not be used. According to Thika-East District Education Office (2015) there are 18 public secondary schools and 2 private secondary schools in the district. All the 18 public secondary schools are District schools and there are no County or National secondary schools. According to the teachers service commission (TSC) unit-Thika-East (2015), there are 25 trained Chemistry teachers in this District. The study focused in public secondary schools since they had trained Chemistry teachers while the two private schools utilised untrained teachers whose instructional
methodologies would have skewed findings. Therefore, the target population was 1165 form two students and 25 Chemistry teachers. A summary of target population is as tabulated in the Table 3.2.

**Table 3.2: Summary of the Target Population**

<table>
<thead>
<tr>
<th>TYPE OF SCHOOL</th>
<th>NUMBER OF SCHOOLS</th>
<th>NUMBER OF FORM TWO STUDENTS</th>
<th>NUMBER OF TRAINED CHEMISTRY TEACHERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public district</td>
<td>18</td>
<td>1100</td>
<td>25</td>
</tr>
<tr>
<td>Private</td>
<td>2</td>
<td>65</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>1165</td>
<td>25</td>
</tr>
</tbody>
</table>


### 3.4.0 Sampling Procedure

Simple random sampling was used to sample ten (10) mixed schools from the 18 public mixed secondary schools for the research. In each sampled school, one form two stream was used for the research. Five schools from the ten sampled schools were randomly selected to be the experimental groups while the other five were the control groups. Purposive sampling was done for piloting the study.

### 3.4.1 Sample Size

The sample size was 423 form two students and ten (10) chemistry teachers from the sampled schools. The following formula was used to determine the sample size.

\[
n = \frac{Z^2 pqN}{e^2(N-1) + Z^2 pq} \tag{1}
\]

(Pagano & Gauvreau, 2000)

\[
n = \frac{1.96^2 \times 0.5 \times 1165}{0.038^2 (1165-1) + 1.96^2 \times 0.5 \times 0.5}
\]
\[ n = \frac{1118.866}{2.6412} = 423 \]

\( P=0.5, q=0.5, Z_{0.025}=1.96, e=0.05 \)

Where; \( n = \) sample size

\( N=\) entire Population

\( Z=\) level of significance (1.96 confidence level)

\( E=\) Expected Error

\( p=\) Probability having the characteristics of interest

\( q=\) Probability of Non characteristics of interest

The sample size is summarised in the Table 3.3.

**Table 3.3: Summary of the Sample Size**

<table>
<thead>
<tr>
<th></th>
<th>Target population</th>
<th>Sample size</th>
<th>Proportion of sample (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate number of Chemistry teachers</td>
<td>25</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Estimate number of form two students</td>
<td>1165</td>
<td>423</td>
<td>36.31</td>
</tr>
<tr>
<td>Number of public secondary schools</td>
<td>18</td>
<td>10</td>
<td>55.56</td>
</tr>
</tbody>
</table>

**3.5.0 Research Instruments**

This research was conducted through the use of interview schedules, observation schedules and written tests.

**3.5.1 Interview Schedules**

Interview schedules were useful in collecting data because they provided in-depth data, which was not possible to obtain using observation schedules. The interview
schedules for teachers of Chemistry (Appendix I) was used to gather qualitative data.

### 3.5.2 Observation Schedules

An observation schedule (Appendix II) was useful in collecting data because the researcher had an opportunity of observing how the motivational strategies were been employed during instruction. The study used naturalistic observation where the researcher observed and recorded the happenings in the classroom directly. To reduce observers’ effects (Hawthorne effect) the researcher visited the sampled classrooms twice before the actual data collection.

### 3.5.3 Chemistry Tests

The researcher made written tests which were used on both the experimental and control groups. The Chemistry tests were administered before the experiment (pre-test) and after the experiment (post-test). The pre-test evaluated on the topics “air and combustion” and “water and hydrogen”. The pre-test assured initial equivalence of the experimental group with the control group as well laying basis for the argument that the resulting difference (if any) in performance of post-test will be caused by treatment. Both the pre-test and the post-test were made, administered and marked by the researcher. The post-test tested on the topic “structure of the atom and the periodic table”. Pre-test is Appendix III while post-test is Appendix IV. The analysed mean scores from the tests enabled gather information on whether there is any effect of motivational strategies on the learner’s performance in chemistry and whether the motivational strategies influence the learner’s Chemistry performance of one gender more than the other.
3.6 Pilot Study

The researcher conducted a pilot study in which the research instruments of the study were pre-tested before the main study. In pre-testing the research instruments, two mixed secondary schools in Thika-East were selected outside the sample schools. The procedure used in pre-testing the instruments was identical to the one that was sampled for the main study. The purpose for the pilot study was to:

a) Test the instruments, to check whether there was enough coverage in terms of information required
b) Check whether there was identifiable ambiguities in the wording of the questions in order to make improvements and replace vague questions
c) Check for relevance of questions in order to omit deficient items
d) Determine the reliability and validity of the instruments

Through piloting, the researcher established some items of the interview schedule that were not clear to the respondents and they were rephrased or reworded.

3.7 Reliability of Research Instruments

According to Orodho (2004) reliability in research concerns the degree to which a particular measuring procedure or instrument gives similar results over a number of repeated trials. The test-retest method was used to estimate the reliability of research instruments. In the test-retest method, research instruments were administered to the same group of subjects not in the sample schools, and then waited for two weeks before administering the research instruments the second time. Then the correlation of both tests was calculated using a Pearson’s product formula (at a confidence of 0.7) and it was established that the contents of the research instruments were
consistent in eliciting the same responses every time the instrument was administered.

**Pearson’s product moment correlation coefficient formula**

\[ r = \frac{N \sum xy - (\sum x)(\sum y)}{\sqrt{[N \sum (x^2) - (\sum x)^2][N \sum (y^2) - (\sum y)^2]}} \]

### 3.8 Validity of Research Instruments

According to Orodho (2004) validity is concerned with establishing whether the research instrument is measuring what it is intended to measure. The content and construct validation was examined through pilot study and it was found that the set of items provided were relevant and representative sample of tasks under consideration. The content validity of the research instruments was also ensured through expert judgement. The content experts who included researcher’s supervisors helped the researcher to assess the concept the instruments tried to measure in order to determine whether the set of items accurately represented the items under study.

### 3.9 Data Collection Procedure

The researcher administered the research instruments to the ten sampled schools. The pre-test was done by both the control and experimental groups. The researcher guided the chemistry teachers of the experimental groups on how to use the motivational strategies. Then, both experimental and control groups were taught the topic “structure of the atom and the periodic table” with the experimental group being exposed to the five motivational strategies for three weeks while the control group was taught in the normal way. After the three weeks, post-test was
administered. The students were not made aware if they were in the control group or experimental group to control Hawthorne effect.

The researcher also booked an appointment with the teachers one week after the pre-test for classroom observation. The interview for the Chemistry teachers was also done sometime within the three weeks. Confidentiality, anonymity and informants’ consent was maintained as a requisite condition for the whole research process.

3.10 Data Analysis

After the data was collected, checking of all instruments was done to determine inaccurate, incomplete data and then correction of detected errors and omissions. The information was then organised in relation to the objectives and hypotheses of the study and then entered in a computer for analysis using Micro-Soft excel, SPSS and SAS. Data generated was both qualitative and quantitative. Quantitative data was from pre-test and post-test while qualitative data comprised of responses from interview schedules and observation schedules. Specific objectives and hypotheses were analysed as discussed below.

Objective 1. To explore the motivational strategies which are used during instruction of Chemistry and objective 2. To determine the challenges teachers of Chemistry encounter when attempting to motivate learners. The responses gathered were analysed based on the analysis of meaning and implications emanating from respondents’ information and comparing responses to documented data on effect of motivation on academic performance. This method was chosen because the data was categorised into themes in relation to opinions, views and perception of the respondents.
Objective 3 and Hypothesis 1: There is no significant relationship between use of motivational strategies and learner’s performance in Chemistry. The pre-test results of the experimental group (n=214) was compared to that of control group (n=209) using descriptive and inferential statistics. The post-test results were also analysed the same way. The pre-test and post-test results of the experimental group were then compared descriptively and inferentially to find any significant difference and the same was repeated for the control group.

Objective 4 and Hypothesis 2. There is no significant difference between the effect of motivational strategies on the performance of boys and that of girls. The pre-test results of experimental group (the group that was exposed to the motivational strategies) were first analysed based on gender to find out whether there was a difference in their performances initially. The same was also done for the post-test to determine whether exposure to motivational strategies led to any difference in the performance. The pre-test and post-test results of boys in the experimental group were compared and the same done for the girls. This was to enable find out who (boys or girls) were affected more by the motivational strategies. In descriptive statistics, Micro-Soft Excel was used to calculate mean scores while inferential statistics involved use of t-test to check whether a statistical difference occurred. When using t-test, level of significance was fixed at 0.05 (p= 0.05) with a 95% confidence interval.

The researcher then presented the data by writing a narrative and interpretive report in order to explain the situation as it occurred in the selected sample. Tables and figures were also used to enhance clarity.
3.11 Logistical and Ethical Considerations

The researcher first obtained an introductory letter from the university detailing her intention of carrying out a research in Thika-East District. A research permit was then sought from National Commission for Science Technology and innovation (NACOSTI) by the researcher as per the laws of the country. Permission was sought from the school administration for the researcher to carry out the study in the school.
CHAPTER FOUR
PRESENTATION OF FINDINGS, INTERPRETATION AND DISCUSSION

4.0 Introduction

This chapter provides findings, interpretations and discussion according to objectives, research questions and hypotheses. The objectives of the study were:

a) To explore the motivational strategies used during instruction in Chemistry.

b) To determine the challenges teachers of Chemistry encounter when motivating learners.

c) To find the relationship between use of motivational strategies and student’s performance in secondary school Chemistry.

d) To find out whether use of motivational strategies affects the performance of one gender more than the other.

The research also sought to test the following hypotheses:

Ho1: There is no significant relationship between use of motivational strategies and learners’ performance in secondary school Chemistry.

Ho2: There is no significant difference between the effect of motivational strategies on the Chemistry performance of boys and that of girls.

4.1.0 General and Demographic Information

4.1.1 Return Rate

A total of ten (10) interview schedules and ten (10) observation schedules were duly filled by the researcher after interviewing Chemistry teachers and observing the
teachers when instructing. All the 423 form two students in the sampled school did the pre-test and post-test.

### 4.1.2 Demographic Information

The demographic information of the ten sampled public mixed secondary schools is summarised in Table 4.1.

**Table 4.1: Summary of the Demographic Information in the Sample**

<table>
<thead>
<tr>
<th>Name of the secondary school</th>
<th>Number of form two students</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Total</td>
</tr>
<tr>
<td>A</td>
<td>27</td>
<td>22</td>
<td>49</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>18</td>
<td>38</td>
</tr>
<tr>
<td>C</td>
<td>12</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td>D</td>
<td>24</td>
<td>31</td>
<td>55</td>
</tr>
<tr>
<td>E</td>
<td>31</td>
<td>34</td>
<td>65</td>
</tr>
<tr>
<td>F</td>
<td>24</td>
<td>11</td>
<td>35</td>
</tr>
<tr>
<td>G</td>
<td>23</td>
<td>11</td>
<td>34</td>
</tr>
<tr>
<td>H</td>
<td>24</td>
<td>11</td>
<td>35</td>
</tr>
<tr>
<td>I</td>
<td>27</td>
<td>20</td>
<td>47</td>
</tr>
<tr>
<td>J</td>
<td>21</td>
<td>16</td>
<td>37</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>233</td>
<td>190</td>
<td>423</td>
</tr>
</tbody>
</table>

Out of the ten schools in the sample, the five schools randomly selected to be in the experimental group were:

a) A.
b) B.
c) D.
d) F.
e) J.
The sample had 233 girls (55%) and 190 boys (45%). The experimental group had a total of 214 students of whom 99 were boys and 115 were girls. The control group had a total of 209 students, 91 were boys and 118 were girls. Their percentages are summarised in Figure 4.1.

![Figure 4.1 Percentages of Boys and Girls in the Experimental and Control groups](image)

### 4.2 Motivational Strategies Used during Instruction in Chemistry

The first objective of the study was to explore the motivational strategies used during instruction in Chemistry. On top of the five motivational strategies under study, the researcher interviewed teachers of Chemistry from the sample as well as observing them as they instructed to find out which other motivational strategies they used. The commonly used motivational strategies and their frequency of usage are summarised in Table 4.2.
Table 4.2: Motivational Strategies Used during Instruction in Chemistry

<table>
<thead>
<tr>
<th>Motivational strategy</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rewarding good performers</td>
<td>9</td>
<td>17.31</td>
</tr>
<tr>
<td>Evaluating often so as to give learners feedback on their mastery of concepts</td>
<td>7</td>
<td>13.46</td>
</tr>
<tr>
<td>Providing a conducive and inclusive learning environment where learners participate freely</td>
<td>8</td>
<td>15.38</td>
</tr>
<tr>
<td>Learners setting their own learning goals</td>
<td>5</td>
<td>9.62</td>
</tr>
<tr>
<td>Encouraging learners to work in groups and promoting competition among the groups</td>
<td>7</td>
<td>13.46</td>
</tr>
<tr>
<td>Verbal appreciation of learners who participate and also perform well in Chemistry</td>
<td>2</td>
<td>3.84</td>
</tr>
<tr>
<td>Use of teaching aids for example models and performing experiments</td>
<td>4</td>
<td>7.69</td>
</tr>
<tr>
<td>Showing relevance of Chemistry and its application on the learner’s day to day lives</td>
<td>5</td>
<td>9.62</td>
</tr>
<tr>
<td>Making learners aware of what is expected of them at the end of the lesson(clear performance standards)</td>
<td>5</td>
<td>9.62</td>
</tr>
<tr>
<td>TOTAL</td>
<td>52</td>
<td>100</td>
</tr>
</tbody>
</table>

From table 4.2, the most commonly used motivational strategies are:

a) Rewarding good performers (17.31%).

b) Evaluating often so as to give learners feedback on their mastery of concepts (13.46%).

c) Providing a conducive and inclusive learning environment where learners participate freely (15.38%).

d) Encouraging learners to work in groups and promoting competition among the groups (13.46%)
The least used motivational strategies are:

a) Verbal appreciation of learners who participate and also perform well in Chemistry (3.84%).
b) Use of teaching aids for example models and performing experiments (7.69%).
c) Making learners aware of what is expected of them at the end of the lesson (clear performance standards) (9.62%).
d) Learners setting their own leaning goals (9.62%).
e) Learners been shown the relevance and application of Chemistry on their day to day lives. (9.62%)

Use of rewards promotes extrinsic motivation which is governed by reinforcement. This motivational strategy is financially costly and may be unsustainable. According to Ryan and Connell (1990) learning outcomes of extrinsic motivation are not as good as those of intrinsic motivation. Performing of experiments and use of models in these schools is not popular. This can be attributed to the fact that, these schools being district schools do not have adequate laboratory facilities. During observations, the researcher observed that most of them have neither laboratories nor laboratory kits. The performance of science experiments and use of models which assist in making abstract concepts concrete is extremely minimal. The use of the other motivational strategies however is very much sustainable and effective since they have no financial implication nor do they require any extra time to implement.

It is also evident that the learners are rarely shown clear performance standards. During classroom observations the researcher observed that majority of the teachers in the control group just mentioned the topic or the sub topic and went ahead to explain the concepts without telling the learners what was expected of them at the
end of the lesson. This implied that the learners did not know exactly what they were expected to learn during the lesson and the support available for them if they needed help learning the information and skills. According to Pintrinch and De Groot (1990), students learn they can be successful if they meet clear performance standards. It is therefore important that the teacher makes learners aware of what is expected of them, which key areas and skills in a topic they need to understand to perform well. The standards set should ensure a degree of success of learners. This is made possible by breaking down of the lessons topic into sections/levels starting from simple concepts to progressively difficult levels. When a student successfully completes a task at every level, a feeling of success is imbued in him/her and this motivates the learner to work harder. This is not attainable where the learner is just explained to concepts without knowing what is expected of him/her.

From Table 4.2, learners were rarely encouraged to set learning goals in Chemistry. Setting of learning goals is a motivational strategy which promotes intrinsic motivation of learners and leads to a better performance in Chemistry. According to Schunk and Miller (2002), when learners set they own learning goals then; they are more willing to put more effort, learn that effort and ability contribute to success, improve academic skills and develop self-determination. Also, setting of learning goals makes learners take increased responsibility of their own learning (D’ Ailly, (2004)). Rare use of this motivational strategy could be contributing to the poor learners’ performance in Chemistry in this District.
4.3 Challenges Teachers of Chemistry Encounter in the Process of Motivating Learners

The challenges teachers of Chemistry encounter when motivating learners were considered under objective two of the study. In an interview, the teachers in both control and experimental group, were asked if they found it challenging to motivate learners and most of them agreed they did.

![Pie chart showing 90% yes and 10% no responses.]

**Figure 4.2 Chemistry Teachers’ Responses**

The challenges were summarised in Table 4.3.
Table 4.3: Challenges Teachers of Chemistry Encounter when Motivating Learners

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of resources</td>
<td>5</td>
<td>22.7</td>
</tr>
<tr>
<td>Lack of time</td>
<td>7</td>
<td>31.8</td>
</tr>
<tr>
<td>Indiscipline and psychological problems among students that require attention first</td>
<td>2</td>
<td>9.1</td>
</tr>
<tr>
<td>Learners low self-esteem which makes them shy away from participating freely and actively in class</td>
<td>3</td>
<td>13.6</td>
</tr>
<tr>
<td>Teachers not finding it their role to motivate learners</td>
<td>1</td>
<td>4.5</td>
</tr>
<tr>
<td>Learners’ negative attitude towards Chemistry</td>
<td>2</td>
<td>9.1</td>
</tr>
<tr>
<td>Low entry behaviour of learners (low cognitive ability) which leads to frequent poor performance (this discourages learners very much).</td>
<td>2</td>
<td>16.2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>22</td>
<td>100</td>
</tr>
</tbody>
</table>

From Table 4.3, the major challenges teachers of Chemistry encounter when motivating learners are lack of time and lack of resources. This can be attributed to the emphasis on extrinsic motivation. Some teachers argued that they had no time to motivate learners since they had large workloads (many lessons per week) and the Chemistry syllabus was very wide. They said they were putting all their effort in covering the syllabus. 16.2% of teachers argued that the learner’s performance in Chemistry was basically based on their cognitive ability (entry behaviour) and the resources available in the school. However, they agreed that learner’s motivation to learn chemistry was important but did not perceive themselves as role players in the enhancement and maintenance of this motivation. The negative attitude towards Chemistry and the discouragement that learners go through could be improved if the
teachers could play their role in the motivation of learners. Teachers should teach students how to deal with the inevitable disappointment that come when learners don’t perform as they expect. The learners should be taught how to use mistakes as learning opportunities and how to control the negative emotions that can interfere with learning (Elias, Blum and Schuler, (1997)). The teachers should therefore encourage learners that with persistence and hard work they can perform well thus promoting self-determination of learners.

When interviewed on how they would recommend the challenges they faced to be dealt with, the teachers gave the following recommendations:

a) Schools to make operational the counselling department to deal with the students’ psychological problems and low self-esteem.

b) Seminars and workshops to sensitize the teachers on the importance of learner’s motivation to learn Chemistry and to emphasise on motivational strategies which do not require finances.

4.4: Relationship between Use of Motivational Strategies and Learners' Performance in Secondary School Chemistry.

The purpose of this study was primarily to find out the relationship between use of motivational strategies and learners’ performance in secondary school Chemistry. This formed objective three and hypothesis H01. The 423 students in experimental and control groups sat for a pre-test exam which was analysed descriptively using Micro-Soft Excel and inferentially using t-test. The results obtained were summarised in Table 4.4.
Table 4.4: Summary of Pre-test Results

<table>
<thead>
<tr>
<th>Groups</th>
<th>Mean score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group (214)</td>
<td>21.653</td>
</tr>
<tr>
<td>Control group (209)</td>
<td>20.434</td>
</tr>
</tbody>
</table>

From table 4.4, the experimental group had a slightly higher mean score than the control group. When the mean scores were subjected to a t-test, they were found to have no significant difference as shown in Table 4.5.

Table 4.5: t-test results of Pre-test of Experimental and Control group

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>Error Mean Square</th>
<th>Critical Value of t</th>
<th>Control</th>
<th>Experimental</th>
<th>Least Significant Difference (LSD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>411</td>
<td>179.321</td>
<td>1.966</td>
<td>20.434</td>
<td>21.653</td>
<td>2.560</td>
</tr>
</tbody>
</table>

Level of significance was fixed at 0.05 (p= 0.05) with a 95% confidence interval.

This implied that the groups were statistically equivalent and hence met the condition for quasi-experimental design. After the pre-test both groups were taught the topic “structure of the atom and the periodic table” with the experimental group been exposed to the motivational strategies for three weeks while the control group was taught conventionally. Both groups were then subjected to a post-test which was marked and analysed just like the pre-test. The results were summarised in Table 4.6.
Table 4.6: Summary of Post-test Results

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental (n=214)</td>
<td>19.947</td>
</tr>
<tr>
<td>Control (n=209)</td>
<td>14.685</td>
</tr>
</tbody>
</table>

From Table 4.6, it is observed that the experimental group performed better than the control group with a gain score of 5.262%. The t-test showed that these two performances were significantly different as summarised in Table 4.7.

Table 4.7: t-test Results of Post-test of Experimental and Control Group

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>Error Mean Square</th>
<th>Critical Value of t</th>
<th>Control</th>
<th>Experimental</th>
<th>Least Significant Difference (LSD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>411</td>
<td>179.023</td>
<td>1.966</td>
<td>14.685</td>
<td>19.947</td>
<td>2.558</td>
</tr>
</tbody>
</table>

Level of significance was fixed at 0.05 (p= 0.05) with a 95% confidence interval.

Irrespective of the abstract nature of the topic tested in the post-test, learners exposed to the motivational strategies (experimental group) maintained a better performance than those who were taught conventionally. This can be explained by the fact that, the use of motivational strategies enhanced and sustained intrinsic motivation of learners and made them improve their conceptualisation of concepts, increased initiation and diligence, sustained interest, active participation and consequently a better performance. “Structure of the atom and the periodic table”, as earlier mentioned is quite abstract and hence required the learner to persist, pay a lot of attention when being taught and have the self-drive to put effort and increase academic learning time (ALT) so as to perform well.
When the students in the experimental group set their learning goals, they became responsible of their learning and were willing to put more effort to attain their goals. Self-satisfaction was the reward for goal attainment. Showing the learners relevance of content made them value and enjoy what they were learning. According to Walker, Greene and Mansel (2006) when students make a connection between learning and their present and future goals, they engage more with the content, put more effort and ultimately reach higher achievements. Giving students feedback informing them that they succeeded as a result of putting more effort, increased their self-determination and they experienced a higher intrinsic motivation as proposed by Schunk and Miller (2002). An accommodative and inclusive learning environment in which the learners would participate freely, for example ask and answer questions, balance equations on their own and discuss in groups, increased learners intrinsic motivation to perform better. Finally, the clear performance standards ensured that the learners knew clearly what they were expected to learn. The outcome of these tests clearly proves that there is a significant relationship between use of motivational strategies and learners’ performance in secondary school Chemistry.

4.5 Difference on the Effect of Motivational Strategies on the Chemistry Performance of Boys and that of Girls.

Finally, the study sought to test whether there existed a significant difference between the effect of motivational strategies on the Chemistry performance of boys and that of girls. Hypothesis H02 was used to determine this effect. The researcher analysed the performance of students, based on gender, in the experimental group who were exposed to the motivational strategies to check whether there was a
difference in the performances. The pre-test results of boys and girls were analysed in Table 4.8.

**Table 4.8: Pre-test Results of Boys and Girls in the Experimental Group**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys (n=99)</td>
<td>26.216</td>
</tr>
<tr>
<td>Girls (n=115)</td>
<td>17.724</td>
</tr>
</tbody>
</table>

From Table 4.8, in the pre-test boys performed better than the girls with a gain score of 8.492% and the t-test showed that the performances were significantly different. The t-test results are summarised in Table 4.9.

**Table 4.9: t-test Results of Pre-test of Learners in the Experimental Group**

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>Error Mean Square</th>
<th>Critical Value of t</th>
<th>Male</th>
<th>Female</th>
<th>Least Significant Difference (LSD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>208</td>
<td>217.552</td>
<td>1.971</td>
<td>26.216</td>
<td>17.724</td>
<td>3.987</td>
</tr>
</tbody>
</table>

Level of significance was fixed at 0.05 (p= 0.05) with a 95% confidence interval.

After been exposed to the motivational strategies when been taught the topic “structure of the atom and the periodic table” the students sat for a post-test and their results analysed as shown in Tables 4.10 and 4.11.

**Table 4.10: Post-test Results of Boys and Girls in the Experimental Group**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys (n=99)</td>
<td>24.924</td>
</tr>
<tr>
<td>Girls (n=115)</td>
<td>15.659</td>
</tr>
</tbody>
</table>
From Table 4.10, the boys performed better than girls in the post-test with a gain score of 9.265%. After the mean scores were analysed using t-test they were found to be significantly different.

Table 4.11: t-test Results of Post-test of Learners in the Experimental Group

<table>
<thead>
<tr>
<th>Degrees of Freedom</th>
<th>Error Mean Square</th>
<th>Critical Value of t</th>
<th>Male</th>
<th>Female</th>
<th>Least Significant Difference (LSD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>208</td>
<td>221.344</td>
<td>1.9714</td>
<td>24.928</td>
<td>15.659</td>
<td>4.021</td>
</tr>
</tbody>
</table>

Level of significance was fixed at 0.05 (p= 0.05) with a 95% confidence interval.

It is evident that the boys in this District perform better than girls in Chemistry. In the post-test, the gain score between mean scores increased slightly by 0.773% from that in the pre-test. From Table 4.6, use of motivational strategies affects performance in secondary school Chemistry of both boys and girls but neither boys nor girls are more affected statistically than the other. Intrinsic motivation therefore, leads to a better performance in Chemistry irrespective of gender of the students. This therefore proves that there is no significant difference between the effect of motivational strategies on the Chemistry performance of boys and that of girls.
CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction
The chapter outlines the summary of findings, the conclusions and recommendations made after the study.

5.1.0 Summary
The summary of the main findings are specifically discussed as per objectives and hypotheses in the study.

5.1.1 Motivational Strategies used During Instruction in Chemistry
The commonly used motivational strategies by teachers of Chemistry during instruction were found to be:

a) Rewarding good performers.
b) Often evaluation of learners so as to give them feedback on their mastery of concepts.
c) Provision of a conducive and inclusive learning environment for learners.
d) Learners been encouraged to work in groups.
e) Use of teaching aids and performance of experiments.
f) Learners being shown relevance of Chemistry and its application on their day-to-day lives.
g) Use of clear performance standards.
h) Learners setting their own learning goals.
i) Verbal appreciation of learners who participate and perform well in Chemistry.
5.1.2 Challenges Encountered by Teachers of Chemistry when Motivating Learners.

Majority of teachers reported that they found it challenging to motivate learners and some of the challenges were found to be:

a) Lack of resources to reward learners.
b) Lack of time to motivate learners.
c) Indiscipline and psychological problems among students.
d) Learners’ low self-esteem.
e) Teachers not finding it their role to motivate learners.
f) Learners’ negative attitude towards Chemistry.
g) Low entry behaviour/ cognitive abilities of learners.

5.1.3 The Relationship between Use of Motivational Strategies and Learner’s Performance in Chemistry.

The use of motivational strategies led to a better performance in the post-test examination of students in the experimental group than those in the control group. The difference in the post-test results of the experimental and the control group can be accredited to use of motivational strategies since both groups were statistically equivalent in the pre-test. Therefore, use of motivational strategies leads to a better performance of learners in secondary school Chemistry.

5.1.4 Difference of Effect of Motivational Strategies on the Performance of Boys and that of Girls in Chemistry

In the experimental group, where motivational strategies were used, boys performed better than girls in both pre-test and post-test. In the post-test, the gain score
between mean scores increased slightly by 0.773% from that in the pre-test. This proves that, there is no significant difference between the effect of motivational strategies on the performance of boys and that of girls in secondary school Chemistry.

5.2 Conclusions
The study has resulted in three main conclusions. First, the most commonly used motivational strategy, use of rewards, promotes extrinsic motivation of learners. Secondly, use of motivational strategies leads to a better performance of learners in secondary school Chemistry. Lastly, both boys and girls can equally be motivated to learn Chemistry.

5.3.0 Recommendations
The research has led to making the following recommendations:

5.3.1 Recommendation for Action
a) There is need for seminars/ workshops for teachers of Chemistry to sensitise them on the importance of intrinsic motivation and emphasise on the motivational strategies in general.

5.3.2 Recommendations for Further Research
The researcher recommends the following further studies:

a) A study should be done to determine the cause (s) of low enrolment of boys in public mixed district secondary schools in Thika-East district.
b) A research should be carried out to investigate how girls can be motivated in learning science and hence lead to a better performance.

c) A similar study is recommended in public national, county or even private schools since this one involved only public district schools.
REFERENCES


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www.DrJohnLatham.com: developing conceptual framework
APPENDICES
APPENDIX I: INTERVIEW SCHEDULE FOR CHEMISTRY TEACHERS

The purpose of this interview schedule is to collect data on the effect of motivational strategies on the learner’s performance in secondary school Chemistry in Thika-East district. The researcher assures you that the information gathered will be treated with utmost confidentiality and utilised only for academic purposes.

SECTION ONE: MOTIVATIONAL STRATEGIES USED IN SECONDARY SCHOOLS DURING CHEMISTRY INSTRUCTION

1. Do you use the following motivational strategies when instructing Chemistry

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Encourage learners to set goals for themselves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Allow learners to interact and participate actively during lessons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Give immediate feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Show the relevance of Chemistry content to learners and show its application to learners day-to-day lives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Let the learners know exactly what is expected of them in every topic you handle (clear performance standard)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. How often do you use the motivational strategies you have ticked?

a) Every lesson ( )

b) Weekly ( )

c) Any other specify
3. If not every lesson, give reasons why
   a) Lack of time ( )
   b) Lack of proper skills ( )
   c) You don’t find it really necessary ( )
   d) The nature of Chemistry content does not allow ( )

Any other, specify.............................................................................................................
........................................................................................................................................
........................................................................................................................................

4. How else do you motivate learners to learn and perform well in Chemistry?
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

5. How do you show relevance of Chemistry content to learners’ lives?
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
6. How do you encourage learners’ participation in your lessons?
   
a) Asking and answering questions ( )
   
b) Forming discussion groups ( )
   
c) Solving problems on themselves ( )
   
d) Carrying out learning activities at the end of every topic ( )
   
   **Any other, specify**
   
   .............................................................................................................................
   .............................................................................................................................
   .............................................................................................................................
   .............................................................................................................................
   .............................................................................................................................

**SECTION THREE: CHALLENGES FACED BY TEACHERS WHEN ATTEMPTING TO MOTIVATE LEARNERS**

7. Do you sometimes find it challenging to motivate learners? Yes ( ) No ( )
8. If (12) is yes, what are some of the challenges you encounter?

   .............................................................................................................................
   .............................................................................................................................
   .............................................................................................................................
   .............................................................................................................................
   .............................................................................................................................
   .............................................................................................................................
9. Specify any other important information regarding the use of motivational strategies and recommend solutions for dealing with the difficulties associated with use of motivational strategies.
APPENDIX II: OBSERVATION SCHEDULE

Tick (√) where appropriate or give the necessary information.

1. Which motivational strategies do the teacher use during instruction in Chemistry?

..........................................................................................................................................................
..........................................................................................................................................................
..........................................................................................................................................................

2. How often are the following motivational strategies used during instruction?

<table>
<thead>
<tr>
<th>Tally of observation</th>
<th>Total count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encouraging learners to set goals for themselves</td>
<td></td>
</tr>
<tr>
<td>Allowing learners to interact and participate actively during lessons</td>
<td></td>
</tr>
<tr>
<td>Giving immediate feedback</td>
<td></td>
</tr>
<tr>
<td>Showing the relevance of Chemistry content to learners and its application to learners day-to-day lives</td>
<td></td>
</tr>
<tr>
<td>Letting the learners know exactly what is expected of them in that topic (clear performance standard)</td>
<td></td>
</tr>
</tbody>
</table>

3. Are the learners shown the relevance of “structure of the atom and the periodic table” and its application in their day-to-day lives? Yes( ) No ( )
4. How many times during the lesson do learners:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Tally of observation</th>
<th>Total count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask questions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Answer questions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solve a problem on their own</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explain a concept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work in a group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carry out an experiment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX III: PRE-TEST

NAME.................................................. SCHOOL..............................

ADMISSION NUMBER: .........................

FORM.................................

TOTAL MARKS: 40

TIME: 1 HOUR

INSTRUCTIONS

- Attempt all the questions
- Answer the questions in the spaces provided
- Show all your working and calculations

1. Is air a mixture or a compound? Explain (2 mks)

2. The diagram below represents a set-up that can be used to prepare and collect oxygen gas. Study it and answer the questions that follow.

![Diagram of apparatus for preparing oxygen gas](image)

i. Name solid x (1 mk)

ii. What is the function of solid x (1 mk)
iii. Identify a mistake in the set-up (1 mk)

iv. Which method of gas collection is this? (1 mk)

v. Why is it possible to collect oxygen using this method? (1 mk)

vi. Explain why it is important not to collect any gas for the first few seconds of the experiment. (1 mk)

vii. What is the confirmatory test for oxygen gas? (1 mk)

viii. Write a word equation for the reaction taking place in the round bottomed flask (1 mk)

3. The following set-up of three test-tubes was used to investigate rusting of iron. Study it and answer the questions that follow.

![Diagram of test-tubes A, B, and C]

i. In which test-tube was there no rusting? Explain (2 mks)

ii. Why was there little rusting in test-tube B? (1 mk)

iii. Write a word equation for rusting (1 mk)

iv. State two methods which can be used to prevent rusting (2 mks)
4. In an experiment, a certain volume of air was passed repeatedly from syringe A to syringe B over heated excess copper turnings as shown in the diagram below.

- i. What is the work of glass wool plug in the experiment? (1 mk)
- ii. Why was the air passed over heated copper turnings repeatedly? (1 mk)
- iii. Given that the initial volume of air in syringe A was 200 cm$^3$ and after the experiment the volume changed to 160 cm$^3$. Calculate the percentage volume of the air used up in the experiment (2 mks)
- iv. State and explain the observations made on the combustion tube (2 mks)
- v. Write a word equation for the reaction in the combustion tube (1 mk)
- vi. State two sources of error in this experiment (2 mks)
5. The diagram below shows a set-up of apparatus used to investigate the products of combustion of candle wax in an experiment.

![Diagram of apparatus](image)

i. What observation was made in the tube containing the anhydrous copper (II) sulphate (1 mk)

ii. Write a word equation for the observation in (i) above (1 mk)

iii. State and explain the observation made in the lime water (2 mks)

iv. Candle wax is made up of two elements. Name the two elements (2 mks)

v. What other test could be carried out to prove the identity of the liquid in the U-tube? (1 mk)

6. The apparatus below was used to investigate the effect of dry hydrogen gas on hot lead (II) Oxide.
i. Which two observations were made in the combustion tube at the end of the experiment? (2 mks)

ii. Write a word equation for the reaction between hydrogen and lead (II) oxide. (1mk)

iii. What is burning at C and why is it necessary to burn it? (2 mks)

iv. After the experiment, why should hydrogen gas continue flowing through the combustion tube until it cools? (1 mk)

v. Name two uses of hydrogen gas. (2 mks)

SUCCESS
APPENDIX IV: POST-TEST

NAME.............................................. SCHOOL........................................

ADMISSION NUMBER:...................... FORM...........................................

TOTAL MARKS: 40

TIME: 1 HOUR

INSTRUCTIONS

- Attempt all the questions
- Answer the questions in the spaces provided
- Show all your working and calculations

1. (a) what is meant by the terms (2 mks)
   i. Element
   ii. Atomic number

(b) The formula of the chloride of titanium is TiCl₃. What is the formula of the sulphate of Ti? (2 mks)

2. The electronic structures for elements represented by letters A, B, C and D are
   A 2.8.6     B 2.8.2     C 2.8.1     D 2.8.8
a) Select the element that forms:

i. A double charged cation  (1 mk)

ii. An acidic oxide  (2 mk)

iii. An element in group (viii) (1 mk)

b) What is the formula of the compound formed by A and B?  (1 mk)

3. The electronic arrangement of an ion of element Q is 2.8.8. If the general formula of the ion is Q\textsuperscript{+} state the group and the period to which Q belongs (2 mks)

<table>
<thead>
<tr>
<th>Period</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Below are four atoms of certain elements

\[ \begin{array}{cccc}
35 & N & 39 & M \\
17 & & 19 & X \\
\end{array} \]

\[ \begin{array}{cccc}
40 & Y & & \\
& 20 & & \\
\end{array} \]

From the information given answer the following questions.

a) What is the number of neutrons and protons in N and Y (2 mks)

<table>
<thead>
<tr>
<th>Element</th>
<th>Protons</th>
<th>Neutrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Which atoms are isotopes?  (1 mk)

c) Write the electronic configuration of a stable ion of Y (1 mk)

d) Draw the structure of the atom of N (1 mk)
5. (a) What do you understand by the term isotope? (1 mk)

(b) The table below shows the relative atomic masses and percentage abundance of the isotopes L₁ and L₂ of element

<table>
<thead>
<tr>
<th></th>
<th>Relative atomic mass</th>
<th>Percentage abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>L₁</td>
<td>62.93</td>
<td>69.09</td>
</tr>
<tr>
<td>L₂</td>
<td>64.93</td>
<td>30.91</td>
</tr>
</tbody>
</table>

Calculate the relative atomic mass of element L (3 mks)

5. Study and complete the table below. The symbols are not the actual symbols of the elements. (3 mks)

<table>
<thead>
<tr>
<th>Atom</th>
<th>Electron arrangement</th>
<th>Formula of ion</th>
<th>Oxidation state</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>2.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>2.8.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>2.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. The table below shows some elements in the periodic table. Use it to answer the questions that follow. The letters are not the actual symbols of elements of elements.

| A    | | | Q | R |
|------| | |   |   |
| B    | | | S | T |

a) Which element belong to period 2 and group (vii) (1/2 mk)

b) Write the electron configuration of atoms of P, Q and S (11/2 mks)
c) An element K has an atomic number of 20. Indicate its position on the grid (1mk)

d) What is the atomic number of R (1 mk)

e) How many electrons does a stable ion of B have? (1 mk)

f) Write a balanced chemical equation for the reaction between A and Q (1 mk)

7. a) Write the chemical formula of the following compounds (4 mks)
   i. Zinc Sulphate
   ii. Lead (II) Carbonate
   iii. Aluminium Nitrate
   iv. Potassium Fluoride

   (b) What is the valency of the cations in the following compounds? (3 mks)
   i. \((\text{NH}_4)_2\text{SO}_4\)
   ii. \(\text{A}_2\text{B}_3\)
   iii. \(\text{X}_2\text{Y}\)

   (c) Complete and balance the following chemical equations (5 mks)
   i. \(\text{NaOH} + \text{HCl} \rightarrow \)
   ii. \(\text{Ca} + \text{H}_2\text{O} \rightarrow \)
   iii. \(\text{MgCO}_3 + \text{HNO}_3 \rightarrow \)
   iv. \(\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \)
   v. \(\text{CuO} + \text{HNO}_3 \rightarrow \)

SUCCESS
APPENDIX V: MARKING SCHEME FOR THE PRE-TEST

1. Is air a mixture or a compound? Explain (2 mks)

   Air is a mixture \textit{m_1}- the components of air can be separated by physical means. \textit{m_1}

2. The diagram below represents a set-up that can be used to prepare and collect oxygen gas. Study it and answer the questions that follow.

   ![Diagram of oxygen preparation setup]

   i. Name solid \textit{x} (1 mk)

      \textbf{Manganese (IV) Oxide} \textit{m_1}

   ii. What is the function of solid \textit{x} (1 mk)

      \textbf{It is a catalyst/ it speeds up the rate of decomposition of Hydrogen Peroxide} \textit{m_1}

   iii. Identify a mistake in the set-up (1 mk)

      \textbf{The round bottomed flask is not covered} \textit{m_1}

      \textbf{Over- water method} \textit{m_1}

   iv. Why is it possible to collect oxygen using this method? (1 mk)
It is slightly soluble in water \( m_1 \)

v. Explain why it is important not to collect any gas for the first few seconds of the experiment. (1 mk)

It contains the air that was initially in the apparatus \( m_1 \)

vi. What is the confirmatory test for oxygen gas? (1 mk)

Oxygen gas/ relights a glowing splint \( m_1 \)

vii. Write a word equation for the reaction taking place in the round bottomed flask (1 mk)

Manganese (IV) Oxide

\[
\text{Hydrogen Peroxide} \rightarrow \text{Water} + \text{Oxygen} \quad m_1
\]

3. The following set-up of three test-tubes was used to investigate rusting of iron. Study it and answer the questions that follow.

![Diagram of test-tubes A, B, C]

i. In which test-tube was there no rusting? Explain (2 mks)

C \( m_1 \) - boiling the water had removed the Oxygen from it and oil prevented entry of air/ absence of oxygen \( m_1 \)

ii. Why was there little rusting in test-tube B? (1 mk)

Though oil prevented entry of air tap water contains Oxygen dissolved in it \( m_1 \)

iii. Write a word equation for rusting (1 mk)

\[
\text{Iron} + \text{Water} + \text{Oxygen} \rightarrow \text{Hydrated Iron (III) Oxide} \quad m_1
\]
iv. State two methods which can be used to prevent rusting (2 mks)

**Painting**

**Oiling/ greasing**

**Galvanising**

**Electroplating** Any 2 @ m_{1}

4. In an experiment, a certain volume of air was passed repeatedly from syringe A to syringe B over heated excess copper turnings as shown in the diagram below.

i. What is the work of glass wool plug in the experiment? (1 mk)

*To prevent copper metal from being blown into the syringe* m_{1}

ii. Why was the air passed over heated copper turnings repeatedly? (1 mk)

*To ensure all the copper reacted with the Oxygen* m_{1}

iii. Given that the initial volume of air in syringe A was 200 cm³ and after the experiment the volume changed to 160 cm³. Calculate the percentage volume of the air used up in the experiment (2 mks)
\[
\frac{(200 - 160) \times 100}{200} = 20\% \ A_1
\]

iv. State and explain the observations made on the combustion tube (2 mks)

**Brown solid change to black** \(m_1\)

**Brown Copper reacts with Oxygen in the air and it is oxidised to Copper (II) Oxide** \(m_1\)

v. Write a word equation for the reaction in the combustion tube (1 mk)

\[
\text{Copper} + \text{Oxygen} \rightarrow \text{Copper (II) Oxide} \ m_1
\]

vi. State two sources of error in this experiment (2 mks)

**Some Oxygen could not have reacted with Copper metal** \(m_1\)

**Inaccurate reading of volumes** \(m_1\)

5. The diagram below shows a set-up of apparatus used to investigate the products of combustion of candle wax in an experiment
i. What observation was made in the tube containing the anhydrous copper (II) sulphate (1 mk)

**Anhydrous Copper (II) Sulphate changes from white to blue**

ii. Write a word equation for the observation in (i) above (1 mk)

**Anhydrous Copper (II) Sulphate + Water → Hydrated Copper (II) Sulphate**

iii. State and explain the observation made in the lime water (2 mks)

**A white precipitate forms in the lime water**

**Lime water reacts with Carbon (IV) Oxide to form insoluble Calcium Carbonate**

iv. Candle wax is made up of two elements. Name the two elements (2 mks)

**Hydrogen** and **Carbon**

v. What other test could be carried out to prove the identity of the liquid in the U-tube? (1 mk)

**Add a few drops of the liquid to anhydrous Cobalt (II) Chloride and it changes from purple to pink**

6. The apparatus below was used to investigate the effect of dry hydrogen gas on hot lead (II) Oxide.

![Diagram of the apparatus](image-url)
i. Which two observations were made in the combustion tube at the end of the experiment? (2 mks)

Lead (II) Oxide changes from yellow to orange when heated then to grey at the end of the experiment m₁

A colourless liquid forms on the cooler parts of the combustion tube m₁

ii. Write a word equation for the reaction between hydrogen and lead (II) oxide (1mk)

\[
\text{Lead (II) Oxide} + \text{Hydrogen} \rightarrow \text{Lead metal} + \text{water} \]

iii. What is burning at C and why is it necessary to burn it? (2 mks)

Unreacted Hydrogen m₁ because when it mixes with air it is explosive m₁

iv. After the experiment, why should hydrogen gas continue flowing through the combustion tube until it cools? (1 mk)

To control the hot Lead metal from being re-oxidised by air m₁

v. Name two uses of hydrogen gas. (2 mks)

Hardening of oils to fats m₁

Rocket fuel m₁
APPENDIX VI: MARKING SCHEME FOR THE POST-TEST

1) a). What is meant by the terms (2 mks)

i. Element

A pure substance that cannot be split into a simpler substance by any chemical or physical means m₁

ii. Atomic number

Number of protons in an atom m₁

b) The formula of the chloride of titanium is TiCl₃. What is the formula of the sulphate of Ti? (2 mks) Ti₂(SO₄)₃ m₂

2) The electronic structures for elements represented by letters A, B, C and D are

A  2.8.6  B  2.8.2  C  2.8.1  D  2.8.8

a) Select the element that forms:

i. A double charged cation (1 mk)

B m₁

ii. An acidic oxide (2 mk)

Am₁

iii. An element in group (viii) (1 mk)

D m₁

b) What is the formula of the compound formed by A and B? (1 mk)

BA m₁

c) The electronic arrangement of an ion of element Q is 2.8.8. If the general formula of the ion is Q³⁻ state the group and the period to which Q belongs (2 mks)
Period 3
Group V

3) Below are four atoms of certain elements

\[
\begin{array}{c|c|c|c|c}
\text{N} & \text{M} & \text{X} & \text{Y} \\
35 & 39 & 37 & 40 \\
17 & 19 & 17 & 20 \\
\end{array}
\]

From the information given answer the following questions.

a) What is the number of neutrons and protons in N and Y (2 mks)

\[
\begin{array}{c|c|c|c|c}
\text{N} & \text{Y} \\
\text{Protons} & 17 & \text{protons} & 20 \\
\text{Neutrons} & 18 & \text{neutrons} & 20 \\
\end{array}
\]

b) Which atoms are isotopes? (1 mk)

\[
\text{N} \text{ and X}
\]

c) Write the electronic configuration of a stable ion of Y (1 mk)

\[
\text{2.8.8}
\]

d) Draw the structure of the atom of N (1 mk)

\[
\text{N.2.8.7}
\]

4. (a) What do you understand by the term isotopes? (1 mk)

Atoms of the same element with the same atomic number but different mass numbers/atoms of the same element with the same number of protons different number of neutrons
(b) The table below shows the relative atomic masses and percentage abundance of the isotopes L₁ and L₂ of element

<table>
<thead>
<tr>
<th></th>
<th>Relative atomic mass</th>
<th>Percentage abundance</th>
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</thead>
<tbody>
<tr>
<td>L₁</td>
<td>62.93</td>
<td>69.09</td>
</tr>
<tr>
<td>L₂</td>
<td>64.93</td>
<td>30.91</td>
</tr>
</tbody>
</table>

Calculate the relative atomic mass of element L (3 mks)

\[
\frac{(69.09 \times 62.93) + (64.93 \times 30.91)}{100 + 100} = 63.55 \text{ A}_1
\]

5. Study and complete the table below. The symbols are not the actual symbols of the elements. (3 mks)

<table>
<thead>
<tr>
<th>Atom</th>
<th>Electron arrangement</th>
<th>Formula of ion</th>
<th>Oxidation state</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>2.3</td>
<td>X³⁺ m₁/²</td>
<td>+3 m₁/²</td>
</tr>
<tr>
<td>Y</td>
<td>2.8.2</td>
<td>Y²⁺ m₁/²</td>
<td>+2 m₁/²</td>
</tr>
<tr>
<td>Z</td>
<td>2.7</td>
<td>Z⁻ m₁/²</td>
<td>-1 m₁/²</td>
</tr>
</tbody>
</table>

6. The table below shows some elements in the periodic table. Use it to answer the questions that follow. The letters are not the actual symbols of elements of elements.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Q</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>K m₁</td>
<td>S</td>
<td>T</td>
</tr>
</tbody>
</table>
a) Which element belong to period 2 and group (vii) (1/2 mk)

\[ Q \text{ m}_{1/2} \]

b) Write the electron configuration of atoms of B, Q and S (11/2 mks)

\[ B \ 2.8.8.1 \text{ m}_{1/2} \quad Q \ 2.7 \text{ m}_{1/2} \quad S \ 2.8.6 \text{ m}_{1/2} \]

c) An element K has an atomic number of 20. Indicate its position on the grid (1mk)

d) What is the atomic number of R (1 mk)

10 \text{ m}_1

e) How many electrons does a stable ion of B have? (1 mk)

18 \text{ electrons} \text{ m}_1

f) Write a balanced chemical equation for the reaction between A and Q (1 mk)

\[ 2A_{(s)} + Q_{2(g)} \rightarrow 2AQ_{(s)} \text{ m}_1 \]

7. a) Write the chemical formula of the following compounds (4 mks)

i. Zinc Sulphate \( \text{ZnSO}_4 \text{ m}_1 \)

ii. Lead (II) Carbonate \( \text{PbCO}_3 \text{ m}_1 \)

iii. Aluminium Nitrate \( \text{Al(NO}_3)_3 \text{ m}_1 \)

iv. Potassium Fluoride \( \text{KF} \text{ m}_1 \)

(b) What is the valency of the cations in the following compounds? (3 mks)

vi. \( (\text{NH}_4)_2\text{SO}_4 \text{ m}_1 \)

vii. \( \text{A}_2\text{B}_3 \text{ m}_1 \)

viii. \( \text{X}_2\text{Y} \text{ m}_1 \)
(c) Complete and balance the following chemical equations (5 mks)

i. \[ \text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} \]

ii. \[ \text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2 \]

iii. \[ \text{MgCO}_3 + 2\text{HNO}_3 \rightarrow \text{Mg(NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O} \]

iv. \[ \text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2 \]

v. \[ \text{CuO} + 2\text{HNO}_3 \rightarrow \text{Cu(NO}_3)_2 + \text{H}_2\text{O} \]
APPENDIX VII: LOCALE OF THE STUDY
APPENDIX VIII: RESEARCH PERMIT

THIS IS TO CERTIFY THAT:
MISS. ESTHER WANGAI MURATHA of KENYATTA UNIVERSITY, 856-1000
thika, has been permitted to conduct research in Kiambu County

on the topic: THE EFFECTS OF MOTIVATIONAL STRATEGIES ON THE LEARNERS PERFORMANCE OF IN SECONDARY SCHOOL CHEMISTRY: THIKA- EAST DISTRICT, KIAMBU COUNTY, KENYA,

for the period ending: 30th September, 2015

Applicant Signature

Director General
National Commission for Science, Technology & Innovation