EMOTIONAL-INTELLIGENCE, REASONING ABILITY AND SELF-EFFICACY AS PREDICTORS OF ACHIEVEMENT OF SENIOR SECONDARY SCHOOL CHEMISTRY STUDENTS, IN ZONKWA EDUCATION ZONE KADUNA STATE NIGERIA

BY

Amos Kwasau LABESA

B. Sc. (Ed) Chemistry (ABU, 2013)
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DECLARATION

I hereby declare that this dissertation entitled "**Emotional-intelligence, reasoning ability and self-efficacy as predictors of achievement of senior secondary school chemistry students in Zonkwa Education Zone, Kaduna State, Nigeria**" is a result of my personal research work. To the best of my knowledge it has never been presented anywhere for the purpose of the award of any degree. All quotations and sources of information are acknowledged by means of references.

…… ……

Amos Kwasau Labesa Date

CERTIFICATION

This dissertation entitled "Emotional-intelligence, reasoning ability and self-efficacy as predictors of achievement of senior secondary school chemistry students in Zonkwa Education Zone, Kaduna State, Nigeria" by Amos Kwasau LABESA, P14EDSC8002 meets the requirement governing the award of Master degree in Science Education of the Ahmadu Bello University, Zaria, Nigeria and it is approved for its contribution to knowledge and literary presentation.

…… ……
Prof. J. S. Mari Date
Chairman Supervisory Committee

…… ……
Dr. B.A. Muhammad Date
Member Supervisory Committee

…… ……
Prof. S.S. Bichi Date
Head of Department

…… ……
Prof. A. Z. Mohammed Date
Dean, School of Post Graduate Studies

DEDICATION

This dissertation is dedicated to my beloved wife Mary S. Amos, my children Charity, Dorcas, Asa, Jordan, Judith and Othniel and finally my late father and mother for their love and motivation which propels me to work hard. I love you all.

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ABSTRACT

The study investigated the Relationship of Emotional-intelligence, Reasoning ability, and Self-efficacy as Predictors of Achievement of Senior Secondary School Chemistry Student. The research design for the study was correlation survey design. The instruments used for the study were the Trait Emotional-Intelligence Questionnaire (TEIQue), Group Assessment of Logical Thinking (GALT) and Chemistry Self – Efficacy Instrument (CSI) while the student (MOCK) examination result was used as chemistry achievement scores. The reliability coefficient of the instruments are as follow; Trait Emotional-Intelligence Questionnaire (TEIQue) = 0.80, Group Assessment of Logical Thinking (GALT) = 0.85, Chemistry Self – Efficacy Instrument (CSI) = 0.75 and MOCK exam = 0.82. The participant in the study were 152 (89 male, 63 female) secondary school students from Zonkwa Education Zone, Kaduna State, Nigeria, with average age of 17 years. Random sampling was used to select the schools, while intact classes were used. To guide the study four research questions and four null hypotheses were generated and tested at 0.05 level of significance. The responses of the students to the instruments were scored and analyzed using descriptive statistics of means and standard deviations; the Pearson Product Moment Correlation Coefficient and Analysis of Variance MANOVA were used to test correlation at $P \leq 0.05$. The results showed that there was a significant positive relationship among emotional intelligence, reasoning ability, self-efficacy and academic achievement in chemistry. The results also indicated that there was a significant positive relationship among emotional intelligence, reasoning ability, self – efficacy and academic achievement of SS II male students, SS II female students and their academic achievement in chemistry. The results further indicated no significant differences between SS II male and female mean scores in chemistry, emotional intelligence, reasoning ability and self efficacy. It was therefore concluded that emotional – intelligence, reasoning ability and self – efficacy are predictors of achievement in chemistry. Self efficacy being the strongest positive predictor while reasoning ability being the least positive predictor. It is recommended that science teachers should encourage their students to develop positive emotional-intelligence, strong reasoning ability and self-efficacy towards learning chemistry so as to perform better in natural science.

KEYWORDS: Emotional-intelligence, Reasoning ability, Self-efficacy, Academic achievement, Relationship, Predictors.

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ABBREVIATIONS

IQ:	Intelligence Quotient
EI:	Emotional Intelligence
PA:	Positive Emotions/Positive Affectively
NA:	Negative Emotions/Negative Affectively
EQ:	Emotional Quotient
EQ-I:	Emotional Quotient Inventory
SREIT:	Self-Report Emotional Intelligence Test
TEIQue:	Trait Emotional Intelligence Questionnaire
GALT:	Group Assessment of Logical Thinking
CSI:	Chemistry Self-Efficacy Instrument
CAS:	Chemistry Achievement Score
NERDC:	Nigeria Educational Research and Development Council
STAN:	Science Teachers Association of Nigeria
FME:	Federal Ministry of Education
NCTM:	National Council of Mathematics Teachers
FEMSA:	Federal Education in Mathematics and Science in African
GESAT:	Gender in Science and Technology
NAEP:	National Assessment of Educational Progress
APP:	Advanced Placement Program
IEA:	International Evaluation of Education Progress
FISS:	First International Science Studies
SISS:	Second International Science Studies
TIMSS:	Third International Mathematics and Science Study
DMCTE:	Debre Markos College of Teachers Education
MSLQ:	Motivated Strategies for Learning Questionnaire
TOLT:	Test of Logical Thinking

OPERATIONAL DEFINITION OF TERMS

Achievement in Chemistry: Refers to a cumulative assessment and measurement of educational Performance of an individual in chemistry.

Emotional-Intelligence (EI): Refers to a form of social intelligence that involves the ability to monitor one's own emotion and others feelings and emotions to discriminate among them, and to use this information to guide one's thinking and action.

Gender Differences: These are differences as a result of being either a female or male arising from social and a cultural construction of roles associated with these sex differences.

Reasoning Ability: Refers to a logical thought patterns which are employed during a process of scientific inquiry that enable an individual to propose relationship between observed phenomena.

Self-efficacy: Refers to subjective judgment of one's capabilities to organize and execute course of action to attain a designated goal.

CHAPTER ONE

THE PROBLEM

1.1 Introduction

Chemistry has become one of the most important disciplines in the school curriculum; its importance in the general education has gained world-wide recognition (Ejidike and Oyelana, 2015). Chemistry as a branch of science is a basic requirement for economic, scientific and technological development of any nation, especially in the manufacturing sector where materials, coloured and attractive clothing, chemicals, plastic material and other useful household equipment are made available to man. Also chemical products such as fertilizers and herbicides, also products of chemistry, help to scale up farming activities, achieve suitable food production and reduce food importation (Bamikole, & Abiodun, 2013). Chemistry occupies a unique position in the sciences as a result of its requirement and pre-requisite to the study of courses such as pharmacy, medicine, biochemistry, agricultural science, engineering among others.

Chemistry is a branch of pure science that deals with the composition, properties and uses of matter. Chemistry has always been viewed as an abstract course which is very difficult to understand by learners. For example concepts like mole, volumetric analysis, quantitative analysis and qualitative analysis among others if not properly taught and understood by the learner may lead to various misconceptions. Special attention is required to ensure alot of concrete examples which are used to teach students who have low emotional intelligence, low formal reasoning (low reasoning ability) and low self-efficacy. This is because researchers tends to show that abstract concepts can only be learnt meaningfully by students who have acquired formal, reasoning ability and good self-efficacy (Sirajo, Mari and

Olorukooba, 2013).This could be an indication that learning could be related to emotional-intelligence, reasoning ability and self-efficacy.

In the early 1940, David Wechsler discussed the concept of intelligence that encompasses both elements of the intelligence quotient of cognitive (intellectual) and non-cognitive intelligence (emotionally). Actually, earlier in the year 1920 Thorndike talked about the concept of social intelligence that has been considered as the basic for the development of the theory of emotional intelligence (Goleman, 1995). Social intelligence is essentially the ability to understand other people, what motivates them, how they work, how to work with them and the ability to act wisely in relationship between human beings. Thus, self – awareness, empathy and dealing with interpersonal relationships are the core of emotional intelligence and the basic elements of social intelligence.

The term emotional intelligence was first described by Mayer and Salovey (1990) as a form of social intelligence that involves the ability to monitor one's own and others feelings and emotions, to discriminate among them, and to use this information to guide one's thinking and action. It was made popular by Goleman (1995)who referred to it as the ability to sense, understand, value and effectively apply the power and acumen of emotions as a source of human energy, information, trust, creativity and influence. Later, Mayer and Salovey (1997) refined the definition of emotional intelligence as "the ability to detect emotions, to enter and create emotions that help thinking, to understand emotions and emotional knowledge acquired, always thought to control emotions to promote emotional and intellectual development" (Azizi, Noordin, Yusuf, Sherin & Goh, 2012). They believe the combination of the idea that emotions make thinking smart and intelligent thinking about emotions. Again, Mayer and Salovey (2008) stated that some individuals have

a greater capacity than others to carry out sophisticated information processing about emotions and emotion-relevant stimuli and to use this information as a guide to thinking and behaviour. Derived from this statement, individuals with high emotional intelligence pay attention to use, understand, and manage emotions, and these skills serve adaptive functions that potentially benefit themselves and others.

Emotionwas classified as positive and negative emotions (Abdullah, Elias, & Uli 2004). Positive emotions, also known as positive affectivity (PA) refers to emotion that range from high energy, enthusiasm and excitement, to calm, quite and withdrawn. Examples of PA are joy, happiness, and laughter. Negative affectivity (NA) involves emotions that are negatively toned, such as anxiety, anger, guilt, and sadness. These emotions are very important to the educative process as the drive attention, and consequently learning and memory (Abdullah et al, 2004).The impact of negative emotions on academic achievement can be examined through the relationship between emotion and learning processes. For instance, emotional maladjustment could result in inattention and poor memorization resulting in poor school work. According to Kanhai (2014), the relationship between emotional maladjustment and school failure actually is a circular one. Emotional maladjustment affects children's ability to concentrate and to remember, resulting in poor school work which later increases the child's anxiety and frustration causing the child to be emotionally disturbed.

Anything that affects the child's emotional state is likely to affect his school achievement. Anxious, unhappy, and angry youngsters do not make ideal students (Kanhai, 2014) and people who are caught in these states do not take in information efficiently or deal with it well (Abdullah et al, 2004). The link between the child's emotional life and academic performance is clearly seen if we consider the question

of anxiety. Over-anxiety can inhibit learning or hinder performance. Take the example of a child who is too anxious to pass an examination to please his parents who have high expectations on him/her. He/she might become so nervous thinking about the consequences of failing his parents that he/she may lose focus to the tasks he/she is attending to. On the other hand, a child who suffers from 'under-anxiety' is not anxious to learn and would not be concerned at his own failure or is not bothered whether learns or not and he is unlikely to progress in school. Other negative effects that portray similar affects on learning are anger, frustration, and sadness. As attention and memorization are crucial in learning and influenced by emotional adjustment, the ability to regulate one's emotion can serve as a tool for adolescents to cope with negative affects when they encounter them in learning situations. Therefore, Emotional Intelligence (EI) plays an important role in students' academic performance above and beyond their cognitive ability.

The connection between emotion and cognition can be explained by the way emotion interacts with cognition. A person who is in good mood tends to think positively and productively and vice versa. As such, the term emotional intelligence quotient. (EQ)implies that emotion and intelligence are interrelated and complementary given rise to emotional intelligence (Mayer, 2001).Belief in the validity of a statement and the ability to reason are also directly connected to emotion. As shown in the Lavins (2011) study where participants' beliefs became more polarized when exposed to arguments disconfirming their beliefs, certain information or topics can elicit emotions in participants, holding the potential to interfere with and bias reasoning as well.

More specifically, further research has focused on how emotions may influence the way in which a person reasons with the information given to them.

Research by Kaufman – Lavins (2011) has found that extremes in emotional arousal can lead to a state of bounded rationality, defined as a person's, "...tendency to call off a search once something is found" (Croskerry, 2002). This is significant for reasoning ability in that individuals in a state of emotionally aroused bounded rationality may fail to consider other important information presented once they have reviewed information that satisfies their own interest (Croskerry, 2002). Thus, when in a heightened emotional state, a person may cease to process information effectively, and thus be unable to reach a logical conclusion.

The ability to reason logically is critical for decision makers and people in everyday life and involves the way we use given knowledge and facts to reach a conclusion. Its application is of crucial importance for advances in the sciences and mathematics, as the scientific method relies heavily on deductive reasoning (a type of logical reasoning in which a conclusion is derived from a premise) and reasoning plays a strong role in a person's ability to make informed, educated and accurate decisions (Lavins, 2011).

Daily functioning and the ability to make important life decisions depend on the person's ability to accurately understand a situation, acknowledge their subjective interpretation of the situation, and reach a logical conclusion based on this supporting knowledge. However, research has consistently shown that people fail to reason logically, and they do so in systematic ways (Lavins, 2011).

Logical reasoning is commonly assessed by evaluating a person's ability to employ deductive reasoning. Deductive reasoning is defined as a closed system in which an individual derives conclusions from preexisting premises and judges truthfulness of a statement though normative logic (e.g., Alldogs are black. Tucker isadog. Therefore, Tucker is black) (Blanchette, 2006). This differs from inductive

reasoning, in which an individual generalizes from a specific assumption (e.g., All the birds I have seen can fly, so all birds can fly).

Students who have acquired formal reasoning ability have deep working memory that enable them solve abstract problems in logical fashion. They are also able to apply scientific thinking in solving problems such as stating and testing hypotheses, isolation-of-variables, analyzing data, and ability to keep concepts and their interrelationships in the mind while considering answers. According to developmental theory, descriptive and theoretical concepts constructions are linked to intellectual development because the process depends on reasoning patterns and also reasoning ability relies on not only maturation but also individual self- regulatory mechanisms that are known to enhance purposive and meaningful learning. This tends to suggest that concept acquisition is dependent on students' reasoning ability. Empirical study in support of this was provided by Lawson – Mari (2012) who reported that reasoning ability highly correlated with performance on concepts acquisition tasks for school Biology and chemistry students. Bitner – Mari (2012) also showed that reasoning ability explained 62% of the variance in high school science grades. Herron– Mari (2012) provides the following generalizations that link misconceptions with reasoning ability:

i. Many misconceptions are related to concepts that involve proportional relationships: density, equilibrium, mole, acceleration, and rates of various kinds.
ii. Many misconceptions are related to theoretical models that require the student to interpret observations in terms of something that cannot be experienced directly: explanations in terms of genetics and evolution, explanations in terms of an atomic model, and explanations in terms of probabilistic models.

iii. Many misconceptions are related to difficulty in following chains of logical inference.

All these arguments point to the significance of reasoning ability to concepts acquisition in science and could also be indication why girls who happen to lag behind boys in reasoning ability perform lower and show less preference for science compared to boy.

When people reason, they must, Bruner, Lohman & Lakin (2009), go "beyond the information given". They do this in one or both of the following ways:

i. They attempt to infer (either automatically or deliberately) concepts, patterns, or rules that best (i.e., most uniquely) characterize the relationships or patterns they perceive among all the elements (e.g., words, symbols, figures, sounds, movements) in a stimulus set. Better reasoning is characterized by the use of concepts or rules that simultaneously satisfy the opposing needs for abstraction (or generalization) and specificity. Such concepts or rules tend to be at least moderately abstract yet precisely tuned. Put differently, a poor inference is often vague and captures only a subset of the relationships among the elements in the set.

ii. They attempt to deduce the consequences or implications of a rule, set of premises, or statements using warrants that are rendered plausible by logic or by information that is either given in the problem or assumed to be true within the community of discourse. They often seem to do this by creating and manipulating mental models of the situation. Such models tend to represent explicitly only what is assumed to be true about the situation. Better reasoning involves providing warrants that are more plausible or consistent with the rules of logic or the conditions embodied in a comprehensive mental model. More advanced deductive

reasoning involves providing either multiple (possible divergent) warrants for a single claim or an increasingly sophisticated chain of logically connected and separately warranted assertions.

Reasoning is the process of thinking about things in logical way. Understanding and high performance is an abstract concept is in consonants with formal reasoning ability, since students with a higher level of formal reasoning perform significantly better and understand certain concept faster than concrete learners. Herron (1975) pointed out that abstract concept can only be leant meaningfully by learners that have acquired formal reasoning. This suggested that students who have advance in their reasoning ability are expected to outperform those with low reasoning ability. Many of the concepts that are traditionally covered in school chemistry are of highly abstract entities that requires students to function at the level of formal operations to understand the concepts and principles.

Researches in science education have also indicated that formal thought (ability to comprehend abstract ideas) is essential for learning many difficult scientific concepts. For instance, Sirajo, Mari and Olorukooba (2013) observed that formal reasoning ability is a reliable indicator of successful achievement in science and mathematics. Mari (2001) observed that, for students to have a deeper understanding of the key concepts and fundamental principles of science, the process involved in generating these concepts and principles must be learnt. Mari went further to identify that formal reasoning ability is highly relevant to science education as it is involved in most of the scientific process skills. According to Lawson (2004), formal reasoning ability is used to denote consistent, social thought patterns which are employed during the process of scientific inquiry that enable individuals propose relationships between observed phenomena; to design experiments which test hypothesis concerning the

proposed relationship; to consider probabilities of occurrences; to predict logical consequences; to weigh evidence or proof, and to use a number of instances to justify a particular conclusion. Research in science education have also brought to light (revealed) the importance of the cognitive factor influencing achievement in science courses. For instance formal reasoning ability (Mari, 2001).

Self-efficacy predicts intellectual performance better than skills alone, and it directly influences academic performance through cognition. Self-efficacy also indirectly affects perseverance, (Tenaw, 2013). Although past achievement raises self-efficacy, it is student interpretation of past successes and failures that may be responsible for subsequent success. Perceived self- efficacy predicts future achievement better than past performance (Tenaw, 2013). Self- efficacy beliefs also contribute to performance since it influences thought processes, motivation, and behavior, (Britner and Pajares, 2006). Fluctuations in performance may be explained by fluctuations in self-efficacy. For example, varying beliefs in self-efficacy may alter task outcome, whether it involves two similarly-skilled individuals or the same person in two different situations (Britner and Pajares, 2006).

Individuals high in self-efficacy attempt challenging tasks more often, persist longer at them, and exert more effort. If there are failures, highly efficacious individuals attribute it to a lack of effort or an adverse environment. When they succeed, they credit their achievement to their abilities. The perception that their abilities caused the achievement affects the outcome rather than their actual abilities Bandura, (2001). "Those who regard themselves as inefficacious shy away from difficult tasks, slacken their efforts and give up readily in the face of difficulties, dwell on their personal deficiencies, lower their aspirations, and suffer much anxiety and stress. Such self-misgivings undermine performance" (Bandura, 2001).

Conversely, individuals with high self-efficacy frequently persevere despite difficult tasks or challenging odds and often succeed because perseverance usually results in a successful outcome (Pajares and Schunk, 2005). Numerous studies Bandura, (2001), Chemers, Hu, and Garcia, (2001)link self-efficacy to academic achievement. For example, in seventh grade Science and English classes, self-efficacy was positively related to cognitive engagement and academic performance (Pajares, 2009). Self-efficacy, self-regulated learning, and test anxiety also were found to be the best performance predictors (Pajares, 2009).

Self-efficacy is the belief in One's ability to perform a specific task. Self-efficacy theory is an important component of Bandura's social cognitive theory which suggests high inter-relation between individual's behavior, environment and cognitive factors. According to Bandura (2001), perceived self-efficacy affects an individual in all aspects of life, including educational experiences. Beliefs about one's competence to successfully perform a task can affect motivation, interest and performance. The higher the perceived efficacy, the higher the goal aspirations people adopt and the firmer their commitment to achieve those goals. An important assumption of social cognitive theory is that personal determinants such as forethought and self-reflection do not have to reside unconsciously within individuals. People can consciously change and develop their cognitive functioning.

Gender is a socially ascribed attribute, differentiating feminine from masculine (Nwagbo and Chukelu, 2011). It has been reported as one of the factors that may interact with cognitive extent and sources of the recorded differences in the achievement of males and females in chemistry. While Ifeako, (2005); Obeka (2007); Nwagbo and Okoro (2012); reported that males achieved significantly higher than females, Ekwueme and Umoinyang (2005, Longjohn (2009) reported in favour of

females. Opera (2002) did not find significant influence of gender on students' achievement.

Gender differences in self-efficacy have been reported in several researches. For instance, Sadker and Sadker – Tenaw, (2013) reported that girls, starting in grade seven tends to underestimate their abilities in mathematics and science. Smist and Owen and Kinsella – Tenaw, (2013) have documented that female students have lower self-efficacy in mathematics and science compared to male students. Girls' capabilities are undermined by sex-role stereotypes in many cultures intimating that females are not as able as males, especially in such disciplines as mathematics and science (Soffa, 2006). Another contributing factor could be the lower level of expectations that parents, teachers and counselors often hold for girls, which can discourage further study in scientific and technical fields (Soffa, 2006) and American Association of University Women Educational Foundation, (1999) among others, in their study on effect of learning about gender discrimination on girls attitudes toward science, Weisgram and Bigler - Tenaw, (2013) mentioned that low confidence level of girls toward science is partially due to prejudge that girls developed ever years: females are not as good as males in terms of science learning. Weisgram and Bigler– Tenaw, (2013) also concluded that informing girls of the discrimination would increase their self-efficacy by changing their attribution of past experience.

Gender Differences in Emotional Intelligence have Competing evidence that exists surrounding whether or not males and females differ significantly in general levels of emotional intelligence. Goleman – Stys and Shelley (2004) asserts that no gender differences in EI exist, admitting that while men and women may have different profiles of strengths and weaknesses in different areas of emotional intelligence, their overall levels of EI. are equivalent. However, studies by Mayer,

Caruso, and Salovey - Stys and Shelley (2004), and Mandell and Pherwani (2003) have found that women are more likely to score higher on measures of emotional intelligence than men, both in professional and personal settings.

Bracket and Mayer (2003) found that females scored higher than males on EI when measured by a performance measure (the Mayer-Salovey-Caruso Emotional Intelligence Test). However, when using self-report measures such as the Bar-On Emotion Quotient Inventory (EQ-i) and the Self-Report Emotional Intelligence Test (SREIT), they found no evidence for gender differences. Perhaps gender differences exist in emotional intelligence only when one defines EI in a purely cognitive manner rather than through a mixed perspective. It could also be the case that gender differences do exist but measurement artifacts such as over-estimation of ability on the part of males are more likely to occur with self-report measures. More research is required to determine whether or not gender differences do exist in emotional intelligence, reasoning ability, self-efficacy and academic achievement.

Academic achievement has become an indicator of a child's future in the present extremely competitive world. Many students seem not to get recognition proportionate with their known or related abilities. Generally, we find students with average abilities excel in different areas. The perplexing facts, which have come into forefront, are that in spite of having similar educational amenities, atmosphere, desires etc. academic achievement of students differs from one another (Gakhar & Aseema, 2014). Therefore, the topic of academic achievement has assumed a lot of meaning in the modern educational system.

In our social set up, academic achievement is considered as a main standard to judge one's whole capabilities and competencies. Therefore, academic achievement occupies an essential place in teaching learning process. In the present

socioeconomic and cultural context academic achievement is of paramount significance. Right from the beginning great stress is placed on achievement at secondary school level (Gupta, Sharma & Gupta, 2012). This stage has its own organized hierarchy which is mainly based on achievement and performance, because this period is a path to enter professional courses.

The academic achievement is a multidimensional and multifaceted phenomenon. There are various factors, which influence pupil's academic achievement namely; school climate, parental involvement, intelligence, learning experiences at schools, parental occupation, their educational level, reasoning personality, motivation, heredity, problem solving interest aptitudes, learning styles and socio-economic status of the parents and many more factors (Can, 2009). In the present times every one desires to have a high academic performance. The entire system of education is centred on students' academic performance. An insignificant research occurs concentrating on the roles of emotional-intelligence, reasoning ability and self-efficacy on pupils' performance in science and other subjects but they are limited and inconsistent.

This study sought to investigate the predictive effect of emotional intelligence, reasoning ability, and self-efficacy on achievement of senior secondary school chemistry students in Zonkwa Education Zone. The study used a different study area and level of the students for better results.

1.1.1 Theoretical Framework

The primary theory utilized in this research is Goleman's Emotional Intelligence Theory(1995). Due to his 1995 book, Emotional Intelligence: Why It Can Matter More Than IQ, Goleman's Emotional Intelligence (1995), theory is possibly the most widely recognized and known of those available. According to his definition,

emotional intelligence is "the capacity for recognizing our own feelings, and those of others, for motivating ourselves and for managing emotions well in our relationships" (Goleman, 1995). Emotional intelligence can similarly be defined as "a type of social intelligence that involves the ability of one to monitor one's own and others' emotions, to discriminate among them and to use the information to guide one's thinking and actions" (Maulding, Townsend, Leonard, Sparkman & Styron, 2010). Regardless of the definition, theories of emotional intelligence share commonalities though the chosen wording may be different; each contains the essence of being aware of your and others' mind-set and behavior to positively impact situations (Greenockle, 2010). A principal, as the leader in the building, that possesses high emotional intelligence can utilize this intelligence to create a culture with high expectations, trusting and respectful relationships, and shared vision of success for all (Egley & Jones, 2005; Moore, 2009). The Goleman's Emotional intelligence theory is utilized in this study to find out if emotional intelligence can be used to predict achievement of senior secondary school students.

Piaget (1972) argued that individuals adapt to their environment by a refining cognitive structure in order to efficiently organize information. The original Piagetian model describes a set of stages in which each- stage represents a new method for information acquisition and management. According to Piaget, adult level of reasoning emerges in late adolescence when the transition is made from the stage of "concrete operations" to the .stage of "formal operation". Both of these stages involve logical reasoning, but formal operation has unique characteristics and advantages not found in concrete operations. While concrete operations allows for the application of logical reasoning to real objects and situations, the reasoning process is still primarily based on perceptual experiences. In contrast, formal operations involve the dominant

use of "prepositional logic", which may be applied to both real and hypothetical or abstract situations. The present study is hinged on Piaget cognitive theory to find out if students at the formal operational level in which prepositional logic which may be applied to both real and hypothetical or abstract situations can be used to predict achievement of senior secondary school students.

Similarly the social cognitive theory of the psychologist Bandura and others who has defined self-efficacy as one's belief in one's ability to succeed in specific situations or accomplish a task. One's sense of self-efficacy can play a major role in how one approaches goals, tasks, and challenges (Luszczynska & Schwarzer 2005). The theory of self-efficacy lies at the center of Bandura's social cognitive theory, which emphasizes the role of observational learning and social experience in the development of personality. The main concept in social cognitive theory is that an individual's actions and reactions, including social behaviors and cognitive processes, in almost every situation are influenced by the actions that individual has observed in others. Because self-efficacy is developed from external experiences and self perception and is influential in determining the outcome of many events, it is an important aspect of social cognitive theory. Self-efficacy represents the personal perception of external social factors (Bandura, Mischel - Luszczynska & Schwarzer 2005). According to Bandura's theory, people with high self-efficacy that is, those who believe they can perform well are more likely to view difficult tasks as something to be mastered rather than something to be avoided.

Bandura explain further that people generally avoid tasks where self-efficacy is low, but undertake tasks where self-efficacy is high. When self-efficacy is significantly beyond actual ability, it leads to an overestimation of the ability to complete tasks. On the other hand, when self-efficacy is significantly lower than

actual ability, it discourages growth and skill development. Research shows that the optimum level of self-efficacy is slightly above ability; in this situation, people are most encouraged to tackle challenging tasks and gain experience (Vdikdxrnymihslyi, - Luszczynska & Schwarzer 2005).

Academic self-efficacy refers to the belief that one can successfully engage in and complete course-specific academic tasks, such as accomplishing course aims, satisfactorily completing assignments, achieving a passing grade, and meeting the requirements to continue to pursue one's major course of study (Soffa, 2006). Various empirical inquiries have been aimed at measuring academic self-efficacy (Rushi, 2007). This study employed the Bandura's social cognitive theory of self-efficacy to find out if self-efficacy can be used to predict achievement of senior secondary school students.

This study was therefore concerned with exploring the correlations of emotional intelligence, reasoning ability and self-efficacy as predictors of academic achievement of senior secondary II in Chemistry in Zonkwa education zone of Kaduna state of Nigeria.

1.2 Statement of the Problem

Researches show that some concepts are formal or abstract in nature and can be learned meaningfully by only learners that acquired high emotional intelligence, formal reasoning ability and high self-efficacy. This tends to suggest that advancement in emotional intelligence, reasoning ability and self-efficacy could enhance the learning of chemistry concepts. It can also be inferred that achievement in chemistry may have co-relationship with emotional intelligence, reasoning ability, and self-efficacy (Furio, Ascona, Guisola & Raclifte, 2000).

Researches in science education have revealed that students generally perform poorly in all science subject (Olorundare; Adeyegbe, and Usman, - Sirajo, Mari and Olorukooba 2013). Researches in science education have also shown that there is a relationship between formal reasoning ability and achievement in science (Mari, 2001).

Researchers have also shown that academic achievement in science is affected by a variety of factors including emotional-intelligence, reasoning ability, self-efficacy attitude and motivation. Numerous studies support a connection between emotional intelligence, and academic achievement, reasoning ability and academic achievement, and self-efficacy and academic achievement in science. Previous researches revealed emotional intelligence, reasoning ability and self efficacy as a success factors in predicting performance of students. There is no study that seems to compare a success of reasoning ability, emotional intelligence and self efficacy in predicting performance of students in chemistry. It is in line with this that the present study sought to compare if the variables in predicting the performance of students in chemistry. From the literature cited, most of the studies carried out used different study areas that are not from Nigeria. This study will therefore use different study area for a better understanding of the relationships among emotional intelligence, reasoning ability self-efficacy and achievement in chemistry among senior secondary II (SS I) school students in Zonkwa Education Zone, Kaduna State-Nigeria.

1.3 Objectives of the Study

The objectives of this study are formulated as follows; to:

1. examine the relationship if any among the mean score of SSII students in emotional-intelligence, reasoning ability and self-efficacy and academic achievement in chemistry.
2. determine the relationship if any among the mean scores of SSII male students in emotional-intelligence, reasoning ability, self efficacy and academic achievement in chemistry.
3. Investigate the relationship if any among the mean scores of SSII female students in emotional-intelligence, reasoning ability, self efficacy and academic achievement in chemistry.
4. determine the difference in the mean scores of SSII male and female students in emotional-intelligence, reasoning ability, self efficacy and academic achievement in chemistry.

1.4 Research Questions

Specifically, this study addressed the following questions:

i. What are the mean scores of SSII chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry?
ii. What are the mean scores of SSII male chemistry students in emotional-intelligence, reasoning ability, self efficacy and academic achievement in chemistry?
iii. What are the mean scores of SSII female chemistry students in emotional-intelligence, reasoning ability, self efficacy and academic achievement in chemistry?

iv. What is the difference between the mean scores of SSII male and female chemistry students in emotional-intelligence, reasoning ability, self efficacy and academic achievement in chemistry?

1.5 Null Hypotheses

To guide the study the following null hypotheses were tested at ≤ 0.05 level of significance:

$H0_1$: There is no significant relationship in the mean scores of SSII chemistry students in emotional-intelligence, reasoning ability, self-efficacy, and academic achievement in chemistry.

$H0_2$: There is no significant relationship in the mean scores of SSII male chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry?

$H0_3$: There is no significant relationship in the mean scores of SSII female chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry.

$H0_4$: There is no significant difference between the mean scores of SSII male and female chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry.

1.6 Significance of the Study

The findings of this study would hopefully be useful in the following ways:

i. **School administrators:** This study would provide information on the effect of emotional-intelligence, reasoning ability, self-efficacy as predictors of academic achievement which will enable school administrators to develop treatment and prevention measures to improve the students performance in sciences (chemistry).

ii. **Researchers:** This study will provide tools for measuring emotional–intelligence, reasoning ability, self-efficacy and academic achievement in chemistry that could be used by other researchers.

iii. **Chemistry Students:** The study will also help the students by educating them on emotional intelligence, reasoning ability and self-efficacy and also how all these relate to their academic achievement in chemistry.

iv. **Chemistry Teachers:** Studying the relationship existing between emotional-intelligence, reasoning ability, self-efficacy and achievement in chemistry will be beneficial to chemistry teachers by making them understand and adjust their methods of teaching to cater for diverse students in their classes.

v. **Science Educators:** In addition to this, researchers in the field of chemistry education will benefit from the expansion of literature in the discipline due to the results of this study,

vi. **Professional bodies:** The results of this study will benefit federal and state ministries of education and other educational bodies like Nigeria educational research and development council (NERDC) and Science Teachers Association of Nigeria (STAN).

1.7 Scope of the Study

The study examined the relationship between Senior Secondary School Student Emotional Intelligence, Reasoning Ability, Self-Efficacy as Predictors of Academic Achievement in Chemistry. It is delimited to senior Secondary Schools Chemistry Students in Zonkwa Education Zone, Kaduna State. The study is delimited to SSII chemistry students of public senior secondary schools. The reason for restricting this study to public schools is that they are the majority and they all use similar curriculum and are managed by the same body. This will also help the

researcher in drawing samples since the school has similar characteristics. The choice of SS II students is because they are stable and are not facing their final year examination. The instruments that would be used for this study in generating data are, Trait Emotional Intelligence Questionnaire (TEIQue), Group Assessment of Logical Thinking (GALT), Chemistry Self-Efficacy Instrument (CSI) and Chemistry Achievement Score (CAS).

1.8 Basic Assumptions

In carrying out this study, the following assumptions were made:

i. The schools have qualified chemistry teachers teaching senior secondary school two (SSII) chemistry (i.e. not less than B.Sc.(Ed) in Chemistry, or B.Sc Chemistry with an added P.G.D in Education Qualification or NCE in Chemistry.

ii. It is also assumed that the third term (qualifying) examination results are true assessment of student achievement in chemistry.

iii. It is assumed that emotional-intelligence, reasoning ability and self-efficacy can be measured

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This study examined the relationship between Emotional-intelligence, Reasoning ability, Self-efficacy as predictors of academic achievement of Senior Secondary School Chemistry Students in Zonkwa Education Zone Kaduna State Nigeria. This chapter contains some literature related to this study discussed under the following sub-headings:

2.2 Meaning and Nature of Chemistry

2.3 Psycho-sociological Factors in Learning

2.4 Emotional-Intelligence, Science Learning and Performance

2.5 Reasoning Ability, Science Learning and Performance

2.6 Self-Efficacy, Science Learning and Performance

2.7 Instructional Models and Emotional Intelligence

2.8 Instructional Models and Reasoning Ability

2.9 Instructional Models and Self-Efficacy

2.10 Gender-Related Differences in Academic Achievement

2.11 Over View of Similar Studies

2.12 Implication of the Literature Review for the Present Studies

2.2 Meaning of Chemistry

Chemistry is a branch of physical science that studies the composition, structure, properties and change of matter (Chemweb, 2011). Chemistry includes topics such as the properties of individual atoms, how atoms form chemical bonds to create chemical compounds, the interactions of substances through intermolecular forces that give matter its general properties, and the interactions between substances

through chemical reactions to form different substances. Chemistry is sometimes called the central science because it bridges other natural sciences, including physics, geology and biology.

Chemistry began as a physical science that did not quite fit the definition of Physics. It is the study of matter, but is obsessed with affecting changes to matter at the molecular level, rather than the forces and laws that govern the changes. The intellectual peak of modern chemistry was the elucidation of the chemical bond, yet to this day it is not possible to write down a mathematical formula to describe how all but the simplest chemical reactions will proceed; only to rationalize it post facto. What propelled Chemistry beyond dyes and explosives and, arguably, defined it in the modern area, was petroleum. Of recent, plastics, pharmaceuticals, photolithography, carbon composites, coatings the chemical roots of modern technology are widespread. Yet one of the most prolific chemists of the 20th Century, Linus Pauling, is not a chemist by modern standards. Pauling explained reactivity in terms of chemical bonds and was integral in uncovering the molecular basis of life, yet these accomplishments are readily parsed as Quantum Mechanics (as is the work of Niels Bohr, one of Pauling's mentors) and Molecular Biology in the parlance of the 21st Century (Ryan, 2015).

But that is precisely what makes Pauling a prototypical chemist; his accomplishments spilled over into and created new fields of science. And that is what Chemistry does; it creates. Chemists create new molecules, new materials, uncover new phenomena, and create new problems that raise new questions. Chemists are experimentalists; if their results contradict a theory, then the theory must be wrong. When chemists unearth a problem of sufficient complexity and interest, a new field of science is created to address it. The fingerprints of Chemistry are all over

Biochemistry, Molecular Biology, Materials Science, Nanotechnology, and myriad other scientific disciplines and areas of research; and modern chemists frequently work at the interface with these fields (Ryan, 2015).

Matter is the building block material of the universe. It is anything that takes up space and has mass. Chemistry is a basic science whose central concerns are: structure and behavior of atoms; composition and properties of compounds; reactions between substances with their accompanying energy exchange; and the laws that unite these phenomena into a comprehensive system (Bagley, 2017).

There are five main branches of chemistry, each of which has many areas of study.

i. Analytical chemistry uses qualitative and quantitative observation to identify and measure the physical and chemical properties of substances. In a sense, all chemistry is analytical.
ii. Physical chemistry combines chemistry with physics. Physical chemists study how matter and energy interact. Thermodynamics and quantum mechanics are two of the important branches of physical chemistry.
iii. Organic chemistry specifically studies compounds that contain the element carbon. Carbon has many unique properties that allow it to form complex chemical bonds and very large molecules. Organic chemistry is known as the "Chemistry of Life" because all of the molecules that make up living tissue have carbon as part of their makeup.
iv. Inorganic chemistry studies materials such as metals and gases that do not have carbon as part of their makeup.
v. Biochemistry is the study of chemical processes that occur within living organisms.

Fields of study in chemistry: Within these broad categories are countless fields of study, many of which have important effects on our daily life. Chemists improve many products, from the food we eat and the clothing we wear to the materials with which we build our homes. Chemistry helps to protect our environment and searches for new sources of energy (Bagley, 2017).

Food science deals with the three biological components of food - carbohydrates, lipids and proteins. Food chemists improve the quality, safety, storage and taste of our food. Food chemists test products to supply information used for the nutrition labels or to determine how packaging and storage affects the safety and quality of the food (Bagley, 2017).

Environmental chemists study how chemicals interact with the natural environment. Environmental chemistry is an interdisciplinary study that involves both analytical chemistry and an understanding of environmental science (Bagley, 2017).

Agricultural chemistry is concerned with the substances and chemical reactions that are involved with the production, protection and use of crops and livestock. It is a highly interdisciplinary field that relies on ties to many other sciences. Agricultural chemists may work with the Department of Agriculture, the Environmental Protection Agency, the Food and Drug Administration or for private industry. Agricultural chemists develop fertilizers, insecticides and herbicides necessary for large-scale crop production. They must also monitor how these products are used and their impacts on the environment. Nutritional supplements are developed to increase the productivity of meat and dairy herds (Bagley, 2017).

Agricultural biotechnology is a fast-growing focus for many agricultural chemists. Genetically manipulating crops to be resistant to the herbicides used to control weeds in the fields requires detailed understanding of both the plants and the

chemicals at the molecular level. Biochemists must understand genetics, chemistry and business needs to develop crops that are easier to transport or that have a longer shelf life (Bagley, 2017).

Chemical engineers research and develop new materials or processes that involve chemical reactions. Chemical engineering combines a background in chemistry with engineering and economics concepts to solve technological problems. Chemical engineering jobs fall into two main groups: industrial applications and development of new products (Bagley, 2017).

Geochemists combine chemistry and geology to study the makeup and interaction between substances found in the Earth. Geochemists may spend more time in field studies than other types of chemists (Bagley, 2017).

Forensic chemists capture and analyze the physical evidence left behind at a crime scene to help determine the identities of the people involved as well as to answer other vital questions regarding how and why the crime was carried out. Forensic chemists use a wide variety of analyzation methods, such as chromatography, spectrometry and spectroscopy (Bagley, 2017).

2.3 Psycho-sociological Factors in Learning

The Federal Government of Nigeria in her National Policy on Education (2009) sees introductory technology as one of the core subjects to be offered at the Junior Secondary School level. Science and Technology enables students to acquire knowledge and skills. Despite this, there are some psychosocial factors that are affecting the teaching and learning of Science and Technology (Oyenuga & Lopez 2012).

It should be noted that no great cornerstone of our understanding about the psychosocial factors affecting the teaching and learning of Science and Technology is

either erected or overthrown. Psychosocial factor is referred to the psychological and social factors that may or mar the study of a subject or course. The school, home background and the interest of the student stand out as strong variables in explaining variation in the teaching and learning of science and technology. Again, it could not be established that differences among school related arrangements bear any direct simple universal relationship to teaching and learning of Science Technology performance especially when the home and interest factors are held constant (Oyenuga & Lopez 2012).

Consequently, it should be noted that most students get a lot out of school, the highest variations in the teaching and learning of Science and Technology is observed around that basic levels may be attributed more to home and interest than to school differences. Cultural and psychosocial learning theories have not been used to explain the factors affecting the performance of students in the teaching and learning of science and technology. This is because no literature has been established in this area of study. However, in order to promote effective teaching and learning of Science and Technology, the school, home and the interest of the students are pertinent factors that must be considered (Oyenuga & Lopez 2012).

According to Cohen, Raudenbush & Ball (2003), school fees constitute an important for schools and represent potential for creating an enabling teaching and learning environment Cohen et al. further stated that school with few financial resources tend to perform poorly in relation to school with greater finances. Oyenuga (2007) linked poor teaching and learning to shortage of qualified teachers and this accounted for poor academics performances in secondary schools. Oyenuga (2007) also attributed the poor teaching and learning in secondary schools to inadequate material and infrastructural resources which are below expectation with some schools

having few classroom accommodations without windows, poor spacing and crowded seats. Okonkwo (2010) attributed the students' poor academic performance to indiscipline in schools and low level of educational standard. From the above, it is pertinent to say that the school is a psychosocial factor that may affect the teaching and learning of Science and Technology in Nigeria secondary public schools.

On the issue of the home as a psychosocial factor in the teaching and learning which can also make or mar students' performance, Oyenuga (2007) argued that good home background and conducive environment tends to promote students academic performance. Ajila and Olutola (2007) viewed that the state of the home affects the individual since the parents are the first socializing agents in an individual life. This according to Okonkwo (2010) is because the family background and concern of a child affect his reaction to life situations and his level of performance. Okonkwo (2010) also sees the home as having a great influence on the students' psychological, emotional, social and economic state. However, one could deduce that the home is a recognized psychosocial factor having a lot of influence in teaching and learning of various subjects in which Science and Technology is of no exception.

On the issue of interest, the home plays a significant role in this regard as many parents may discourage or encourage their children towards a particular subject or career. Teachers also play a significant role in the interest of a student in a particular subject. In a study carried out by Fakunade – Oyenuga & Lopez (2012), it was reported that students' hatred for some school subjects was a result of poor instructional strategies by the teachers. In order to facilitate teaching and learning of Science and Technology, interest of the students is also a relevant factor Chukwu (2002) (Oyenuga 2010) stated that interest has been viewed as emotionally oriented behavioral trait which determines a student's whim and vigour in tackling educational

programmes or other activities. Therefore, interest is an affective behaviour that can be aroused and sustained in teaching and learning through motivation and appropriate teaching technique. It has been widely acknowledged in science, technical and vocational acquisition research that the learning of Science and Technology is an inseparable subset of science and technical education as the school; home and interest may influence the perception of the society on the subject.

Socio - Psychological influences (socialization theory): Focuses on cultural and environmental influences and argues that socio and cultural forces work to create different experiences and expectations for girls and boys and to communicate to children what behaviors are considered sex-appropriate. It has been found out that parents encourage the development of natural and interpersonal skills in their daughters and spatial and practical skills in their sons, an emphasis seen to be dictated by culturally determined images of appropriate female and male behaviors (Busolo 2010).

Sex related differences are strongly influenced by learning and environmental influences (Fennema and Sherman – Busolo 2010). Cross-cultural studies have noted that sex differences on certain spatial tests (e.g. the embedded figures test) appear only in highly stratified cultures in which males exercise strong authoritarian control over females. Less structured societies (e.g. the Eskimos where females are not socialized to be more dependent than men, show little differences.

The fact that boys and girls begin to show the greatest differentiation of intellectual functioning at adolescence may suggest that the phenomenon is caused by developmental changes at this time in life. Social theorists have suggested that these changes are primarily the result of boys' and girls' initiation into adult roles, which are dictated by society (Kelly – Busolo 2010) It is the time when many girls do develop

the 'will to fail' in a society which differentiates roles in terms of gender, it follows that individual behaviors will be influenced by what is considered to be sexually appropriate. Tasks considered not to be sexually appropriate will be ignored in favor of more appropriate or useful tasks. If society deems that science and mechanical activities are the province of males, whereas literature, languages, social studies are the province of females, these judgments will be reflected in the choice of subjects and in the amount of effort expended by boys and girls on these subjects. It is referred to as "culture hypothesis" (Kelly – Busolo 2010).

It suggests that girls achieve less well than boys do in science because society does not encourage or expect girls to achieve as well as boys in science particularly in physical science. It therefore asserts that, throughout the world in the present - day society, achievement by women is neither expected nor encouraged, nor adequately recognized when it occurs. Women are respected for various achievements through their husbands and children, but direct personal achievement is considered hard and in feminine. In these circumstances, girls reduce their aspirations and fulfill society's expectations of them by under achieving (Kelly – Busolo (2010). Culture hypothesis explains that girls are socialized away from science at an early age by virtue of the toys they are given to play with, hobbies they are encouraged in, household jobs, and the masculine image of science and scientists in books, films and television.

According to social learning theory of sex-role socialization, there is a sequence whereby a child advances from dependency and anxiety to acceptable forms of behavior. This is brought about through reinforcement's fear of punishment and mechanism of initiation and identification (Busolo 2010).

There is evidence that the perception of task as sexually appropriate may mediate behavior by influencing pupil's expectations and the values they place in

attaining success on a task. Sex-role socialization has been held responsible for the different ways girls and boys spent their free time. Some kinds of play and games provide a psychological environment in which important cognitive learning can take place. Differences in the kinds of play activities that boys and girls engage in constitute a reward system structured for the maintenance of sex-role stereotypes. In addition, there is a major influence of the family status on students' achievement in science (Keeves and Saha – Busalo (2010); Postelthwaite and Wiley – Busalo 2010).

Although the research examining social behaviour focuses heavily on environmental factors related to achievement, some investigator have chosen the personality of the child as a target for study. Aremu & Oluwole (2001), Adeyemo and Oluwole (2001), Odedele (2000) and Wuensch & Lao (1987) have submitted that the way and manner the child perceived himself could affect his academic performance. Gaver and Goliez (1984) argue that underachievers, when compared to their more academically successful peers, are plagued by an assortment of personal deficits. They are highly anxious, self-derogatory, likely to act defensively in the face of authority; tend to feel rejected, and set unrealistic goals for themselves. This study also reviewed the psych-sociological factors in the teaching and learning which can also make or mar students' performance, apart from emotional intelligence, reasoning ability and self-efficacy.

2.4 Emotional-Intelligence, Science Learning and Performance

In 1980, Bar-On began research to determine the success and the ability of a person in hislife than anyone else. From the results of his research, he found a lot of intelligence and non-cognitive factors have contributed to the success of a person in his life. Later in 1985, Bar-On also coined the term EQ (Emotional Quotient) to reflect the approach in the assessment of general intelligence. He describes the

emotional intelligence reflects one's ability to negotiate well with others and control over their own sense of self. He also displays emotional intelligence reflects one's ability to negotiate with the daily environment challenges and helps predict the life of him, including career and personal affairs. He also suggested there was a scale of five components of emotional intelligence is intrapersonal, interpersonal, stress control, the ability to adapt and general mood.

The definition of emotional intelligence is widely understood sense of self and ability to handle those feelings without influenced by it, is able to motivate themselves to complete the work, creative, and strive to achieve the maximum level, notice the feelings of others and handle social relationships effectively (Higgs and Dulewicz, - Azizi *et al.*, 2012). Therefore, they suggested that the seven elements of emotional intelligence is self-awareness, the preservation of emotion, motivation, interpersonal sensitivity, persuasion, firmness and prudence with integrity. Gardner in a study in the field of human intelligence has established a theory that explains the various intelligence quotient of the number owned by men (Azizi et al, 2012) discovered the existence of seven types of intelligence. Among the seven intelligences, two intelligence known as intrapersonal intelligence and interpersonal intelligence is a component that is included in emotional intelligence. Intrapersonal intelligence is the ability of someone to control himself through knowledge and understanding of feelings, desires, needs and personal goals. With the abilities of this, one can motivate himself, impulse control and bad faith, lack of acting hastily. While interpersonal intelligence is the ability and emotional sensitivity to the psychological state of others. This ability helps a person to choose an adequate response, to feel empathy and communicate well with others. Clearly seen that the person who has these both intelligence and will be shaping a high emotional intelligence.

After that, the term emotional intelligence and academic writing exists in a series of. Mayerand Salovey in 1990, 1993 and 1995. Mayer and Salovey (1993) was the first to present an academic about their findings in the field of emotional intelligence. They define emotional intelligence as a kind of social intelligence that involves the ability to control the emotions of self and others, to distinguish between types of emotion, using information to guide thinking and actions of a person. According to them, emotional intelligence can be categorized into five aspects of the dominance of self-awareness, emotional management, self motivation, empathy and interpersonal skills.

i. Self-awareness of the self-observation and identification of a feeling when it appears.
ii. Emotional management is the feeling that it is sufficient to handle the behavior, recognizing the feelings behind.
iii. Self-motivation is a move to the goal of positive emotions, better self-control and to delay gratification and impulse weakens.
iv. Empathy is sensitive to the feelings of others, caring and accepting their perspective and appreciate the differences that exist in the feelings of others.
v. Interpersonal skills to control the emotions of other people, have social competence and social skills

Later, Mayer and Salovey – Azizi et al. (2012) refine the definition of emotional intelligence as "the ability to detect emotions, to enter and create emotions that help thinking, to understand emotions and emotional knowledge acquired, always thought to control emotions to promote emotional and intellectual development. They believe the combination of the idea that emotion makes thinking smart and intelligent thinking about emotions. Again, Mayer Salovey and Caruso, (2008) stated that some

individuals have a greater capacity than others to carry out sophisticated information processing about emotions and emotion-relevant stimuli and to use this information as a guide to thinking and behavior. Derived from this statement, it seem that individuals with high emotional intelligence pay attention to, use, understand, and manage emotions, and these skills serve adaptive functions that potentially benefit themselves and others.

The term emotional intelligence became popular and mainstream in the discussion of intelligence exists only after the publication of Goleman in 1995. He discussed that IQ contributes only 20% in the success of life and the rest by other factors. These factors may include emotional intelligence, luck and social class. Hebelieves that emotional intelligence has a stronger influence in IQ. Moreover, emotional intelligence can be enhanced if taught in a certain way. Goleman - Azizi et al. (2012) defines emotional intelligence as the ability to understand the sense of self and others, to motivate themselves and regulate emotions in both self and personal relationships with others.

General research surrounding emotion has pointed to numerous effects of emotional state on decision making capabilities, judgments and reasoning (Kunda – Lavins 2011). The experience associated with some emotions, such as anger and contentment, can lead to feelings of certainty, while emotions such as surprise, fear and worry can lead individuals to feel uncertain or unsure about their current situation (Tiedens & Linton, 2001). These emotional states, then, can impact their subsequent decision making. For example, in a recent study, researchers found that participants induced to feel emotions associated with certainty were more likely to rely on heuristic cues (superficial cues like the expertise of the source) and be more certain about their judgments when answering questions, than those induced to feel emotions

associated with uncertainty (Tiedens & Linton, 2001). Because reliance on heuristics can cause a participant to disregard important information, this suggests that eliciting emotions associated with certainty can potentially lead to illogical reasoning.

Literature further reveals that emotional intelligence skills and competencies are essential to success and that significant positive relationships exist between emotional intelligence and academic achievement among higher education students. For instance, Nasir and Masur (2010) found that emotional intelligence significantly predicted academic achievement among the 132 students in different departments of International Islamic University, Islaabad. Also in an earlier investigation by Rozell, Pettijohn, and Parker (2002), a significant relationship was found between emotional intelligence and CGPA of undergraduate students of Mid-Western University. Similarly among 246 Pakistan adolescents, Farooq (2003) reported that students with high emotional intelligence showed better academic performance than the students with low emotional intelligence. A similar finding among the Nigerian university students by Adeyemo (2007) revealed significant correlations between emotional intelligence and academic self-efficacy .with academic achievement. Sunbul and Aslan (2008) equally reported relationship between emotional intelligence and academic achievement among 312 Education students in Kenya, Turkey. Moreover, there is a significant body of research indicating that El and other non-traditional measures are just as predictive of success as traditional IQ tests (Low, Lomax, Jackson & Nelson 2004; Low & Nelson 2005).

There is also a growing realisation that transitions through education from school-college-career are challenging and difficult, especially for minority, first generation and non-traditional college students and that emotional intelligence influences variables in students' achievement and retention during transition period.

For instance, Law and Nelson (2005); Nelson, Low and Vela (2004) reported this among high school graduates in the first year of college in Texas universities and colleges. Likewise, Parker, Summerfeldt, Hogan and Majeski (2004) found that emotional intelligence is a predictor in identifying academically successful and academically unsuccessful students during transition period.

Some studies exploring the relationship between emotional intelligence and academic performance have produced mixed results. A study by Schutte, Malouff, Hall, Cooper & Dorheim - Shipley, Jackson & Segnest (2012) found that scores on a self-report measure of emotional intelligence completed at the beginning of the academic year significantly predicted grade point average at the end of the year. In a study by Rozell, Pettijohn, & Parker (2002), there was a small, but significant relationship between "academic success, as measured by grade point average, and three out of the five factors within the utilized emotional intelligence scale utilizing the Goleman (1995, 1998) scale.

In a study conducted by Rode, Mooney, Arthaud-Day, Near, Baldwin, Rubin & Bommer, (2007), it was predicted that emotional intelligence was related to academic performance for two reasons. First, academic performance involves a great deal of ambiguity which has been shown to cause felt stress. Students are required to manage numerous assignments, adapt to the differing teaching styles and expectations of instructors, work independently toward objectives, and manage conflicting academic and non-academic schedules. In addition, some aspects of academic work may be considered highly stressful, such as taking exams (Rode, et al., 2007).

Second, the majority of academic work is self-directed, requiring high levels of self-management (Rode et al., 2007). Understanding the causes and effects of various emotions is an important element of emotional intelligence. Rode et al. (2007)

continued by including the research of Mayer and Salovey (1997): individuals with a high level of emotional intelligence are able to direct positive emotions to uphold the energy needed for high performance over long periods of time and to redirect negative emotions into productive behaviors. Thus, Rode et al. (2007) reasoned that individuals with high emotional intelligence would perform better academically. Despite their prediction, emotional intelligence was not significantly associated with grade point average, however, they did find an interaction of emotional intelligence with conscientiousness explained unique variance in academic performance (cumulative GPA), as well as public speaking and group behavior effectiveness.

A number of other studies did not find significant relationships between emotional intelligence and academic success. Newsome, Day, and Catano (2000) investigated the relationship of emotional intelligence, cognitive ability, and personality with academic achievement. Emotional intelligence was measured using the Emotional Quotient Inventory (EQ-i), including the total EQ-i score and five EQ-i composite factor scores. None of the EQ-i factor scores, nor the total EQ-i score, was significantly related to academic achievement. A study by O'Connor and Little (2003) assessed the relationship between emotional intelligence and academic achievement, as measured by grade point average, in college students, using both self-report and ability-based measures of emotional intelligence. The results showed that emotional intelligence was not a strong predictor of academic achievement regardless of the type of instrument used to measure it.

Considering the mixed nature of literature on the relationship between emotional intelligence and academic performance, the concept warrants further research. Perhaps the studies trial did not find a significant relationship between emotional intelligence and academic performance did not examine the sub-factors of

emotional intelligence or perhaps it was due to the scale that was utilized. Based on all the theoretical literature on emotional intelligence. The researcher intends to investigate the relationship between emotional intelligence, reasoning ability and self-efficacy as prediction of achievement in SS II chemistry students.

An extensive review of chemical education literature indicated that influence of emotional intelligence on chemistry achievement has not been explored. On the basis of the above controversy, postulation and the strong recommendations of Uzoechi, Kurumeh & Azuka (2013) that studies on emotional intelligence be carried out in various subject areas in Nigerian secondary education curriculum to ascertain its relationship with academic achievement, it becomes important to investigate if there is any significant influence of emotional intelligence on students achievement in chemistry. The present study aimed at finding out if there is correlations between emotional intelligence, science learning and performance in senior secondary school chemistry students.

2.5 Reasoning Ability, Science Learning and Performance

Since the evolution of human beings, reasoning ability has been used as an important element to solve their day to day related problems. It has been acknowledged as the main component of human nature. Its expression can be found in the teaching of Socrates, Confucius and others (Chen, 2000). The aim of education is to equip the people with the ability to reason out. Therefore, the development of reasoning skills, its improvement and various approaches invited the attention of teachers, thinkers, and academics for years (Kemler, - Bhat 2016).

Reasoning is a thoughtful activity that has vital significance during the whole life. Almost all the theories of intelligence give much emphasis on the reasoning and have crucial importance in daily routines and patterns of life (Wilhelm, 2004).

The students make use of reasoning ability in various life patterns in general and education in particular. It helps students to draw conclusions and these conclusions help them to solve their problems. It assists students in gaining true knowledge, because knowledge is based on logic and rationality. Besides, it helps students in decision making, problem solving, causal relationships, making inductive and deductive generalizations and academic excellence. Studies also revealed that reasoning helps in developing IQ (Leighton & Sternberg, 2004).

In various thought process such as decision making, critical thinking and problem solving, reasoning is pivotal (Samarap, 2009). The researchers (Tella et al, 2008) claimed that pupils' reasoning ability is an essential condition for the assessment of the performance in learning and is also an indicator of their future performance. Moore and Bruder (1996) highlighted the significance of reasoning ability they stated that reasoning skills help students think clearly and logically to act upon multiple problems with a rational approach.

Reasoning is a very important aspect of human existence. In today's complex world, the ability to think and reason logically is essential for everybody. The ability to reason is indispensable when problem solving skills are required. Without reasoning, already acquired knowledge and experiences cannot be applied to new situations (Bhat, 2014).

Progressive psychologists explore the growth and expansion of reasoning from birth to maturity. The first comprehensive theory of reasoning development was Piaget's theory of cognitive development (Demetriou, 1998). Cognitive psychologists and mathematics teachers have great interest in area of reasoning (National Council of Mathematics Teachers [NCTM], 2000). Without reasoning, already accomplished knowledge and experiences cannot be applied to new situations. Reasoning is broadly

defined as "the process of drawing conclusions" (Leighton and Sternberg, 2004, p. 3, 4). The true conclusions assist in problem solving because they are reliable representations of the external environment. Therefore, the main aim of education is to make available the situations which will stimulate the students' with reasoning abilities (Valanides, 1997).

Earlier there were two categories of reasoning such as inductive and deductive made by philosophers. Later on abduction was introduced and finally it was acknowledged that there are three categories of reasoning (Allan, 2006). Roediger & Rushton (1987) in their book "Psychology" has mentioned some types of reasoning, like- conditional, analogical and linear reasoning.

Although, there are some more categories of reasoning from which some are not familiar. These are cause-and- effect reasoning, comparative reasoning, criteria reasoning, decomposition reasoning, systematic reasoning, syllogistic reasoning (Vince, 2011; Wason and Johnson, 1972; Jeotee, 2012).

Reasoning abilities are not static. They are developed through experience and rendered easier to perform through exercise (Lohman & Lakin 2009). Recall that individual differences in reasoning are substantially correlated with the amount of information individuals can hold in working memory while performing some transformation on it. The ability to do this depends in large measure on the attentional resources individuals bring to a task, their familiarity with the to-be-remembered information, and their skill in performing the required transformations. Thus, prior knowledge and skill are critical determiners of the level of reasoning that one can exhibit both on reasoning tests and in everyday tasks. The dependence on prior knowledge is most pronounced on tasks that require deductive reasoning with authentic stimulus materials, and is least pronounced on tasks that require inferential

reasoning with simple geometric or alphanumeric stimuli. The processes that support sophisticated reasoning by experts in a knowledge-rich domain, however, appear to be largely the same as those which enable the novice to infer consistencies or deduce likely consequents in novel problem-solving (Bruner – Lohman & Lakin 2009).

There are many sources of evidence that bear on the construct validity and practical importance of reasoning tests. First is the fact that reasoning is the central or most general cognitive ability in any diverse battery of tests. Second, reasoning tests predict success in academic learning because - as Snow, Greeno, Bruner, - Lohman & Lakin (2009) have pointed out-academic learning is at its core one grand game of inference and deduction making. All instruction is incomplete in some respects. Effective learning requires that the student continually go beyond the information given to find similarities and differences between new patterns and concepts already in memory. Third, reasoning abilities are the critical moderator of instructional adaptations. By tracking what increases or decreases the relationship between reasoning ability and learning outcomes, we understand better both what reasoning abilities are and how instruction can be made more effective for more learners. Fourth, there is now a substantial research base in cognitive psychology on the nature of human reasoning (e.g., Leighton & Sternberg, 2004; Holyoak & Morrison, 2005). Especially helpful are studies of individual differences in reasoning measured on test-like tasks modeled after those used on ability tests. Indeed, one would be hard pressed to think of any construct in psychology that is better understood, and whose practical relevance for education at all levels is better demonstrated than reasoning abilities.

The development of reasoning ability has been the subject of a long line of research within developmental psychology, educational psychology, and science education (Johnson 2007). The general conclusion of such research is that reasoning

pattern, do developed across adolescent, at least in some students and play an important role in the ability to do science and construct scientific concepts. Reasoning skills therefore, develop through a person's life time and at different rates for different individuals. Early investigation on cognitive development and children's reasoning ability typically define the level of cognitive functioning in terms of performance on one test or the other related measured (Sokan, 1998). One question that seems pertinent based on this assertion is that what does reasoning ability have to do with achievement in science? It is in the search of answer to this question that this study is conceived.

Investigations have shown that full comprehension of some science concepts by students requires what Piaget defines as formal reasoning (Wilhelm, 2004). For example Heron-Sirajo et al, (2013) suggests that certain chemical concepts are "formal" because they require formal reasoning patterns to understand them, where as other concept are "concrete" because they require concrete reasoning to comprehend.

According to Heron - Sirajo et al (2013), to increase comprehension of science, we must either assists students in their development on reasoning or we must learn to teach so that ideas of science are understood by students who remain at concrete operational level. Other researchers have pointed out that certain concept no matter how they are taught cannot be comprehended by students at the concrete operational level. Goodstein and Howe-Sirajo et al, (2013) after the use of some "hands-on" method to teach students some chemistry concepts reported that concrete level students cannot, learn concepts which require advanced formal reasoning no matter how the concepts are taught.

The relationship between various variables and formal reasoning has received a special attention in science education research for many years. For example, five

formal operational reasoning modes, namely proportional reasoning, controlling variables, probability reasoning, correlation reasoning and combinational reasoning have been identified as essential abilities for success in school science and mathematics courses (Bitner-Mari, 2012). Considering this importance, some other authors have argued that the development of formal reasoning ability should be a major priority in science education Decarcer, Lawson-Sirajo et al, (2013). In fact, proportional reasoning for example is important in many qualitative aspects of science. Without access to proportional reasoning an understanding of the derivation and use of vast number of functional relationships in science is not attainable. This applies especially in the construction and interpretation of tabulated data and graphs. Hence, proportional reasoning leads to a good understanding of derivation and use of functional relationships in science. Similarly, correlation reasoning is central to scientific investigation at all levels. It is important in formulation of hypothesis which considers potential relationships between variables. It is also important in the interpretation of data where the potentials relationships between variables are considered. Controlling variables is important in planning, implementation and interpretation. The interpretation of data from investigations, observations, or experimentation often requires probabilistic reasoning. And lastly, combinatorial reasoning occurs in the formulation of alternative hypothesis to test the effect of selectee! variables on a responding variable. Ironically, most science students do not bear this type of reasoning ability (Ganertt & Tobin-Mari (2012).

The entire system of education is centred on students' academic performance. An insignificant research occurs concentrating on the role of reasoning ability on pupils' performance in science and other subjects but they are limited and inconsistent. The result of Oloyede (2012) found that formal reasoning ability as a

strong predictor for the achievement in chemistry. If has been studied that reasoning can be used to predict the performance of students' achievement in chemistry (Abdu, -Bhat 2016). The results of Sungur, Tekkay, Geban, (2001) also indicated that reasoning ability significantly affects students' achievements. Tekkaya and Yenilmez (2006) discovered that reasoning skill was the chief predictor of understanding, showing 31% of variation. Kuhn and Rolling (2009) showed that reasoning ability appears to be significant for predicting academic achievement in science. The results of Nnorom (2013) depicted that those students who had high reasoning ability achieved better in biology than the students who had low reasoning ability.

In line with this ideas Johnson and Lawson, (1998) investigated the relative effects of reasoning ability and prior-knowledge on biology achievement in expository and inquiry classes. They found that reasoning ability explained a significant portion of variance in final examination scores in both instructional methods. Reasoning ability was also found to be the best predictor of students' achievement in solving genetic problems (Michel and Lawson-Lavins 2011).

Similarly Chadran, Treagust and Tobin-Lavins 2011). Showed that formal reasoning ability and prior knowledge were significant predictors of performance on chemical calculations, Laboratory applications and chemistry content knowledge. In. addition, Huppert and Lazarowitz, (2002) investigated computer simulation's impact on student's academic performance and on their mastery of science process skills in relation to their cognitive stages. Their results indicated that concrete and transition operational students in the experimental group achieved significantly higher performance than their counterparts in the control group.

Sungur, Tekkaya and Geban (2001) investigated the effect of gender and reasoning ability on the human circulatory system concepts achievement and attitude

towards biology, there was statistically significant mean difference between concrete and formal students with respect to achievement and attitude towards biology. Also, Oliva (2003) investigated the effect of reasoning ability on changing the alternative conceptions related to machines. The results showed that the students with the highest level of formal reasoning changed their alternative conceptions more easily when they display a higher level of initial structuralization.

Yalanides-Butler (2013) examined the reasoning abilities of high school Cypriot students with respect to gender. Results revealed that students" performance was higher on proportional reasoning and controlling variable items. Concerning gender difference, findings indicated that boys had significantly superior performance than girls on probabilistic reasoning items. Regarding students' general performance, the results revealed that girls had significantly higher achievement than boys. There seems to be general agreement by most science educators that formal reasoning is the central core of science education. This suggest the need for the development of a sound psychological theory and set of teaching principles to best promote the development of students formal reasoning ability (Mari, 2001).

In summary, the importance of formal reasoning ability among science students cannot be overemphasized, especially for students in physical sciences. Since most of the concepts, taught in this discipline required student to operate at the formal reasoning level, before they can be understood. Both sets of reasoning tasks can and should be used when studying reasoning ability. The benefits would be duals reasoning items as used in cognitive research and latent variables from reasoning ability test might reveal important differences between the experimental tasks. Similarly, variability in the difficulties of items from standard psychometric reasoning that can be possibly explained by application of various theories of reasoning

processes-like the mental model theory. The present study sought to find out if there is correlation between reasoning ability, and achievement in chemistry. If reasoning ability can be used to predict achievement in chemistry.

2.6 Self-Efficacy, Science Learning and Performance

Self-efficacy, also called perceived ability, refers to the confidence people have in their abilities for success in a given task (Bandura – Tenaw, 2013). If they possess the ability to successfully perform, then that task will be attempted. The task will be avoided if it is perceived to be too difficult (Bandura-Tenaw (2013). Although inefficacious individuals usually avoid challenging tasks, when they do attempt them they give up more easily than individuals with high efficacy. When inefficacious individuals fail, they attribute the unsuccessful result to a lack of ability and tend to lose faith in their capabilities. When they succeed, they are more likely to attribute their success to external factors (Britner & Pajares, 2006). If students master a challenging task with limited assistance, their levels of self-efficacy rise (Britner & Pajares, 2006).

Individuals who possess a high degree of self-efficacy are more likely to attempt challenging tasks, to persist longer at them, and to exert more effort in the process. If highly efficacious individuals fail, they attribute the outcome to a lack of effort or an adverse environment. When they succeed, they credit their achievement to their abilities. It is the perception that their abilities caused the achievement that affects the outcome rather than their actual abilities (Kiran & Sungur, 2011).

Four factors determine self-efficacy: enactive mastery experience, vicarious experience, verbal persuasion, and physiological and emotional states (Bandura-Tenaw,2013). The most influential of these factors is enactive mastery experience, which refers to individuals' experiences with success or failure in past situations.

Information gathered from these experiences is then internalized. Past successes raise self-efficacy and repeated failures lower it, which indicates to individuals their levels of capability (Bandura-Tenaw, 2013). In a vicarious experience, individuals compare themselves to peers whom they perceive are similar in ability and intelligence to themselves. Watching peers succeed raises observer's self-efficacy and seeing them fail lowers it. Exposure to multiple successful role models helps increase self-efficacy in observers (Bandura-Tenaw,2013). Verbal persuasion tries to convince individuals, who may doubt their capabilities, that they possess the skills needed for success at a given task. In education, verbal persuasion delivered by teachers often takes the form of verbal feedback, evaluation, and encouragement. Persuasion must be realistic, sincere, and from a credible source; otherwise it can negatively affect student self-efficacy beliefs (Bandura-Tenaw,2013). Emotional state can either positively or negatively affect interpretation of an event's outcome (Bandura-Tenaw,2013). In addition to the four factors that determine general self-efficacy, aptitude, attitudes, and attributions are found to predict science self-efficacy (Smeat, 1997).

Efficacy beliefs vary between individuals and will actually fluctuate within an individual for different tasks (Pajares & Schunk, 2001). In many activities, self-efficacy contributes to self-esteem (Pajares & Schunk, 2001). Self-efficacy beliefs affect how people approach new challenges and will contribute to performance since these beliefs influence thought processes, motivation, and behavior (Lodewyk & Winne, 2005). Self-efficacy is not static and can change over time resulting from periodic reassessments of how adequate one's performance has been (Lodewyk & Winne, 2005). For example, in a college population, Chemistry laboratory self-efficacy increased over the course of a school year whereas Biology self-efficacy decreased over the same duration (Smist, 1993).

Self-efficacy predicts intellectual performance better than skills alone, and it directly influences academic performance through cognition. Self-efficacy also indirectly affects perseverance (Multon, brown & Lent 1991). Although past achievement raises self-efficacy, it is student interpretation of past successes and failures that may be responsible for subsequent success. Perceived self-efficacy predicts future achievement better than past performance (Chemers & Gareia, 2001). Self-efficacy beliefs also contribute to performance since they influence thought processes, motivation, and behavior (Bandura-Tenaw, 2013). Fluctuations in performance may be explained by fluctuations in self-efficacy. For example, varying beliefs in self-efficacy may alter task outcome, whether it involves two similarly-skilled individuals or the same person in two different situations (Bandura-Tenaw, 2013).

In a meta-analysis of 39 studies from 1977 to 1988, positive and statistically significant relationships were found among self-efficacy, academic performance, and persistence for a number of disciplines (Muttan, Brown & Lent, 1991). Out of the studies analyzed, 28.9 % involved higher education. Four factors affected the link between self-efficacy and academic performance. One factor was the time period when the two were assessed. A stronger relationship resulted post-treatment meaning that experimental manipulations to change self-efficacy beliefs were successful not only in raising self-efficacy but in enhancing academic performance as well. Another factor involved a stronger link between self-efficacy beliefs and performance for low-achieving students. A study by Green & Muller – Tenaw, (2013) found a positive correlation between perceived ability, learning goals, and meaningful cognitive engagement which then influenced academic achievement in college students enrolled in educational psychology. Additional analysis supported this causal model of

perceived ability and learning goals leading to meaningful cognitive engagement which then led to academic achievement (Miller, Green & Nichols – Tenaw, 2013). They cautioned that the variables of rewards and penalties, strategies, and other self-regulatory activities, not specifically addressed by their study, could have influences on achievement (Miller, Green & Nichols – Tenaw, 2013). One criticism of their research is they measured achievement by only using one midterm exam score from the course. Also, they administered their instrument immediately before students took the midterm exam. Test anxiety may have affected the outcome.

In two studies conducted (Miller, Green & Nichols – Tenaw, 2013) perceived ability was the best predictor of achievement for high school math students. According to numerous studies, cognitive skills, modeling, feedback and goal-setting together affected self-efficacy beliefs that, in turn, affected performance (Schunk-Tenaw, 2013). Student Self- beliefs affected the amount of effort and perseverance they engaged which subsequently influenced achievement (Pajares, 2009)

Few studies have investigated the relationship between self-efficacy and academic achievement in higher education. Silver, Smith and Green (2001) support a connection between self-efficacy and academic achievement. In general, students at the college level need to be self-directed and take greater responsibility for their learning. Students possessing a high degree of self-efficacy are more successful at accomplishing these tasks and as a result, perform better academically (Jewett – Tenaw 2013). Accordingly, self-efficacy beliefs are "crucial" when applied to the cognitive demands of higher education (Bandura, 1997).

A study of college students found academic self-efficacy to be significantly more predictive of career choice than academic achievement (Hirschom – Tenaw, 2013). The study also found semester academic performance was positively

influenced by perceived goals and previous academic experience, instead of self-efficacy (Hirschom – Tenaw, 2013). The researcher stated her findings do not negate self-efficacy's mediating influence on past achievement and thus, self-efficacy could contribute to academic achievement via this mediatory role. Other studies Greene & Miller – Tenaw (2013) support the mediating effects self-efficacy has on academic achievement.

Self-efficacy beliefs therefore determine how people feel, think, motivate themselves and behave. Such beliefs produce and enhance human accomplishment and personal wellbeing in many ways. People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than threats to be avoided. Such an efficacious outlook fosters intrinsic interest and deep engrossment in activities. They approach threatening situations with the assurance that they can exercise control over them. In contrast, people who doubt their capabilities shy away from difficult tasks, which they view as personal threats (Bandura, 2001). They have low aspirations and weak commitments to the goal they choose to pursue. When faced with difficult tasks, they dwell on their personal deficiencies, on the obstacle they will encounter, and all kinds of adverse outcomes rather than concentrate on how to be successful. They slacken their efforts and give up easily in the face of difficulties. They are slow to recover their sense of efficacy following failure or setbacks. They view insufficient performance as deficient aptitude. It does not require much failure for them to lose faith in their capabilities. They fall easy victims to stress and depression (Bandura, 2001).

In summary, self-efficacy generally refers to the confidence people have in their abilities that they will be successful at a given task. It is determine by enactive experience, vicarious experience, verbal persuasion and physiological and emotional

state of an individual of these factors enactive mastery experience has the most influence.

In science education therefore, the importance of self-efficacy cannot be overemphasized. This is because students with science self-efficacy tend to work harder to accomplish a given task and be more efficient in using problem solving strategies and management of the working time than students with low science self-efficacy (Zimmerman, – Tenaw, (2013). The present study sought the predictive effect if any of self-efficacy on achievement in chemistry using a different study area for a better result.

2.7 Instructional Models and Emotional Intelligence

Early theorists such as Thorndike and Gardner paved the way for the current experts in the field of emotional intelligence. Each theoretical paradigm conceptualizes emotional intelligence from one of two perspectives: ability or mixed model. Ability models regard emotional intelligence as a pure form of mental ability and thus as a pure intelligence. In contrast, mixed models of emotional intelligence combine mental ability with personality characteristics such as optimism and well-being (Mayer-Stys & Shelley, 2004). Currently, the only ability model of emotional intelligence is that proposed by Mayer and Salovey. Two mixed models of emotional intelligence have been proposed, each within a somewhat different conception. Bar-On has put forth a model based within the context of personality theory, emphasizing the co-dependence of the ability aspects of emotional intelligence with personality traits and their application to personal well-being. In contrast, Goleman proposed a mixed model in terms of performance, integrating an individual's abilities and personality and applying their corresponding effects on performance in the workplace (Goleman, 2001).

1. Salovey and Mayer: An Ability Model of Emotional Intelligence

Salovey and Mayer first coined the term "emotional intelligence" in 1990 (Salovey & Mayer, 1990) and have since continued to conduct research on the significance of the construct. Their pure theory of emotional intelligence integrates key ideas from the fields of intelligence and emotion. From intelligence theory comes the idea that intelligence involves the capacity to carry out abstract reasoning. From emotion research comes the notion that emotions are signals that convey regular and discernable meanings about relationships and that at a number of basic emotions are universal (Mayer, Salovey, & Caruso, 2000). They propose that individuals vary in their ability to process information of an emotional nature and in their ability to relate emotional processing to a wider cognition. They then posit that this ability is seen to manifest itself in certain adaptive behaviours (Mayer, Salovey, & Caruso, 2000).

Mayer and Salovey's conception of emotional intelligence is based within a model of intelligence, that is, it strives to define emotional intelligence within the confines of the standard criteria for a new intelligence (Mayer, Salovey, Caruso, & Sitarenios, 2003). It proposes that emotional intelligence is comprised of two areas: experiential (ability to perceive, respond, and manipulate emotional information without necessarily understanding it) and strategic (ability to understand and manage emotions without necessarily perceiving feelings well or fully experiencing them). Each area is further divided into two branches that range from basic psychological processes to more complex processes integrating emotion and cognition. The first branch, emotional perception, is the ability to be self-aware of emotions and to express emotions and emotional needs accurately to others. Emotional perception also includes the ability to distinguish between honest and dishonest expressions of emotion. The second branch, emotional assimilation, is the ability to distinguish

among the different emotions one is feeling and to identify those that are influencing their thought processes.

The third branch, emotional understanding, is the ability to understand complex emotions (such as feeling two emotions at once) and the ability to recognize transitions from one to the other. Lastly, the fourth branch, emotion management, is the ability to connect or disconnect from an emotion depending on its usefulness in a given situation (Mayer & Salovey-Stys & Shelley, 2004). A depiction of this four-branch model is illustrated in Figure 1, which outlines the four branches and the corresponding stages in emotion processing associated with each branch.

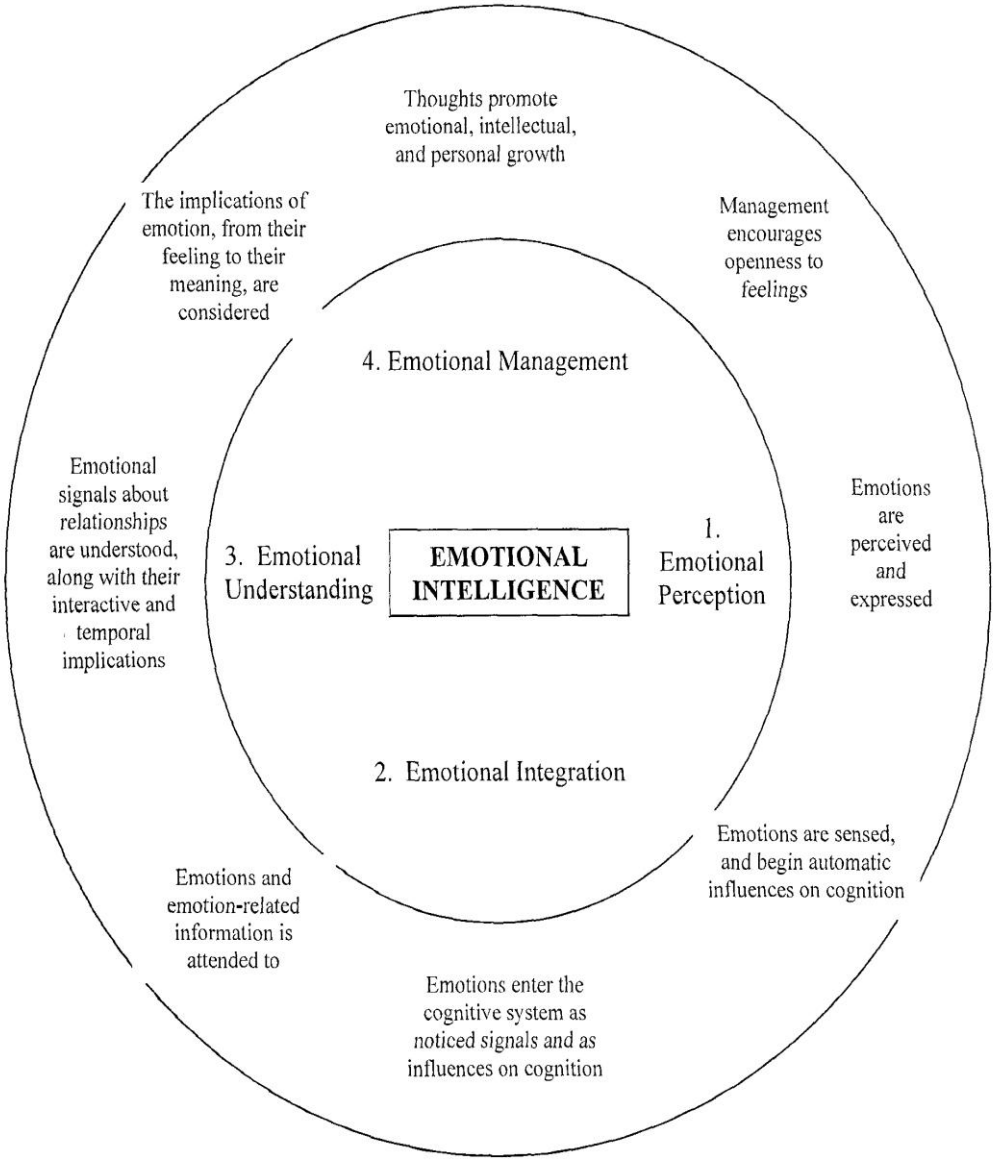

Figure 1: Mayer and Slovey's (1997) Four- branch Model of Emotional-intelligence

Bar-On: A Mixed Model of Emotional Intelligence

The director of the Institute of Applied Intelligences in Denmark and consultant for a variety of institutions and organizations in Israel, Reuven Bar-On developed one of the first measures of emotional intelligence that used the term "Emotion Quotient". Bar-On's model of emotional intelligence relates to the potential for performance and success, rather than performance or success itself, and is considered process-oriented rather than outcome-oriented (Bar-On, 2002). It focuses on an array of emotional and social abilities, including the ability to be aware of, understand, and express oneself, the ability to be aware of, understand, and relate to others, the ability to deal with strong emotions, and the ability to adapt to change and solve problems of a social or personal nature (Bar-On, 1997). In his model, Bar-On outlines 5 components of emotional intelligence: intrapersonal, interpersonal, adaptability, stress management, and general mood. Within these components are sub-components, all of which are outlined in Table 1. Bar-On posits that emotional intelligence develops over time and that it can be improved through training, programming, and therapy (Bar-On, 2002).

Bar-On hypothesizes that those individuals with higher than average E.Q.'s are in general more successful in meeting environmental demands and pressures. He also notes that a deficiency in emotional intelligence can mean a lack of success and the existence of emotional problems. Problems in coping with one's environment is thought, by Bar-On, to be especially common among those individuals lacking in the subscales of reality testing, problem solving, stress tolerance, and impulse control. In general, Bar-On considers emotional intelligence and cognitive intelligence to contribute equally to a person's general intelligence, which then offers an indication of one's potential to succeed in life (Bar-On, 2002).

Table 1: Bar-On's Model of emotional Intelligence

Components	Sub-Components
Intrapersonal	Self Regard emotional Self-Awareness Assertiveness Independence Self-Actualization
Interpersonal	Empathy social responsibility Interpersonal Relationship
Adaptability	Reality Testing Flexibility Problem Solving
Stress Management	Stress tolerance Impulse Control
General Mood Components	Optinism Happiness

Goleman: A Mixed Model of Emotional Intelligence

Daniel Goleman, a psychologist and science writer who has previously written on brain and behaviour research for the New York Times, discovered the work of Salovey and Mayer in the 1990's. Inspired by their findings, he began to conduct his own research in the area and eventually wrote Emotional Intelligence(1995), the landmark book which familiarized both the public and private sectors with the idea of emotional intelligence. Goleman's model outlines four main emotional intelligence constructs. The first, self-awareness, is the ability to read one's emotions and recognize their impact while using gut feelings to guide decisions. Self-management, the second construct, involves controlling one's emotions and impulses and adapting to changing circumstances. The third construct, social awareness, includes the ability to sense, understand, and react to other's emotions while comprehending social networks. Finally, relationship management, the fourth construct, entails the ability to inspire, influence, and develop others while managing conflict (Goleman, 1998).

Goleman includes a set of emotional competencies within each construct of emotional intelligence. Emotional competencies are not innate talents, but rather learned capabilities that must be worked on and developed to achieve outstanding performance. Goleman posits that individuals are born with a general emotional

intelligence that determines their potential for learning emotional competencies. The organization of the competencies under the various constructs is not random; they appear in synergistic clusters or groupings that support and facilitate each other (Boyatzis, Goleman, & Rhee -Stys & Shelley, 2004) Table 2 illustrates Goleman's conceptual model of emotional intelligence and corresponding emotional competencies. The constructs and competencies fall under one of four categories: the recognition of emotions in oneself or others and the regulation of emotion in oneself or others.

Table 2: Goleman's (2001) Emotional Intelligence Competencies

	Self Personal Competence Self-Awareness	**Other Social Competence Social Awareness**
RECOGNITION REGULATION	Emotional Self-Awareness Accurate Self-Assessment Self-confidence **Self – Management** Self-Control Trustworthiness Conscientiousness Adaptability Achievement Drive Initiative	Empathy Service Orientation Organizational Awareness **Relationship Management** Developing others Influence Communication Conflict Management Leadership Change Catalyst Building Bonds Teamwork and Collaboration

Other Models

Several measures of emotional intelligence used in scientific research, particularly those sold for use in industrial and organizational settings, are not based on any of the aforementioned theories of emotional intelligence. Two of these measures: the Levels of Emotional Awareness Scale (LEAS) and the Self-Report Emotional Intelligence Test (SREIT) are described in the following section.

2.8 Instructional Models and Reasoning Ability

Development of reasoning started with piaget's theory of cognitive development, Demetriou, (1998), describes a sequence of stages in the development of reasoning from infancy to adulthood. According to the neo-Piagetian theories of cognitive development, changes in reasoning with development come from increasing working memory capacity, increasing speed of processing, and enhanced from increasing working memory capacity, increasing speed of processing, and enhanced executive functions and control. Increasing self-awareness is also an important factor, (Demetriou, Mouyi & Sponoudis, 2010).

There are several competing theories for the description and explanation of reasoning processes. The theories are distinguished by the broadness of phenomena they can explain and how profound the proposed explanations are. They are also different with respect to how much experimental research was done to investigate them and how much supportive evidence was collected. One view is that people rely on a mental logic consisting of formal (obstract or Synthetic) inference rules similar to those developed by logicians in the propositional calculus (O' Brien, 2009). Another view is that people rely on domain-specific or content-sensitive rules of inference. (Cosmides 2005). A third view is that people rely on mental models that is mental representations that correspond to imagine possibilities (Laird & Byrne, 2002). A fought view is that people compute probabilities, (Oaksford & Chater, 2007.Two theories have dominated psychological theorizing about reasoning: mental rules and mental models. Both theories were first applied to the study of deductive reasoning tasks such as syllogisms and then later applied to a broader range of reasoning tasks. The mental rules theory of deductive reasoning (Lohman & Lakin 2009) posits mental processes common to all normally developed adults that operate directly on the

representations of the premises. Humans are assumed to be natural logicians who are sometimes fallible because of errors in processing or because of limitations of the human cognitive system. According to mental rules theory, the basic processes involved in solving deductive reasoning problems are (a) encoding the premises into representations stored in working memory, (b) applying abstract, rule-based schemas to these representations to derive a conclusion, and (c) applying other rules to check the contents of working memory for incompatibilities. Although the model posits several sources of error, the number of steps to be executed in applying rules is the major source of difficulty. Errors in performance are thus primarily attributable to working memory overload (Gilhooly, 2004).

The mental models theory (Johnson-Laird, 2004) of deductive reasoning posits that the individual first transforms the premises of an argument into another representation (i.e., a mental model) that is consistent with the premises. Importantly, multiple mental models that are consistent with the premises must often be constructed and then compared in order to reach a valid conclusion. Each mental model represents a possible state of affairs that must be evaluated. Bara, Bucciarelli, and Johnson-Laird and Byrne (2002) identified the following factors that affect syllogistic inference in the mental models approach: (a) assembling a prepositional representation of premises; (b) constructing models that integrate information from premises; (c) formulating a conclusion which integrates relationships not expressed in the premises; (d) searching for alternative models to refute conclusions; and (e) recognizing similarities between models. All these processes require working memory resources. Limitations of working memory are considered especially important in understanding individual differences in reasoning in this theory, because working memory limits the number of mental models that can be held in mind at once.

Individuals with limited working memory capacity can fail to generate enough models to evaluate the validity of a conclusion (Stanovich, Sa, & West, 2004).

The mental rules and mental models theories of reasoning propose universal but somewhat contradictory mechanisms for deductive reasoning (Roberts, 1993). Furthermore, advocates of both theories have been able to marshal considerable evidence in support of their position. Research that explicitly attempts to account for individual differences in reasoning offers a possible explanation for this paradox: On some problems, the behavior of some reasoners is more consistent with the mental models theory, whereas the behavior of other reasoners is more consistent with the predictions of a mental rules theory (Stanovich et al., 2004). In addition to stable individual differences in propensity to solve reasoning problems in one way or another, how the problem is presented can encourage individuals to change their strategies across items (Galotti, Baron, & Sabini, 1986). Therefore, what a task measures cannot be determined by simple inspection. Rather, what is measured depends on a complex interaction between the characteristics of the examinee, the task, and the situation. This does not mean, however, that one cannot know what tasks typically measure when they are attempted by individuals of known characteristics, but that what tasks measure and for whom and under what circumstances are inferences that must be supported by other data-not merely presumed to be the case.

2.9 Instructional models and self-efficacy

Models provide an important vicarious source of self-efficacy information (Bandura, 1986). Observing competent models successfully per-form actions conveys information to observers about the sequence of actions one should use to succeed. Modeled displays convey that observers are capable of learning or accomplishing the task if they follow the same sequence of actions. The belief that one knows what to do

to perform a task raises self-efficacy, and this vicarious increase can motivate observers to perform the task (Schunk, 1989).

Research shows that models can have profound effects on self-efficacy, motivation, and achievement. In the context of a long-division instructional program, Schunk (1981) provided low-achieving children with either cognitive modeling or didactic instruction. For the cognitive modeling, children observed an adult model explain division operations and apply them to sample problems. Following this modeled exposure, children received guided practice as they solved problems and received corrective instruction from the models as necessary. Children then solved problems alone during independent practice. In the didactic condition, children reviewed instructional material that explained and exemplified division operations, after which they received guided and independent practice. Before and after instruction children's division skill, persistence, and self-efficacy for solving different types of division problems were assessed.

Cognitive modeling and didactic instruction raised self-efficacy equally well; however, modeling led to greater gains in division skill and to more accurate perceptions of capabilities as these children's efficacy judgments corresponded more closely to their actual performances. Didactic subjects tended to overestimate what t.hey could do. Regardless of treatment condition, self-efficacy related positively to persistence and achievement. As will be discussed later, path analysis showed that self-efficacy mediated the relation between instructional treatment and division performance.

Other achievement research supports the influence of models on self-efficacy. Zimmerman and Ringle (1981) had children observe a model unsuccessfully attempt to solve a puzzle for a long or short time and verbalize statements of confidence or

pessimism, after which children attempted the puzzle themselves. Observing a low-persistent but confident model raised self-efficacy; children who observed a pessimistic model persist for a long time lowered their self-efficacy. Relich, Debus, and Walker (1986) found that exposing low-achieving children to models explaining mathematical division and providing them with feedback stressing the importance of ability and effort had a positive effect on self-efficacy.

Perceived similarity to models is an important attribute. Observing similar others succeed can raise observers' self-efficacy and motivate them to try the task because they are apt to believe that if others can succeed, they can as well (Schunk, 1987), Similarity may be especially influential when individuals are uncertain about their capabilities, such as when they lack task familiarity and have little information to use in judging efficacy or when they previously experienced difficulties and have doubts about performing well.

Similarity may be varied through the use of coping and mastery models. Coping models initially demonstrate the typical behavioral deficiencies and possibly fears of observers but gradually improve their performances and gain self-confidence. These models illustrate how effort and positive thoughts can overcome difficulties. Mastery models demonstrate faultless performance from the outset (Schunk, 1987).

Schunk and Hanson (1985) had low-achieving children observe videotapes of peer mastery or coping models or adult teacher models explaining and demonstrating subtraction operations. Peer mastery models solved problems correctly and verbalized statements reflecting high self-efficacy and ability, low task difficulty, and positive attitudes. Peer coping models initially made errors and verbalized negative statements, but then began to verbalize coping statements (e.g., "I need to pay attention to what I'm doing") and eventually verbalized and performed as well as mastery models.

Teacher models displayed mastery behaviors. Other children did not observe models. Following this modeling phase all children judged self-efficacy for learning to solve problems, received subtraction instruction and practice solving problems over sessions, and a posttest on self-efficacy and skill.

Peer models increased self-efficacy for learning and posttest self-efficacy and skill better than the teacher model or no model; teacher-model children outperformed no-model students. All model conditions displayed higher motivation than did no-model subjects based on the number of problems solved during the instructional sessions. Schunk and Hanson hypothesized that subjects might perceive themselves more similar to coping models, but the mastery- and coping-model conditions did not differ. Subjects may have recalled instances of prior successful performance in subtraction and believed that if the models could learn, they could too.

Schunk, Hanson, and Cox (1987) employed a similar methodology but used an arithmetic task (fractions) on which children had experienced few previous successes. These researchers also tested the idea that multiple models are better than a single model because multiple models increase the likelihood that students will view themselves similar to at least one model (Schunk, 1989). The first study showed that benefits of coping models were obtained with a more-difficult task: Observing a coping model enhanced self-efficacy for learning, motivation, and posttest self-efficacy and skill, more than did observing a mastery model. In the second study, multiple models-coping or mastery promoted achievement out-comes as well as a single coping model and better than a single mastery model. Children who observed single models judged themselves more similar in competence to coping than mastery models. Benefits of multiple models were not due to perceived similarity in

competence, which suggests that similarity may be important when students have few cues to assess efficacy.

In a follow-up study, Schunk and Hanson (1989a) further explored variations in perceived similarity by exposing average-achieving children to one of three types of peer models. Mastery models easily grasped arithmetic operations and verbalized positive beliefs (e.g., "I know I can do this one"). Coping-emotive models initially experienced difficulties and verbalized negative statements (e.g., "I'm not very good at this"), after which they verbalized coping statements (e.g., "I'll have to work hard on this one") and displayed coping behaviors; eventually they per-formed as well as mastery models. Coping-alone models performed in identical fashion to coping-emotive models but never verbalized negative beliefs. Coping-emotive models led to the highest self-efficacy for learning. Mastery and coping-alone subjects perceived themselves as equal in competence to the model; coping-emotive subjects viewed themselves as more competent than the model. The belief that one is more talented than an unsuccessful model can raise efficacy and motivation. Following the instructional program the three conditions did not differ in efficacy or skill, which shows that actual task experience outweighed initial vicarious model effects.

The highest degree of model-observer similarity is attained through self-modeling, or behavioral-change that occurs from observing one's own behaviors (Dowrick, 1983). Typically one is viewed while performing a task and subsequently views the tape. Self-model tapes allow for review and are especially informative for tasks one cannot watch while performing, such as a golf swing or tennis serve. When performance errors occur, commentary by a knowledgeable individual during tape review helps to prevent performers from becoming discouraged (Hosford, 1981). The ex-pert can explain how to execute the behavior better the next time. Tapes can

convey to observers that they are becoming more skillful and can continue to make progress, which raises self-efficacy.

Schunk and Hanson (1989b) found support for these points during acquisition of arithmetic (fraction) skills. Subjects were children who had been identified by school personnel as working on below-grade-level material. Children received instruction and problem solving practice. Self-modeling subjects were videotaped while successfully solving problems and were shown their tapes, others were videotaped but not shown their tapes until after the study was completed (to control for potential effects of taping), and those in a third condition were not taped (to control for effects of participation). Self-modeling benefits were obtained as these children scored higher on self-efficacy for learning, motivation, and post-test self-efficacy and skill, than did children in the other two conditions. There were no differences between mastery self-model subjects who viewed tapes of their successful problem solving and progress self-model children whose tapes portrayed their gradual improvement as they acquired skills, which support the point that the perception of progress or of mastery can build efficacy (Schunk, 1989).

Research in the sport domain has yielded benefits due to model similarity. Gould and Weiss (1981) had college women view a similar model (female student with no athletic background) or dissimilar model (male physical education professor) perform a muscular endurance task. While performing, the model made either positive or negative efficacy statements; irrelevant- and no-statement conditions also were included. Subjects who viewed the similar model performed the task better and judged efficacy higher than students who observed dissimilar models. Regardless of treatment condition, self-efficacy related positively to performance.

These results were replicated by George, Feltz, and Chase (1992) using female college students and models performing a leg-extension endurance task. Students who observed a nonathletic male or female model extended their legs longer and judged self-efficacy higher than those who observed an athletic model, among these unskilled observers, model ability was a more important similarity cue than model gender.

McCullagh's (1987) study assessed the effects of model similarity on motor performance, College women were exposed to a videotaped peer performing a balance task. Subjects in the similar condition were told that the model was a college student who had no previous experience; dissimilar-condition subjects were informed that the model was a dancer and gymnast who had extensive experience with balance tasks. Similar-model subjects performed the task better than those who observed the dissimilar model. The similar and dissimilar conditions did not differ in self-efficacy and efficacy was not related to actual performance, which may have resulted because subjects' efficacy scores were high and far exceeded their performances.

Results of a study by Lirgg and Feltz (1991) conflict with the earlier evidence on the benefits of peer models compared with adult models (Schunk & Hanson, 1985). Lirgg and Feltz exposed sixth-grade girls to a skilled or unskilled teacher or peer videotaped model demonstrating a ladder-climbing task; control subjects observed no model. Subjects then judged self-efficacy for climbing successively higher levels on the ladder and performed the task over trials. Controls demonstrated poorer performance than those exposed to models; among the latter, children who viewed a skilled model (adult or peer) performed better than those who observed an unskilled model. Skilled-model subjects also judged self-efficacy higher.

It is difficult to resolve the discrepancy with Schunk and Hanson's (1985) results because all of their models were skilled and their task involved learning of

cognitive skills. Schunk and Hanson also employed as subjects students who previously had experienced learning difficulties. Peer models may be more effective for such subjects as a means of raising self-efficacy for learning which in turn enhances motivation and skill acquisition. The modeling literature is clear in showing that model competence moderates the effect of exposure to models on observers' behaviors (Bandura, 1986; Schunk, 1987).

In summary, models teach skills and are vicarious sources of self-efficacy information, and perceived similarity to models affects self-efficacy and motivation. The latter effect may be especially pronounced among students who have had difficulty acquiring skills. Also, the belief that one is more competent than a model can raise efficacy. Benefits of multiple models presumably occur because one can identify with at least one of the models and because many peers accomplishing the task imply that it must not be too hard. Self-model tapes convey progress and allow for close observation of behavior, which is especially important when progress is difficult to gauge or one cannot observe one's actions while performing.

2.10 Gender-Related Differences in Academic Achievement in Chemistry

The advent of colonisation and the introduction of western education and western social values, brought education that was modeled predominantly towards the mental development of boys and men; this was evidenced by the number of boys' schools. There were established during this era and the enrolment figures of boys, compared to girls (Uwaezuoke and Ezeh, 2008). Girls' secondary schools came after serious agitations, and when it did, parents were already skeptical about sending their girls to school (Anugwom, 2009). Also, the work establishment created by these institutions, such as Civil Service, Boat Industries, Churches and Schools were almost exclusively open to men only (Nka, Zuga-Oti, 2013).

Aside from psychological factors of self-esteem and self-efficacy influencing the career growth of women, Colletti, Mulholland, and Sonnad (2000) found social and family issues to be (a) major concern for both male and female academic surgeons. However, both men and women report differences in the conflict between family and career responsibilities and perceptions of balancing those responsibilities for men and women. Two thirds of both men and women reported that the demands of their surgical faculty position adversely affect their relationships with spouses. Men reported a slightly higher tendency to miss family activities because of job demands, while women were significantly more likely to miss work activities because of family responsibilities.

In addition, women have been known to be care givers. This is why they have excelled in careers like Nursing, Secretarial profession, and teaching at lower levels. Studies have also affirmed that they give support to their spouses, children and significant others, (James, 2002; Okonweze, 2005; Oluwole, Hammed, and Hal. Awaebe, 2010),but women themselves lack the necessary support that may be required to foster the growth they need in their different careers and life's endeavours Chovwen, (2004); Oti and Oyelude, (2006). Oti and Oyelude, (2006) found work/home conflict to be a strong determinant of female academics' career path to leadership. They found that the career mobility of their respondents were slower during the 1st five years of marriage; then they began to have full concentration as their children matured.

Scott and King-Oti, (2013) found that spousal support is a predictor of whether female college students will return to school, while Cutrona and Suhr, Derlega, Barbee, and Winstead-Oti (2013) found that lack of social support is a predictor of negative outcomes, including absenteeism, burnout, depression and

anxiety. Harris, Winskowski and Enghahl – Oti (2013) found perceived spousal support, workplace social support to predict job satisfaction, and job tenure.

Luke (2001) further observes that despite years of affirmative action and the passing of statutes outlawing sexual discrimination (USA and UK in 1972; Australia in 1984), "the rate at which women have ascended academic career ladders in these countries is maddeningly slow". Women in the United Kingdom constitute 7-8 percent of the professoriate, in Ireland just over 5 percent, in the United States 16 percent of those with full professorial status and in Finland 18 percent.

In a study, Forster (2001) reports on the views that female academics have about their career prospects, growth, equal opportunities and the conflicts they experience between their work and personal lives in one UK University. The university in question has formal equal opportunities policies, and gender monitoring systems in place. However, very few women have progressed into senior academic roles.

Despite of the efforts aiming at improving science and technology in Nigeria, the benefits of scientific and technological development seem to have been unevenly distributed. In particular, the benefits seem not to have been the same for boys and girls. In educational institutions, girls and women over the years have tended not to study science and technology when compared with boys and men (Djallo, 2004; Agueler & Agwagalu, 2007). There is a persistent gender stereotype. Djallo (2004) noted that, "Being a scientist appears to be one of the most stereotyped of all occupations and there is quiet a psychological barrier to overcome, if more girls are to be attracted to science subjects". The problem of dwindling girls' enrolment in science exists all over Africa. This has necessitated the development of several projects, one of which is "FEMSA (Female Education in Mathematics and Science in Africa)".

This regional NGO (non-governmental organization) aims to improve the participation and performance of girls in science and technological subjects at primary and secondary levels. It sets up national centers to provide teacher capacity building and a forum for brainstorming by women scientists.

From Table 3, it can be seen that the number of females in both primary and secondary schools is greater than that of males. But what percentages of these females offer science, it must be noted that women in developing countries are a repository of indigenous technologies because of the nature of activities in which they are traditionally involved (Daris, 2006). This should be a boost for female participation in science and technology, if the knowledge possessed by women is used to relate local learning experiences to science and technology in the school curricula.

Table 3: ***Females as Percentage of Males in Primary and Secondary in Selected African Countries 2004***

Country	Primary (%)	Secondary (%)
Cameroun	85	70
Kenya	94	93
Lesotho	100	127
Malawi	102	81
Mozambique	83	70
Nigeria	85	81
Tanzania	96	
Uganda	100	79
Zambia	96	79

Source: UNESCO, Global Education Digest (2006).

There are, however, some encouraging signs observed (Adetunde & Akinsina, 2008). In Ghana, for example, the government adopted the Science and Technology Clinic for Girls Program aiming at giving girls more accesses to science and technology education, and targeting at girls in secondary schools. In Botswana, also, there is a science and technology road shown for girls. These initiatives were

launched in collaboration with the Commonwealth Secretariat and NGO, such as GESAT (gender in science and technology) (Adetunde & Akinsina, 2008).

Girls' underachievement and low enrolment in science are also pronounced in Nigeria (Agueler & Agwagalu, 2007), and being the most populous nation in Africa and having more females than males who are surprising, as it is a source of worry. According to the 1991 census figures, the population of women was 49.7%. The figure rose to 51.2% in year 2005. There is likely to be a consistent increase following this trend. It is, therefore, said that despite of this large number, women still underachieve and are underrepresented in science and technology in Nigeria. In a cross-national study and educational attainment at the university level, Dorman (2004) established that girls appeared to perform less well than boys in science and technological courses.

Also, in the study of employment statistics according to occupation and sex in Nigeria industries, Omoniyi & Oloruntegbe (2012) observed that women were more in secretariat jobs and very few in engineering and technological professions. Gorriz and Medina (2007) equally observed that for years, women have held a minority position in the high-status, high-salaried jobs in computer and technology fields. In their study, they found that many boys and young men are drawn towards these fields at an early age by their involvement with computer games and other high-tech activities. Their findings were also corroborated by the work of Comber, (2006) who also found that girls and young women often were less confident and less interested in computers and the skills associated with science and technology.

Many researchers, Sheila (2004), DeRemer (2005), and Duyilemi (2006) had identified variables, such as religious factors, school environment, poor performances in mathematics, socialization patterns and gender-stereotyping among others as

factors militating against the participation of girls and women in science and technological advancement. Added to these factors is girls' anxiety towards mathematics which is a core subject in science and technology.

In some studies, mixed results have been revealed regarding the gender differences in science achievement. In the comparison study of 2011 Trends in International Mathematics and Science Study (TIMSS), Amelink (2009) reported that American male and female fourth-graders did not show a significant difference in their science performances, but male eighth-graders represented significantly better performances than female counterparts overall in science (i.e., physics, biology & earth science) except chemistry. This phenomenon has been consistent based on the American data of the National Assessment of Educational Progress (NAEP) from 1969 to 1999 which found that males in the primary and middle schools outperformed females on science achievement tests, and the data of 1999 TIMSS which indicated that males outperformed females significantly in science tests. In addition, the result from Advanced Placement Program (APP) for American high school students in 2007 confirmed that male students scored higher on 35 tests including chemistry test than female students. The percentage of male students receiving a score of 5(i.e. extremely well qualified) in APP chemistry test participants is 18% while the one of female students is 11%. This phenomenon seemed to be extended to the American higher institutions. Obrentz (2012) reported that there was a significant difference in the final chemistry grades between university males and females. Male students scored better than female students.

The cross-cultural evaluation of science achievement conducted by International Evaluation of Education Achievement (IEA) also pointed out the same trend of lower female achievement compared with male students. Also the First and

Second International Science Study (FISS & SISS), and Third International Mathematics and Science Study (TIMSS) revealed that there has been consistent outperforming of male students in the written achievement tests of every science subject Amunga, Amadalo, & Musera, (2011). Also found out male students outperformed female students in chemistry in 32 secondary schools in Western Province of Kenya. The chemistry results of male students had the upper hand from the year of 2005 until 2009 compared with female students. Likewise, Male students' higher performances in chemistry have also been seen in other countries such as Nigeria and Kenya.

Ezeudu and Obi-Theresa (2013) investigated the effects of gender and location on students' chemistry achievement in a local government area in Nigeria. The findings showed that chemistry achievement of male students was significantly higher than the one of female students in both rural and urban areas. The same phenomenon was found in an Ethiopian college in which Tenaw (2013) investigated the gender difference of 100 students in terms of chemistry performance. The finding showed that male students are better performers than female in chemistry.

Also Oludipe's (2012) reported that there was no significant difference in basic science achievement between male and female junior secondary school students in Nigeria. This study was based on a quasi-experimental design which had a treatment period of cooperative learning strategy in basic science class. The same result was also found by Afuwape (2011) who used an ex post facto research design. The performance of secondary school male and female students in basic science had no significant difference. Given that there were some other studies reporting the disadvantaged position and low interest of male students in science subjects Omoniyi, (2006), eventual achievement by learners seem to be closely related to personal

efforts, cognitive abilities. The present sought to find out the difference between male and female students emotional intelligence reasoning ability, self-efficacy and chemistry achievement of SS II students. A different study area is used for a better result.

2.11 Over View of Similar Studies

This section contains a summary of some related studies in Emotional-intelligence, reasoning ability, self-efficacy and achievement in chemistry.

The study carried out by Arockia, M. and Sangeetha, R. (2013), on the relation between emotional intelligence and academic performance among the final year undergraduates has been a popular topic of debate in the field of education in general and management in particular. It is considered as a successful predictor of academic success/performance/achievement. Researchers have claimed that EI predicts success at schools, and colleges. However, little empirical research has been conducted to test this assertion. In the study of the relationship of EI as measured by Mangal and Shubra Mangal's EI Inventory (MEII) and academic performance were examined in a sample of final year under graduate students (N=300). EI in its four specified domains namely Intrapersonal Awareness, Interpersonal Awareness, Intrapersonal Management and Interpersonal Management separately as well as totally was found to be positively associated with academic performance of the selected respondents. Also the total EI score showed a percentage of 7.5 per cent of the sample being emotionally intelligent. The significant 'f' value has evidently showed that EI could predict academic performance of college students. The findings provide a further need on how to improve upon the academics of students. Also, the study has shown that emotional well-being could be emphasized on academic success. The present study examined if Emotional-Intelligence, Reasoning Ability and Self-

Efficacy can be used as Predicators of Achievement of Senior Secondary School Chemistry in Zonkwa Zone Kaduna State Nigeria

Fayombo (2012) examined the relationships between emotional intelligence and academic achievement among 163 undergraduate psychology students in The University of the West Indies (UWI), Barbados, Survey research design was used and the two instrument used for data collection were Barchard (2001)'s Emotional Intelligence Scale and an Academic Achievement Scale. Findings revealed significant positive correlations between academic achievement and six of the emotional intelligence components, and a negative correlation with negative expressivity. The emotional intelligence components also jointly contributed 48% of the variance in academic achievement. Attending to emotions was the best predictor of academic achievement while positive expressivity, negative expressivity and empathic concern were other significant predictors. Emotion-based decision-making, responsive joy and responsive distress did not make any significant relative contribution to academic achievement, indicating that academic achievement is only partially predicted by emotional intelligence. These results were discussed in the context of the influence of emotional intelligence on university students' academic achievement. The present study used trait emotional intelligence questionnaire (TEI Que) instrument, which is different from the Barchard (2001), emotional intelligence scale. A different study area was used for a better result.

Azizi, Noordin, Yusuf, Shehrin & Goh (2012) examined the impact of the five emotional intelligence elements identified as self-awareness, emotional management, self motivation, empathy, interpersonal skills towards secondary school students' academic achievement. Their study also aims to identify whether the five elements of emotional intelligence have been able to contribute to academic

achievement. The survey method was used with a focus on inference the relationship of emotional intelligence on academic performance of students in some secondary schools in Johor Bahru. The subjects were secondary school form four students (N = 370) with Statistical inference of the Pearson-r and multiple regression was used to analyze the data. The results showed that the significant relationship between self awareness (r = 0.21), emotional management (r = 0.21) and empathy (r = 0.21) at the level of p <0.05 with academic achievement. Multiple regression analysis (stepwise) result showed that only three elements of emotional intelligence which is self-awareness (ß = 0261), self motivation (ß =-0182) and empathy (ß = 0167) accounted for 8.7% of variation in criterion (academic achievement). Research also presented a model designed to reflect the relationship between the elements of emotional intelligence and academic achievement. These studies imply that the level of emotional intelligence contributes to and enhances the cognitive abilities in student. Thus, to produce a competent generation and successful country in line with the philosophy of education, persistence of the emotional intelligence in student is essential. The subjects for the present are SS II students, and instrument used is traid emotional-intelligence questionnaire and a different study area was used for a better result.

In his study Azuka (2012) to determine the relationship between emotional intelligence and academic achievement of senior secondary students in mathematics. To guide the study some research questions and hypotheses were generated. The research design for the study was correlation survey design. The instruments used for the study were the Emotional Intelligence Inventory and Mathematics Achievement Test. The Emotional Intelligence Inventory has reliability coefficient of 0.79 while the Mathematics Achievement Test has reliability coefficient of 0.94. The population for

the study was the senior secondary school two students in public schools in the Federal Capital Territory, Abuja, Nigeria. Proportionate stratified sampling was used to select the sample (N=1160) for the study. The responses of the students to the instruments were scored and analyzed using mean and Pearson Product Moment Correlation. To test the level of significance of the correlation coefficient the t-test was used. The result showed that there was a significant low positive relationship between the emotional intelligence of SS2 students and their academic achievement in mathematics. The result also indicated that there was a significant low positive relationship between the emotional intelligence of SS2 male students, SS2 female students, urban school students, and rural school students, and their academic achievement in mathematics. It was therefore concluded that apart from cognitive factors, emotional intelligence of students also affects their academic achievement in mathematics. It is recommended that there is need to include emotional intelligence curriculum in schools.The present study used SS II students from a different study area to find the correlation between emotional intelligence and chemistry achievement. The trait emotional-intelligence questionnaire was used in place of emotional intelligence inventory and chemistry achievement score was used in place of mathematic achievement score for a better result.

In their study Sirajo, Mari and Olorukooba (2013) investigated, the relationship between students' reasoning ability, self-efficacy and achievement in chemistry among pre-degree chemistry students. This study employed a descriptive research design. Group Assessment of Logical Thinking Test (GALT) and chemistry self-efficacy instrument were administered to 546 pre-degree chemistry students to determine their reasoning ability and chemistry self-efficacy respectively. Their final semester examination scores in chemistry were used as their achievement scores in

chemistry. The results were correlated using Pearson Product-Moment Correlation (PPMC) statistical technique to test the hypothesis postulated at $p \leq 0.05$. Regression analysis procedure was used to determine the predictive effect of the variables on each other. The results of the analysis revealed that there was a significant relationship between students' reasoning ability, self-efficacy and achievement in chemistry. The regression analysis also revealed that both self-efficacy and reasoning ability can be used to predict the performance of students in chemistry. This study therefore, concluded that for students to perform better in chemistry, there is a need for them to have a positive self-efficacy and operate at a formal reasoning level. From the findings of this study, recommendations are made such as chemistry teachers should put at the back of their minds the reasoning ability and self-efficacy of chemistry students when teaching them. The present study used SS II students and not pre-degree student. A different study area was used for a better result.

Bhat (2016) examined the predictive power of reasoning ability on academic achievement. The contribution of six components of reasoning ability (inductive reasoning, deductive reasoning, linear reasoning, conditional reasoning, cause-and-effect reasoning and analogical reasoning) to explain the variation in academic achievement of class 10^{th} students. The survey method was used. Through stratified random sampling technique five hundred and ninety eight students solved 35 contextualized different components of reasoning standardized by the investigator. The different components of reasoning ability were assessed with help of automatic linear modeling. The predictive power of various components of reasoning ability for academic achievement was 31.5%. Out of the six dimensions of reasoning ability, the maximum involvement was reflected by deductive reasoning (.49) followed by cause and effect reasoning (.26) inductive reasoning (.16), linear reasoning (.05),

conditional reasoning (.03) and analogical reasoning (.02) on academic achievement. The results achieved with the help of this method predicted greater accuracy and authenticity. A different instrument and study area were used for the present study for a better result.

Tenaw (2013) in his study to investigate the relationship between self-efficacy, academic achievement and gender in analytical chemistry at Debre Markos College of Teacher Education. The level of students' self-efficacy, gender difference in self-efficacy and achievement and also relationships between self-efficacy and achievement for second year students in the fall of 2012 in Analytical Chemistry I (ACI) at Debre Markos College of Teacher Education (DMCTE). The self-efficacy survey and the ACI achievement test were completed by 100 students. The self-efficacy survey data were gathered by Likert scale questionnaire. By using inferential statistics (t-test), difference of self-efficacy and achievement in gender is calculated and by using Pearson correlation, the relationships between self-efficacy and achievement were investigated. The analysis of the data indicated that students' level of self-efficacy is medium (50.08), and there is no significant difference in theirself-efficacy between sexes ($t(98) = 0.161$, $p > 0.1$), but there is a statistically significant difference in achievement between sexes ($t(98) = 0.68$, $p < 0.1$) and also a significant relationship exists between self-efficacy and achievement ($r=0.385$, at 0.01 level with 98 degree of freedom). Based on these results, recommendations which will improve the quality of our training specifically in the field of chemistry were forwarded. The present study used SS II students, different instrument and different study area for a better result.

In the study by Baanu, Oyelekan and Olorundare (2016) sought to find out the relationship between chemistry students' self-efficacy and their academic

achievement in senior secondary schools in north-central, Nigeria. The study is an ex-post facto research and is a descriptive survey. The subjects of the study were one thousand one hundred and fifty (1150) senior secondary school III chemistry students selected from Kogi, Kwara and Niger States of Nigeria. The instruments used for the study are students' self-efficacy questionnaire (SEQ) and Joint Mock School Certificate Examination jointly conducted by all states is North-Central Nigeria. The data collected were analyzed using descriptive and inferential statistics of mean, percentage and Pearson Product Moment Correlation. The findings revealed that no significant relationship existed between self-efficacy and the academic achievement of the chemistry students. The study concludes that students' self-efficacy needs in chemistry. It is therefore a host of other factors to achieve high academic achievement in chemistry to complement students' high self-efficacy, so that a combination of these factors could result in high academic achievement in chemistry. A different study area, and instrument were used for the present study, for a better result.

Xin Wu (2008) investigated relationship between Self-efficacy, gender, and motivations are subjective predictors of students' academic achievement. Self-assessment prompted by knowledge surveys involves meta-cognition, i.e., students' awareness of how they learn. Knowledge surveys can be used to measure changes in students' achievement level and to assist students in content review and inspire reflection on one's ability to learn. In his work, he combined these predictors (self-efficacy, gender, motivation, knowledge survey scores) into a survey to determine whether achievement in general chemistry can be predicted. My proposed research was conducted on 426 students enrolled in General Chemistry I classes (Chemistry for science majors) during a regular 15-week semester at Louisiana State University. The research design employed two instruments: the MSLQ instrument and a Content

Knowledge Confidence Survey (CKCS). MSLQ instrument will used to measure the three factors indicating students' academic achievement: self-efficacy, motivation, and gender. The Motivated Strategies for Learning Questionnaire (MSLQ) survey was administered during the last week of classes. Data were analyzed via descriptive statistics, as well as correlation, linear and multiple regression statistical analyses with the correlation of total grades throughout the semester. The analysis results show that self-efficacy, motivation and knowledge survey scores can be used to statistically significantly predict students' future chemistry achievement, and gender turned out to be not a statistically significant predictor in this study. The present study used SS II students, and different instruments were used while a different study area was also used for a better result.

Diane (2003) investigated the relationships between self-efficacy, gender, age, and academic achievement in a two-year college science course, Anatomy and Physiology (A & P). A confidential self-report survey was administered to 216 A & P students to measure student self-efficacy levels. Most students had moderate to high levels of self-efficacy in A & P. A potential relationship between gender and self-efficacy was studied but no significant relationship was found between them. A connection between age and self-efficacy was also examined to determine whether differences existed in self-efficacy between traditional college students (18 to 24 years of age) and nontraditional college students (greater than 24 years of age). No significant findings linked age to self-efficacy. However, there was a significant positive relationship found between self-efficacy and the number of completed college semesters. Finally, the relationship between self-efficacy level and academic achievement in A & P was investigated. Students' midterm and final A & P grades were used as the measure of academic achievement. Of 216 survey respondents, 158

released their A & P grades for this study. ANOVA results comparing self-efficacy to both midterm and final A & P grades showed highly significant positive relationships between self-efficacy and academic achievement in A & P. Because of the significant link found between self-efficacy and academic achievement, recommendations are presented for educators on how they can address low student self-efficacy levels. SS II students have been used for the present study. Also different instruments and study area were used for a better result.

Mari (2012), Investigated Gender Related Differences in Acquisition of Formal Reasoning Schemata: Pedagogic Implication of Teaching Chemistry Using Process-Based Approaches to determine the effects of process based instruction on acquisition of formal reasoning ability in male and female Subjects under study. To determine the gender related differences in acquisition of formal reasoning ability 38 Subjects randomly selected from a Secondary School in Kaduna State, Nigeria were pre-tested using Group Assessment of Logical Thinking Test (GALT), after which they were exposed to process-based instruction for six weeks. The male and female subjects' posttest scores were compared using t-test statistics. The initial gap between the male and female subjects in formal reasoning ability was bridged in all the Schemata (conservation, control of variables, proportional reasoning, probability reasoning, and combinatorial reasoning) except in correlational reasoning. Based on the results, one of the major recommendation made was that process-based instruction should be introduced in the early years in the Secondary Schools as means to reduce if not totally eliminate the gender-related differences in reasoning ability between male and female students in secondary schools. The same instrument and same level of students but different study area were used for the present study for a better result.

Tekkaya and Yenilmez (2006) carried out a study to investigate students' logical thinking abilities: the effect of gender and grade level. A total of one hundred and seventy four students (109 boys and *65* girls) participated in the study. Among the students sixty two were in sixth-grade, fifty eight in seventh- and fifty four in eight-grade. The mean ages of students ranges from eleven-nineteen years. The results revealed that boys have higher scores than girls on proportional probabilistic and combinatorial reasoning, while girls have higher scores on controlling and correlation reasoning. Gender different was found to be statistically significant only for proportional reasoning in favor of boys. The results also revealed that students attending higher grade levels had higher scores in test of logical thinking (TOLT). The mean scores of students in four reasoning modes (proportional reasoning, controlling variables, correlation and combinatorial reasoning) increased as the grade level increased. MANOVA results showed that there was significant effect of grade level on the three modes of reasoning ability; proportional reasoning controlling variables and combinatorial reasoning. However no statistically significant effect was found on probabilistic and correlation reasoning with respect to grade level. Follow-up tests revealed that there was a significant difference between grades six and eight concerning proportional reasoning, controlling variables and combinatorial reasoning. Moreover it was found that there was a significant difference between grades seven and eight concerning combinatorial reasoning ($p<0.05$). the mean scores of seven and eight grade students on probabilistic and correlation reasoning were very close to each other, although in general, there was an increase in the mean scores as grade level increases. In fact, it was expected that as grade level increases, because according to piagetian model of cognitive development, formal thought begin to developed at age eleven or twelve and reaches equilibrium state at fifteen or sixteen.

Piagetian model of cognitive development indicate that at late adolescence, young adults should function at the formal operation level of cognitive development.

2.12 Implications of the Literature Review for the Present Studies

The literatures reviewed clearly explained the concepts emotional-intelligence, reasoning ability, self-efficacy and academic achievement. It also highlighted many studies carried out by several researchers such as Mayer, Caruso and Salovey, (2008); Svetlana (2007) and Azuka (2012) who found a strong positive significant relationship between emotional-intelligence and academic achievement. It also highlighted studies carried out by Sungur (2001, Nasir and Mansur (2010), Oloyede (2012), Sirajor, Mari and Olorukooba (2013) and Bhat (2016) who also found a strong positive significant relationship between reasoning ability and academic achievement. Similarly Bandura (1997), Britner (2008), Kiran and Sungut (2011) and Baanu, Oyelekan and Olorundare (2016) who have affirmed the relationship between self-efficacy and student achievement. The literature reviewed clearly reveals that people with high emotional-intelligence performed better than those with low emotional-intelligence. Also shows that formal reasoning ability is a strong predictor for achievement in chemistry. This findings further revealed that people with high assurance of their capabilities (positive efficacy) approach difficult task as challenges which eventually result in better performance in that given tasks.

Literature studies from Amelink (2009), Afuwape (2011) and Oludipe's (2012), revealed that there is no significant difference in science performance between male and female students, while Obrentz (2012), Ezeudo and Obi-Theresa (2013) who revealed that male students are better performance than female students in chemistry. Also Cheeseman, Simpson and Wint (2006) and Fayombo (2012), found out that there was favour at the female. This shows mixed results on gender. Gender differences

have mixed result on emotional-intelligence, reasoning ability, self – efficacy and academic achievement. The previous researches on the predictive effect of emotional – intelligence, reasoning ability, self – efficacy and academic achievement has been carried out separately on the correlation of these variable on academic achievement and yielded mixed results. No study have investigated the combined correlation of emotional intelligence, reasoning ability, self – efficacy and academic achievement in chemistry. From the literature cited, most of the studies carried out used different study areas not from Nigeria. The aspect of Nigeria was not addressed in the literature cited. No study has combined the three variable together and such studies have not been carried on Zonkwa Education Zone.

Therefore present study is conceived to fill this gap. This research therefore used a different study area for better understanding of the relationship among emotional intelligence, reasoning ability, self-efficacy and academic achievement in chemistry among senior secondary (SS II) school students in Zonkwa Education Zone, Kaduna, Nigeria.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study investigated the relationship among emotional-intelligence, reasoning ability, self-efficacy as predictors of achievement of senior secondary school chemistry students in Zonkwa Education Zone Kaduna. The chapter presented the research methodology that was used under the following sub-headings.

3.2 Research Design

3.3 Population of the Study

3.4 Sample and Sampling Techniques

3.5 Instrumentation

3.6 Procedure for Data Collection

3.7 Procedure for Data Analysis

3.2 Research Design

This study, employed correlational survey design. Correlation research involved the collection of data in order to determine whether and to what degree a relationship exists between two or more quantifiable variables. This research design is chosen because the study is interested in finding the relationship among the variables and in observing what has happened to the sample subjects without any attempt to control or manipulate them.

3.3 Population of the Study

The population of the study comprises of all public co-educational senior secondary school student (SS II) offering chemistry in Zonkwa Education Zone. The schools are fifteen in number, with students population of 413 (246 males and 167

females) of average age of 17 years, with five (5) urban and ten (10) rural schools. Detail of the population of this study is in Table 3.1.

Table 3.1: Population of the Study

S/No	Name of school	Male	Female	Total
1	G.S.S Farman	18	14	32
2	GTC Abet	25	10	35
3	GSS Fanjim	10	11	21
4	GSS Marsa	11	6	17
5	GSS Anchuna Sarki	12	8	20
6	TBMC Samaru	20	18	38
7	GSS Zutrung	8	7	15
8	GSS Mabushi	16	11	27
9	GSS F/Kaje	25	18	43
10	GSS Zonkwa	20	9	29
11	GSS F/Kamanto	11	7	18
12	GSS B/Kogi	13	8	21
13	GSS Z/kataf	21	11	32
14	GSS Madakiya	19	16	35
15	GSS Jankasa	17	13	30
	Total	246	167	413

Source: Zonal Education Office, Zonkwa (2016).

3.4 Sample and Sampling Techniques

Six schools were selected from the fifteen schools in Zonkwa zone that formed the sample of the study, by simple random sampling technique using draw-from-the-hat method. According to William (2005) random sampling is a simple procedure which ensures that each element in a population has equal chance of being selected. This was done by putting the names of all the schools of the population inside a container, shaked and then the six schools were picked one at a time without replacement.

All the chemistry students in the sampled schools were used for the study (students in an intact class). The total numbers of students are 152; 89 male and 63 female students).

The six schools are represented in the table 3.2.

Table 3.2: Sampled Schools for the Study

S/No	Name of school	Male	Female	Total
1	G.S.S Farman	18	14	32
2	GSS F/Kamanto	11	7	18
3	GSS Zonkwa	20	9	29
4	GSS Fanjim	10	11	21
5	GSS Madakiya	19	16	35
6	GSS Marsa	11	6	17
	Total	89	63	152

Source: Researcher's Field Work(2016)

3.5 Instrumentation

In this study four Instruments were used for data collection. They were:

3.5.1 Trait Emotional Intelligence Questionnaire (TEIQue)

3.5.2 Group Assessment of Logical Thinking (GALT)

3.5.3 Chemistry Self-efficacy Instrument (CSI)

3.5.4 Chemistry Achievement Score (CAS)

3.5.1 Trait Emotional Intelligence Questionnaire (TEIQue)

To measure the Emotional-intelligence of Students, The Trait Emotional Intelligence Questionnaire (TEIQue) was developed by Petrides (2001),was adopted with a reported reliability coefficient of 0.80 used and is a scientific instrument used to measure trait emotional intelligence (Petrides, 2001). The TEIQue is composed of fifteen facets that were derived from a comprehensive content analysis of prominent emotional-intelligence literature: adaptability, assertiveness, emotion appraisal (self and others), emotion expression, emotion management (others), emotion regulation, impulsiveness (low), relationship skills, self-esteem, self- motivation, social competence, stress management, trait empathy, trait happiness, and trait optimism (Petrides & Furnham, 2001). In Conte (2005) reviewed and critized various El measures. While, he did not specifically examine the TEIQue measure, he found that

most of the El measures have sufficient internal reliability. However, some ability-based El subscales have marginally acceptable internal consistency and test-retest reliability.

The instrument chosen to measure trait emotional intelligence in this study was the Trait Emotional Intelligence Questionnaire (TEIQue), (Petrides & Furnham, 2006). The thirty question TEIQuebased on the long form of the TEIQue and is designed to measure global trait intelligence (Petrides, 2001). Two questions from each of the fifteen subscales of the TEIQue were included in the short form, which were chosen based on their "correlations with the corresponding total subscale scores" (Petrides & Furnham, 2006). These fifteen subscales were used to provide scores on four broader factors: well-being, self-control, emotionality, and sociability (Petrides, 2001).

A high score indicates an overall sense of well-being. In general, individuals with a high score on this factor are fulfilled and satisfied with life. On the other hand, low scores represent individuals that have poor self-esteem and are not satisfied with life at the present time.

The self-control factor refers to one's degree of control over their urges and desires. Individuals with a high self-control score have the ability to manage and regulate external pressures. However, individuals with a low score tend to display impulsive behaviors and are unable to properly manage stress.

Individuals with a high emotionality score possess a wide array of emotion-related skills: recognizing internal emotions, perceiving emotions, and expressing emotions. In turn, these skills are often used to form and nurture close relationships with family and friends. On the contrary, individuals with a low emotionality score have difficulty recognizing their own emotions and conveying their feelings to others.

In turn, these individuals generally experience less gratifying personal relationships with others.

The sociability factor focuses on one's social influence. This factor differs from the emotionality factor in that it evaluates one's influence in a variety of social contexts, rather than just in personal relationships with family and friends. Individuals with a high sociability score are good listeners and effective communicators. Individuals with a low score are not as effective at social interaction. They appear unsure of themselves in social interactions and are unable to affect others' emotions (Petrides, 2001). See appendix A

3.5.2 Group Assessment of Logical Thinking (GALT)

To measure Reasoning Ability of the students the Group Assessment of Logical Thinking (GALT), developed by Road-Rangka, Yeang and Padilla (1982), adopted from Mari, (2001) with a reported reliability coefficient of 0.85, was adopted. The instrument consists of twelve questions testing six reasoning ability of schemata namely;

A. Conservation
B. Proportional reasoning
C. Controlling variables
D. Probabilistic reasoning
E. Correlation reasoning
F. Combinational reasoning.

Items 1 and 2 deal with conservational ability, 3 and 4 proportional reasoning, 5 and 6controlling variables, 7 and 8 probabilistic reasoning, 9 and 10 correlation reasoning and lastly 11 and 12 test combinational reasoning.

Reason for choosing GALT together paper and pencil test are:

1. It was developed keeping in mind the real spirit of piagetian concepts of developmental stages of logical thinking.
2. It has stood the test of time and proved useful in a variety of research studies in several countries.
3. It employs several items to measure each one of the operational concepts so as to provide a reliable assessment of each concept.
4. It is easy to administer and does not require more than a normal instructional period of time.
5. The test has a suitable reliability coefficient of 0.85.
6. The test deals more with level of acquisition of scientific concepts and less on acquisition of language.

3.5.3 Chemistry Self- efficacy Instrument (CSI)

Chemistry Self-efficacy Instrument (CSI) adopted from the work of Baldwin, Ebert-May and Burn (1999) in Mari (2013), which is in form of questionnaire with a reliability co-efficient of 0.75 was administered to determine the students self-efficacy in chemistry.

This Instrument which was originally created, for biology student was adapted to be used for chemistry students. The original instrument contains a fifteen statement about students' confidence in doing things related to biology. All the fifteen statements were modified to suit chemistry students. The name of the instrument was change to Chemistry Self-efficacy Instrument (CSI). The Instrument contains fifteen statements about students' confidence in doing things related to chemistry. It was designed to assess the students chemistry efficacy. The instrument is a fifteen items question with items answered on a five point likert scale from totally confident to not at all confident. The questions range from testing students self-efficacy about

chemistry experiments, chemistry courses like organic, physical and analytical chemistry to testing their self-efficacy concerning the chemistry courses they are currently undergoing. See appendix D.

3.5.4 Chemistry Achievement Score (CAS)

Academic achievement score used in this study, measured by the students' MOCK result as their chemistry achievement assessment. The Joint Mock School Examination jointly conducted by all the zones in states. The Joint Mock School Examination questions were normally taken through the basic processes of validation and reliability before they were administered, has a reliability co-efficient of 0.82. Hence, the examination questions were deemed valid and reliable.

3.6 Procedure for Data Collection

The instruments trait Emotional Intelligence Questionnaire (TEIQue), Group Assessment of Logical Thinking (GALT) and Chemistry Self-Efficacy Instrument (CSI) were administered by the researcher with the help of research assistance. Chemistry teachers of the sampled schools assisted in administering the instruments under the supervision of the researcher. The three instruments were administered at the same time to the students.

3.7 Procedure for Data Analysis

The null hypotheses are restated along with the appropriate statistical tools to be used in data analysis. The statistical tools include descriptive statistical of means and standard deviations were used to answer research question one, two and three while mean ranks were used to answer research question four, and Pearson correlation coefficient was used to test the relationship. Inferential statistic of Pearson correlation was used to answer null hypotheses one, two, and three. Inferential statistical of one-

way Multiple Analysis of Variance, (MANOVA) was used to answer null hypotheses four.

To guide the study the following null hypotheses were tested at ≤ 0.05 level of significance:

$H0_1$: There is no significant relationship in the mean scores of SSII chemistry students in emotional-intelligence, reasoning ability, self-efficacy, and academic achievement in chemistry.

An inferential statistic of Pearson Product Moment Correlation PPMC was used.

$H0_2$: There is no significant relationship in the mean scores of SSII male chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry?

An inferential statistic of Pearson Product Moment Correlation PPMC was used.

$H0_3$: There is no significant relationship in the mean scores of SSII female chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry.

An inferential statistic of Pearson Product Moment Correlation PPMC was used.

$H0_4$: There is no significant difference between the mean scores of SSII male and female chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry.

An inferential statistic of One-way MANOVA was used.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

4.1 Introduction

The chapter is presented under the following sub-headings:

4.2 Data analysis and results presentation

4.3 Summary of findings

4.4 Discussion of results

4.2 Data Analysis and Results Presentation

For the purpose of data collection, Trait Emotional Intelligence Questionnaire (TEIQue), Group Assessment of Logical Thinking (GALT) and Chemistry Self-efficacy Instrument (CSI) were used to measure students emotional-intelligence, reasoning ability and self-efficacy respectively. Student's SSII third term (qualifying) examination results in chemistry were used as their academic achievement in chemistry.

4.2.1 Answers to Research Questions

In this section the data collected were analyzed using means, standard deviations and mean ranks statistics depending on the type of data collected. Means and standard deviations were used to answer research questions 1, 2 and 3 while mean ranks were used to answer research question 4.

Research Question One

What are the mean scores of SSII chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry?

This research question was answered using descriptive statistics of means and standard deviations. The summary of the computation is presented in Table 4.1.

Table 4.1: Means and Standard deviations of Students' in Chemistry

	N	Mean	Std. Deviation
EI	152	130.18	32.401
RA	152	4.53	1.675
SE	152	34.32	9.657
CAS	152	47.95	8.432

Table 4.1 shows the mean emotional-intelligence, reasoning ability, self-efficacy and academic achievement scores of SS II students in chemistry. The mean achievement scores for emotional intelligence, reasoning ability, self-efficacy and Chemistry Achievement Test were (M=130.18, SD=32.401), (M=4.53, SD=1.675), (M=34.32, SD=9.657), and (M=47.95, SD=8.432) respectively. The SSII chemistry students had a higher mean in emotional intelligence followed by chemistry achievement course, self-efficacy and least mean in reasoning ability.

Research Question Two

What are the mean scores of SSII male chemistry students in emotional-intelligence, reasoning ability, self efficacy and academic achievement in chemistry?

This research question was answered using descriptive statistics of means and standard deviations. The Pearson Correlation Coefficient was used to test the relationship. The summary of the computation is presented in Table 4.2.

Table 4.2: Means and Standard Deviations of Male Students' in Chemistry Achievement Test Scores, Emotional-intelligence, Reasoning Ability, and Self-efficacy

	N	Mean	Std. Deviation
CAS	89	47.49	8.301
EI	89	129.60	34.121
RA	89	4.45	1.752
SE	89	33.67	9.546

Table 4.2 shows the mean Chemistry Achievement Test scores, emotional-intelligence, reasoning ability, and self-efficacy scores of SS II male students in chemistry. The mean achievement score for emotional intelligence, reasoning ability, self-efficacy and Chemistry Achievement Test were (M=47.49, SD=8.301); (M=129.60, SD=34.121); (M=4.45, SD=1.752); and (M=33.67, SD=9.546) respectively. The male students had a higher mean in emotional intelligence and a least mean in reasoning ability.

Research Question Three

What are the mean scores of SSII female chemistry students in emotional-intelligence, reasoning ability, self efficacy and academic achievement in chemistry?

This research question was answered using descriptive statistics of means and standard deviations. The Pearson Correlation Coefficient was used to test the relationship. The summary of the computation is presented in Table 4.3.

Table 4.3: Means and Standard Deviations of Female Students' in Chemistry Achievement Test Scores, Emotional-intelligence, Reasoning Ability, and Self- efficacy

	N	Mean	Std. Deviation
CAS	63	48.60	8.637
EI	63	131.00	30.054
RA	63	4.63	1.569
SE	63	35.24	9.816

Table 4.3 shows the mean Chemistry Achievement Test scores, emotional-intelligence, reasoning ability, and self-efficacy scores of SS II female students in chemistry. The mean scores for Chemistry Achievement Test scores, emotional intelligence, reasoning ability, and self-efficacy were (M=47.49, SD=8.301); (M=129.60, SD=34.121); (M=4.45, SD=1.752); and (M=33.67, SD=9.546)

respectively. The female students had a higher mean in emotional intelligence and a least mean in reasoning ability.

Research Question Four

What is the difference between the mean scores of SSII male and female chemistry students in emotional-intelligence, reasoning ability, self efficacy and academic achievement in chemistry?

This research question was answered using descriptive statistics of means and standard deviations. The summary of the computation is presented in Table 4.4.

Table 4.4: Means and Standard Deviations of Male and Female in Chemistry

	N	Sex	Mean	Std. Deviation
CAS	89	1 male	47.49	8.301
	63	2 female	48.60	8.637
	152	Total	47.95	8.432
EI	89	1 male	129.60	34.121
	63	2 female	131.00	30.054
	152	Total	130.18	32.401
RA	89	1 male	4.45	1.752
	63	2 female	4.63	1.569
	152	Total	4.53	1.675
SE	89	1 male	33.67	9.546
	63	2 female	35.24	9.816
	152	Total	34.32	9.657

Table 4.4 shows the means and standard deviations on chemistry academic achievement, emotional intelligence, reasoning ability and self-efficacy for male and female SS II students. The mean academic achievement score on Chemistry for male was (M=47.49, SD=8.301) and that of female was (M48.60, SD=8.637). The mean difference was -1.109 in favor of the female students. The mean emotional intelligence score in Chemistry for male was (M=129.60, SD=34.121) and that of female was (M131.00, SD=30.054). The mean difference was -1.4 in favor of the

female students. The mean reasoning ability score on Chemistry for male was (M=4.45, SD=1.752) and that of female was (M4.63, SD=1.569). The mean difference was -0.18 in favor of the female students. The mean self-efficacy score on Chemistry for male was (M=33.67, SD=9.546) and that of female was (M35.24, SD=9.816). The mean difference was-1.57 in favor of the female students. This shows that there was a difference between the mean academic achievement scores, emotional intelligence, reasoning ability and self-efficacy of male and female SS II students' in chemistry in favor of female students. The female students have shown a better result in academic achievement scores, emotional intelligence, reasoning ability and self-efficacy than their male counterparts.

4.2.2 Null Hypotheses Testing

The variables of emotional intelligence, reasoning ability and self-efficacy were analyzed using non-parametric test of Mann-Whitney U test, and academic achievement scores were analyzed using parametric test of independent sample t-test. The three null hypotheses formulated were tested at $p \leq 0.05$.

Null Hypothesis One

There is no significant relationship in the mean scores of SSII chemistry students in emotional-intelligence, reasoning ability, self-efficacy, and academic achievement in chemistry.

To test this null hypothesis, an inferential statistic of Pearson Correlation was used. The summary of the computation is presented in Table 4.5.

Table 4.5: Summary of Pearson Correlation on Emotional-intelligence, Reasoning Ability, Self-efficacy and Academic Achievement of Students' in Chemistry

Variable	N	EI	RA	SE	CAS	Mean	SD
EI	152	..	.698**	.728**	.803**	130.18	32.401
RA	152	..	..	.659**	.797**	4.53	1.675
SE	152	..	..	..	.851**	34.32	9.657
CAS	152	..	..	..	..	47.95	8.432

**. Correlation is significant at the 0.05 level (2-tailed).

Table 4.5 shows the Pearson Product Moment on emotional-intelligence, reasoning ability, self-efficacy and academic achievement of students in chemistry, the six pairs of variables were significantly correlated. The strongest positive correlation, was between self-efficacy and Chemistry Achievement Test scores, $r(150)=0.851$, $p \leq 0.05$. This means that students who had relatively high scores in self-efficacy were likely to have high scores in Chemistry Achievement Test. The least positive correlation was between reasoning ability and chemistry achievement test scores ($r=0.797$, $p<0.05$). All the relationships had a large effect size according to Cohen (1988). There was significant relationship between the mean emotional-intelligence, reasoning ability, self-efficacy and academic achievement scores of SS II students in chemistry. Therefore, the null hypothesis that stated no significant relationship was rejected.

Null Hypothesis Two

There is no significant relationship in the mean scores of SSII male chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry?

To test this null hypothesis, an inferential statistic of Pearson Correlation was used. The summary of the computation is presented in Table 4.6.

Table 4.6: Summary of Pearson Correlation on Emotional-intelligence, Reasoning Ability, Self- efficacy and Academic Achievement of Male Students

	N	CAS	EI	RA	SE	Mean	Std. Deviation
CAS	89	..	.804**	.800**	.813**	47.49	8.301
EI	89	..	..	.701**	.682**	129.60	34.121
RA	89	..	..	..	.614**	4.45	1.752
SE	89	..	..	..	..	33.67	9.546

**. Correlation is significant at the 0.05 level (2-tailed).

Table 4.6 shows the pearson product moment correlation on emotional-intelligence, reasoning ability, self-efficacy and academic achievement of male students, the six pairs of variables were significantly correlated. The strongest positive correlation, was between self-efficacy and Chemistry Achievement Test scores, ($r=0.813$, $p\leq0.05$). This means that students who had relatively high scores in self-efficacy were likely to have high scores in Chemistry Achievement Test. The least positive correlation was between reasoning ability and Chemistry Achievement Test scores ($r=0.800$, $p\leq0.05$). All the relationships had a large effect size according to Cohen (1988). There was significant relationship between the mean emotional-intelligence, reasoning ability, self-efficacy and academic achievement scores of SS II male students in chemistry. Therefore, the null hypothesis that stated no significant relationship was rejected.

Null Hypothesis Three

There is no significant relationship in the mean scores of SSII female chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry.

To test this null hypothesis, an inferential statistic of Pearson Correlation was used. The summary of the computation is presented in Table 4.7.

Table 4.7: Summary of Pearson Correlation on Emotional-intelligence, Reasoning Ability, Self -efficacy and Academic Achievement of Female Students

	N	CAS	EI	RA	SE	Mean	Std. Deviation
CAS	63	..	.810**	.796**	.899**	48.60	8.637
EI	63	..	..	.693**	.807**	131.00	30.054
RA	63	..	..	..	.728**	4.63	1.569
SE	63	..	..	..	..	35.24	9.816

**. Correlation is significant at the 0.05 level (2-tailed).

Table 4.7 shows the pearson product moment correlation on emotional-intelligence, reasoning ability, self-efficacy and academic achievement of female students, the six pairs of variables were significantly correlated. The strongest positive correlation, was between self-efficacy and Chemistry Achievement Test scores, ($r=0.899$, $p<0.05$). This means that students who had relatively high scores in self-efficacy were likely to have high scores in Chemistry Achievement Test. The least positive correlation was between reasoning ability and chemistry achievement scores ($r=0.796$, $p<0.05$). All the relationships had a large effect size according to Cohen (1988). There was significant relationship between the mean emotional-intelligence, reasoning ability, self-efficacy and academic achievement scores of SS II female students in chemistry. Therefore, the null hypothesis that stated no significant relationship was rejected.

Null Hypothesis Four

There is no significant difference between the mean scores of SSII male and female chemistry students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement in chemistry.

To test this null hypothesis, an inferential statistic of one-way MANOVA was used. The summary of the computation is presented in Table 4.8.

Table 4.8: Summary of MANOVA of Academic Achievement in Chemistry by Gender

Statistics	Value	F	Hypothesis df	Error df	p
Pillai's Trace	.010	.380[a]	4.000	147.000	.822
Wilks' Lambda	.990	.380[a]	4.000	147.000	.822
Hotelling's Trace	.010	.380[a]	4.000	147.000	.822
Roy's Largest Root	.010	.380[a]	4.000	147.000	.822

a. Exact statistic
b. Design: Intercept + sex

Table 4.8 shows one-way MANOVA was calculated examining the effect of gender on emotional-intelligence, reasoning ability, self-efficacy and academic achievement scores. No significant effect was found ((Lambda(4,147)= .380, p> .05), the null hypothesis which stated no significant difference was retained. None of emotional-intelligence, reasoning ability, self-efficacy and academic achievement was influenced by gender. Therefore, there is no significant difference in the mean score of male and female students in emotional-intelligence, reasoning ability, self-efficacy and academic achievement.

4.3 Findings

The summary of findings of the study includes the following:

i. There was significant relationship between the mean emotional-intelligence, reasoning ability, self-efficacy and academic achievement scores of SS II students in chemistry. The strongest positive correlation was between self-efficacy and Chemistry Achievement scores, r (150) = 0.851, $P \leq 0.05$. The least positive correlation was between reasoning ability and Chemistry Achievement score ($r = 0.797$, $P \leq 0.05$).

ii. There was significant relationship between the mean emotional – intelligence, reasoning ability, self – efficacy and academic achievement scores of male SS

II students in chemistry. The strongest positive correlation was between self-efficacy and chemistry achievement scores ($r = 0.813$, $P \leq 0.05$) and the least positive correlation was between reasoning ability and chemistry achievement cores ($r = 0.800$, $P \leq 0.05$).

iii. There was significant relationship between the mean emotional – intelligence, reasoning ability, self-efficacy and academic achievement score of female SS II students in chemistry. The strongest positive correlations was between self – efficacy and chemistry achievement score ($r = 0.899$, $P < 0.05$) and the least positive correlation was between reasoning ability and chemistry achievement scores ($r = 0.796$, $P < 0.05$).

iv. There was no significant difference between the mean chemistry achievement scores $F(1, 150) = 0.636$, $P = 0.426 > 0.05$; mean emotional intelligence scores $F(1, 150) = 0.069$, $P = 0.793 > 0.05$; mean reasoning ability scores $F(1, 150) = 0.450$, $P = 0.503 > 0.05$, and mean self-efficacy scores $F(1, 150) = 0.967$, $P = 0.327 > 0.05$ of male and female SSII students in chemistry.

4.4 Discussion

The objective of this was to examine the relationship of emotional-intelligence, reasoning ability, self-efficacy and achievement in chemistry among senior secondary students (SS II) and to see if emotional-intelligent, reasoning ability and self-efficacy can be used to predict achievement in chemistry. For this purpose the student emotional-intelligence, reasoning ability and their self-efficacy were measured using Trait Emotional Intelligence Questionnaire, Group Assessment of Local Thinking and Chemistry Self-Efficacy Instrument, respectively. Their third term (MOCK) examination results were used for their chemistry achievement. Based

on the four variables, four hypotheses were formulated for testing. The results are discussed as follows:

Null Hypothesis One:

From the results in Table 4.5, it was found that there was significant relationship in emotional-intelligence, reasoning ability, self-efficacy and achievement in chemistry. The strongest correlation was between self-efficacy and achievement in chemistry and the least correlation was between reasoning ability and achievement in chemistry.

This findings agrees with that of Mayer, Caruso and Salovey, (2000); Nada, (2000); Habibah, (2007); Rahil (2007); Svetlana, (2007); and Azuka, (2012) who found a positive significant relationship between emotional-intelligence and academic achievement. This finding further reveals that people with high emotional-intelligence performed better than those with low emotional – intelligence. This findings also agrees with that of Sungur (2001), Tekkaya and Yenilmez, (2006), Nasir and Mansur (2010), Oloyede (2012), Sirajo, Mari and Olorukooba (2013), Nnorom (2013) and Bhat (2016) who also found a positive significant relationship between reasoning ability and academic achievement. This shows that formal reasoning ability is a strong predictor for the achievement in chemistry. Many chemistry problems required application of chemical principles and functional relationship among concepts. This implication requires the ability to apply formal reasoning and critical thinking in order to be successful in them.

Heron (1975) had suggested that chemistry courses were generally taught at a level of abstraction requiring a formal thought and critical thinking before it can be comprehended. Similarly Bandura (1997), Britner (2008), Kiran and Sungut (2011) and Baanu, Oyelekan and Olorundare (2016) who have affirmed the relationship

between self-efficacy and students achievement. Therefore, this finding further revealed that people with high assurance of their capabilities (positive efficacy), approach difficult task as challenges which eventually result in better performance in that given tasks. These explain why there is a positive relationship between self-efficacy and achievement in chemistry. Similarly the more efficacious student's achieve greater level of success, where as the students lower in self – efficacy experience more failures. These outcomes then foster student's subsequent self-efficacy beliefs, enhancing successful students self-efficacy and diminishing the self-efficacy of students who gave up easily and thereby failed.

Null Hypothesis Two

From the result in Table 4.6, it was found that there was significant relationship in emotional – intelligence, reasoning ability, self – efficacy and achievement in chemistry among male SS II students in chemistry. The strongest correlation was between self – efficacy and achievement in chemistry and the least correlation was between reasoning ability and achievement in chemistry.

This finding agrees with that of Mayer, Caruso and Salovey, (2000); Nada, (2000); Habibah, (2007); Rahil (2007); Svetlana, (2007); and Azuka, (2012) who found a positive significant relationship between emotional-intelligence and academic achievement. This finding further reveals that people with high emotional-intelligence performed better than those with low emotional – intelligence. This findings also agrees with that of Sungur (2001), Tekkaya and Yenilmez, (2006), Nasir and Mansur (2010), Oloyede (2012), Sirajo, Mari and Olorukooba (2013), Nnorom (2013) and Bhat (2016) who also found a positive significant relationship between reasoning ability and academic achievement. This shows that formal reasoning ability is a strong predictor for the achievement in chemistry.

Many chemistry problems required application of chemical principles and functional relationship among concepts. This implication requires the ability to apply formal reasoning and critical thinking in order to be successful in them. Heron (1975) had suggested that chemistry courses were generally taught at a level of abstraction requiring a formal thought and critical thinking before it can be comprehended. Similarly Bandura (1997), Britner (2008), Kiran and Sungut (2011) and Baanu, Oyelekan and Olorundare (2016) who have affirmed the relationship between self-efficacy and students achievement. Therefore, this finding further revealed that people with high assurance of their capabilities (positive efficacy), approach difficult task as challenges which eventually result in better performance in that given tasks. These explain why there is a positive relationship between self-efficacy and achievement in chemistry. Similarly the more efficacious student's achieve greater level of success, where as the students lower in self – efficacy experience more failures. These outcomes then foster student's subsequent self-efficacy beliefs, enhancing successful students self-efficacy and diminishing the self-efficacy of students who gave up easily and thereby failed.

Null Hypothesis Three

From the results in Table 4.7, it was found that there was significant relationship in emotional – intelligence, reasoning ability, self – efficacy and achievement in chemistry among female SSII students in chemistry. The strongest correlation was between self – efficacy and academic achievement in chemistry and the least correlation was between reasoning ability and achievement in chemistry.

This findings agrees with that of Mayer, Caruso and Salovey, (2000); Nada, (2000); Habibah, (2007); Rahil (2007); Svetlana, (2007); and Azuka, (2012) who found a positive significant relationship between emotional-intelligence and academic

achievement. This finding further reveals that people with high emotional-intelligence performed better than those with low emotional – intelligence. This findings also agrees with that of Sungur (2001), Tekkaya and Yenilmez, (2006), Nasir and Mansur (2010), Oloyede (2012), Sirajo, Mari and Olorukooba (2013), Nnorom (2013) and Bhat (2016) who also found a positive significant relationship between reasoning ability and academic achievement. This shows that formal reasoning ability is a strong predictor for the achievement in chemistry.

Many chemistry problems required application of chemical principles and functional relationship among concepts. This implication requires the ability to apply formal reasoning and critical thinking in order to be successful in them. Heron (1975) had suggested that chemistry courses were generally taught at a level of abstraction requiring a formal thought and critical thinking before it can be comprehended. Similarly Bandura (1997), Britner (2008), Kiran and Sungut (2011) and Baanu, Oyelekan and Olorundare (2016) who have affirmed the relationship between self-efficacy and students achievement. Therefore, this finding further revealed that people with high assurance of their capabilities (positive efficacy), approach difficult task as challenges which eventually result in better performance in that given tasks. These explain why there is a positive relationship between self-efficacy and achievement in chemistry. Similarly the more efficacious student's achieve greater level of success, whereas the students lower in self – efficacy experience more failures. These outcomes then foster student's subsequent self-efficacy beliefs, enhancing successful students self-efficacy and diminishing the self-efficacy of students who gave up easily and thereby failed.

Null Hypothesis Four

From Table 4.8 it was found that there was no significant difference between the mean academic achievement, emotional-intelligence, reasoning ability and self-efficacy of male and female SS II students in chemistry.

This findings agrees with that of Omoniyi (2006), Amelink (2009), Afuwape (2011) and Oludipe's (2012) who reported that there was no significant difference in science performances between male and female students. The findings disagrees with that of Amunga, Amadato and Musera (2011), Obrentz (2012), Ezeudo and Obi – Theresa (2013) and Tenaco whose findings showed that male students are better performers than female in chemistry; Cumberbatch (1993), Cheeseman, Simpson and Wint (2006) and Fayombo (2012) found out that there was significant gender difference in academic achievement in favour of the female. This shows that there are gender differences and similarities in academic achievement at different levels of education around the globe. Also this finding agrees with that of Goleman (1998) who asserted that no gender differences in emotional-intelligence, exist, admitting that while men and women may have different profiles of strength and weakness in different areas of emotional-intelligence, their overall levels of emotional-intelligence are equivalent. However, studies by Mayer and Geher (1996), Mayer, Caruso and Salovey (1999), Mandell and Pherwani, Brackett and Mayer (2003), found that females scored higher than males on emotional-intelligence. Jordan (2010) who indicated that gender differences were particularly pronounced for science for which stronger relationships were observed all emotional-intelligence components for males. Competing evidence exists surrounding whether or not males and females differ significantly in general levels of emotional-intelligence. Perhaps gender differences exist in emotional-intelligence only when one defines emotional-intelligence in purely

cognitive manner rather through a mixed perspective. It could also be the case that gender differences do exist but measurement artifacts such as over – estimation of ability on the part of males are more likely to occur with self-report measures.

More research a required to determine whether or not gender differences do exist on emotional-intelligence. Also this study agrees with Shemesh in Mari (2001), Mani (2006) Sadket (2012), revealed that there was no significant difference in the performance of the male and female student. It disagrees with Graybill (1975), Ajagun (1998) who revealed the superiority of girls over boys. Also Graybill (1975), Good (1977) and Howe and Shayer (1981) who demonstrated that boys are superior to girls in their level of performing piagetian like formal reasoning tasks. Also this study agrees with Wigfield, Eccles, Maclver, Reuman and Midgley (1991), Britner (2002), who observed that in the area of mathematics, boys and girls reported equal confidence during the elementary year. Ruvikumar and Manimozh (2011) reported that the self-efficacy of boys and girls is almost equal among the biology students. Kirna and Sungur (2012), establish that no gender difference was found concerning science self-efficacy. Also this study disagrees with Pajera and Miller (1994), Debacker and Nelson (2000), Calvallo, Rozman, Larebee and Ishikawa (2001), Louis and Mistela (2012) who found significant gender difference with male students. Student began the course with significantly higher self-efficacy and ended the course also with higher self-efficacy. Also disagrees with Britner and Pajares (2006), who revealed that girls reported stronger science self-efficacy than did boys.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This study investigated the relationship among students emotional-intelligence, reasoning ability and self-efficacy as predictors of achievement among senior secondary school chemistry students. The data collected were analyzed using the following statistical tools: mean and standard deviation were used to answer research question 1, 2, and 3 while mean ranks were used to answer research question 4. This chapter is presented under the following sub-headings:

5.2 Summary of the Study

5.3 Conclusion

5.4 Recommendations

5.5 Limitation of the Study

5.6 Implication of the Study

5.7 Contributions to Knowledge

5.8 Suggestion for Further Studies

5.2 Summary of the Study

This study investigated the relationship of students emotional-intelligence, reasoning ability and self-efficacy as predictors of achievement of senior secondary school chemistry students of Zonkwa Education Zone, Kaduna, Nigeria.

The study population comprised all public co-educational senior secondary school students (SSII) offering chemistry in Zonkwa Education Zone. The samples consisting of 152 senior secondary chemistry students were used for data collection. Three hypotheses were tested. There instruments were used for the purpose of data collection. They were Trait Emotional Intelligence Questionnaire (TEIQue), Group

Assessment of Local Thinking (GALT) and Chemistry Self-efficacy Instrument (CSI). The TEIQue was used to determine students' emotional-intelligence, GALT was used to measure student's reasoning ability and CSI was used to determine the student's self-efficacy in chemistry. The students' third term result (qualifying examination) was used as their chemistry academic achievement. The variables emotional-intelligence, reasoning ability and self-efficacy of were analyzed using non-parametric test of Mann-Whitney u test, and academic achievement scores were analyzed using parametric test of independent sample t test. The three null hypotheses formulated were tested at $P \leq 0.05$ level of significance as seen in chapter four.

i. There was significant relationship between the mean emotional-intelligence, reasoning ability, self-efficacy and academic achievement scores among SS II students in chemistry. The strongest positive correlation was between self-efficacy and Chemistry Achievement Test scores. The least positive correlation was between reasoning ability and Chemistry Achievement Test score .

ii. There was significant relationship between the mean emotional – intelligence, reasoning ability, self – efficacy and academic achievement scores among male SS II students in chemistry. The strongest positive correlation was between self-efficacy and chemistry achievement test scores and the least positive correlation was between reasoning ability and chemistry achievement test score

iii. There was significant relationship between the mean emotional – intelligence, reasoning ability, self-efficacy and academic achievement score among female SS II students in chemistry. The strongest positive correlations was between self – efficacy and chemistry achievement test score and the least positive

correlation was between reasoning ability and chemistry achievement test scores .

iv. There was no significant difference between the means chemistry achievement scores and mean emotional intelligence scores; mean reasoning ability scores and mean self-efficacy scores among male and female SSII students in chemistry.

5.3 Conclusions

i. There was positive correlation in emotional-intelligence, reasoning ability, self-efficacy and achievement in chemistry among SS II chemistry students and the strongest correlation was between self-efficacy and academic achievement while the least positive correlation was between reasoning ability and academic achievement.

ii. Student's emotional-intelligence, reasoning ability and self-efficacy are predictors of achievement in chemistry. Self-efficacy being the strongest followed by emotional intelligence and reasoning ability being the least. That is students with high scores in emotional-intelligence, reasoning ability and self-efficacy performed better than those with low emotional intelligence, reasoning ability and self-efficacy.

iii. There was positive correlation among emotional – intelligence, reasoning ability, self – efficacy and academic achievement in chemistry of SS II male students and the strongest correlation was between self – efficacy and academic achievement, followed by emotional intelligence while the least positive correlation was between reasoning ability and academic achievement.

iv. There was positive correlative in emotional – intelligence, reasoning ability, self – efficacy and achievement in chemistry among SS II female students and

the strongest correlation was between self – efficacy and academic achievement followed by emotional intelligence while the least positive correlation was between reasoning ability and academic achievement.

v. Emotional – intelligence, reasoning ability and self – efficacy are predictors of achievement in chemistry with self – efficacy being the strongest and reasoning ability the least. That male and female students with high scores in emotional – intelligence, reasoning ability and self – efficacy performed better than those with low emotional – intelligence, reasoning ability and self – efficacy.

vi. There was no difference in male and female achievement in chemistry and emotional-intelligence, reasoning ability and self-efficacy. That is both male and female students performed equally.

Finally, the overall result of this study revealed that there exist a positive relationship among students, emotional-intelligence, reasoning ability, self-efficacy and achievement in chemistry and all the three variables can be used to predict students academic achievement in chemistry for both male and female. It was also revealed that there is no significant difference between the male and female students' achievement in chemistry emotional-intelligence, reasoning ability and self-efficacy.

5.4 Recommendations

Based on the findings of this study the following recommendations are made;

i. It was observed that emotional-intelligence, reasoning ability and self-efficacy correlated well with achievement in chemistry. Therefore science teachers should encourage their students to develop positive emotional-intelligence, strong reasoning ability and self-efficacy towards science so as to perform better in natural science.

ii. Chemistry teachers should acknowledge the relevance of emotional – intelligence, self – efficacy a significant psychosocial factor in chemical education.

iii. The emotion and feelings of students in terms of stress mood, and adaptability, intrapersonal and interpersonal psychological reactions in the chemistry classroom setting should be identified and understood by the teachers.

iv. As teachers plan chemistry lessons, tests and examinations the emotional understanding, skills and capabilities, reasoning ability and self – efficacy of the students should be put into consideration.

5.5 Limitation of the Study

Except for achievement measured by student's final (qualifying) examination scores and their reasoning ability measured using Group Assessment of Logical Thinking (GALT) test instrument, the emotional-intelligence, and self-efficacy data were gathered entirely through student's self- report. Student may have found that the statement on the survey did not resonate with their own perspective and unique self-beliefs, or students may have found some survey items difficult to interpret. In additional self-report data entails the risk that students may not have answered items honestly therefore resulting in some of them rating themselves lower than their emotional-intelligence and self-efficacy and some rating themselves higher that their emotional-intelligence and self-efficacy.

5.6 Contribution to Knowledge

This study has contributed to knowledge in the following ways:

i. It was established that there is a strong positive relationship between the mean emotional-intelligence, reasoning ability, self-efficacy and academic achievement.

ii. The study established that there is a strong positive relationship between the mean emotional-intelligence, reasoning ability, self-efficacy and academic achievement.

iii. The study showed that there are no significant differences between the mean chemistry achievement and emotional-intelligence, reasoning ability, self-efficacy among male and female students.

iv. It has added to the existing literature

v. The study is on emotional-intelligence, reasoning ability, self-efficacy as predictors of achievement in chemistry in Zonkwa Education, Zone Kaduna State for the first time.

5.7 Suggestions for Further Study

Based on the findings of this research, the following suggestions were offered for further studies;

i. Since the sample respondents were drawn from some selected co-educational public schools in Zonkwa educational zone Kaduna, Nigeria, the effect found may mainly reflect the situation on the zone. Hence, the findings may not be representative of all secondary schools in Nigeria. Thus, this study needs to be replicated in other parts of Nigeria in order to get a better general picture of the whole country. This will facilitate better decision making as regards

relationship among emotional-intelligence, reasoning ability, self-efficacy and achievement in chemistry.

ii. Similar study in other science subjects needs to be carried out.

iii. Since the study was done using senior secondary (II) students similar studies could be replicated using pre-degree and undergraduate students.

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APPENDIX A
TRAIT EMOTIONAL INTELLIGENCE QUESTIONNAIRE (TEIQue)

School:

……

Sex: Male: …….. Female: ……

Age:……Class: ……

Questionnaire and Scoring Key – Instruction: Please answer each statement below by putting a circle around the number that best reflects your degree of agreement or disagreement with that statement. Do not think too long about the exact meaning of the statements. Work quickly and try to answer as accurately as possible. There is no right or wrong answers. There are seven possible responses to each statement ranging from 'Completely Disagree' (number 1) to 'Completely Agree' (number 7). The examination has nothing to do with your result. All information you will provide will be regarded as highly confidential and will be treated as such.

1.	Expressing my emotions with words is not a problem for me.	1	2	3	4	5	6	7
2.	I often find it difficult to see things from another person's viewpoint.	1	2	3	4	5	6	7
3.	On the whole, I'm a highly motivated person.	1	2	3	4	5	6	7
4.	I usually find it difficult to regulate my emotions.	1	2	3	4	5	6	7
5.	I generally don't find life enjoyable.	1	2	3	4	5	6	7
6.	I can deal effectively with people.	1	2	3	4	5	6	7
7.	I tend to change my mind frequently.	1	2	3	4	5	6	7
8.	Many times, I can't figure out what emotion I'm feeling.	1	2	3	4	5	6	7
9.	I feel that I have a number of good qualities.	1	2	3	4	5	6	7
10.	I often find it difficult to stand up for my rights.	1	2	3	4	5	6	7
11.	I'm usually able to influence the way pother people feel.	1	2	3	4	5	6	7
12.	On the whole, I have a gloomy perspective on most things.	1	2	3	4	5	6	7
13.	Those close to me often complain that I don't treat them right.	1	2	3	4	5	6	7
14.	I often find it difficult to adjust my life according to the circumstance	1	2	3	4	5	6	7
15.	On the whole, I'm able to deal with stress.	1	2	3	4	5	6	7
16.	I often find it difficult to show my affection to those close to me.	1	2	3	4	5	6	7
17.	I'm normally able to "get into someone's shoes" and experience their emotions.	1	2	3	4	5	6	7
18.	I normally find it difficult to keep myself motivated.	1	2	3	4	5	6	7
19.	I'm usually able to find ways to control my emotions when I went to.	1	2	3	4	5	6	7
20.	On the whole, I'm pleased with my life.	1	2	3	4	5	6	7
21.	I would describe myself as a good negotiator.	1	2	3	4	5	6	7
22.	I tend to get involved in things I later wish I could get out of.	1	2	3	4	5	6	7
23.	I often pause and think about my feelings.	1	2	3	4	5	6	7
24.	I believe I'm full of personal strengths.	1	2	3	4	5	6	7
25.	I tend to "back down" even if I know I'm right.	1	2	3	4	5	6	7
26.	I don't seem to have any power at all over other people's feelings.	1	2	3	4	5	6	7
27.	I generally believe that things will work out fine in my life.	1	2	3	4	5	6	7
28.	I find it difficult to bond well even with those close to me.	1	2	3	4	5	6	7
29.	Generally, I'm able to adapt to new environment.	1	2	3	4	5	6	7
30.	Others admire me for being relaxed.	1	2	3	4	5	6	7

Questions 1 – 30 measure trait emotional intelligence using the Trait Emotional Intelligence Questionnaire Short Form (TEIQue-SF) (Petrides & Furham, 2006) Questions 1 – 30 provide scores for four factors: Well-being, self-control, emotionally, and sociability. Well-being is comprised of questions 5, 20, 9, 24, 12 and 27. Self-control is comprised of questions 4, 19, 7, 22, 15 and 30. Emotionally is comprised of questions 1, 16, 2, 17, 8, 23, 13 and 28. Sociability is comprised of 6, 21, 10, 25, 11, and 26. Questions 2, 4, 5, 7, 8, 10, 12, 13, 14, 16, 18, 22, 25, 26, and 28 are reverse-coded. Questions 3, 14, 18, and 29 contribute only to the global trait EI score.

APPENDIX B

GROUP ASSESSMENT OF LOGICAL THINKING (GALT)

School:

……

Sex: Male: …….. Female: …….

Age: …… Class:

……

Directions

The purpose of the questions in this booklet is to find out how logically you think. Your reason for choosing an answer is as important as the answer itself. The examination has nothing to do with your result. All information you will provide will be regarded as highly confidential and will be treated as such.

Answer every Question

In answering each question, go through the following steps:

1. Read the questions carefully
2. Record your answer in the space provided on the answer sheet.
3. Read the set of possible reasons and carefully select the reason which best matches your thinking.
4. Record your reason in the space provided on the answer sheet.

GROUP ASSESSMENT OF LOGICAL THINKING (GALT)

Answer Sheet

Name: _____

Date of Birth: _____

Month Day Year

Sex: _____

School: _____

Directions

For each item you are to choose the best answer and reason for selecting that answer. Record your answer in the space provided according to the test item from the test booklet.

	Item	**Best Answer**	**Reason**
1.	Piece of clay	_____	_____
2.	Metal weights	_____	_____
3.	Glass size	_____	_____
4.	Scale	_____	_____
5.	Pendulum length	_____	_____
6.	Ball	_____	_____
7.	Squares and Diamonds 1	_____	_____
8.	Squares and Diamonds 2	_____	_____
9.	The Mice	_____	_____
10.	The Fish	_____	_____
11.	"The Dance"	_____	_____

Put your answers below:

A – L

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Item 12: “The Shopping Centre”

Put your answers below:

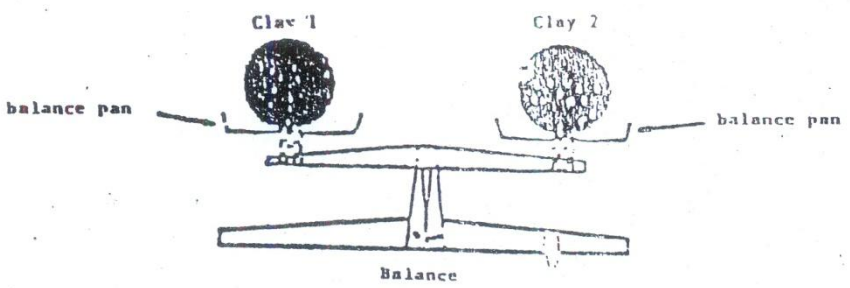
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

BDGC

Item 1

Piece of Clay

Tom has two balls of clay. They are the same size and shape. When he places them on the balance, they weigh the same.



The balls of clay are removed from the balance pans. Clay 2 is flattened cake a pancake.

WHICH OF THESE STATEMENTS IS TRUE?

a. The pancake-shaped clay weighs more.
b. The two pieces weigh the same.
c. The ball weighs more.

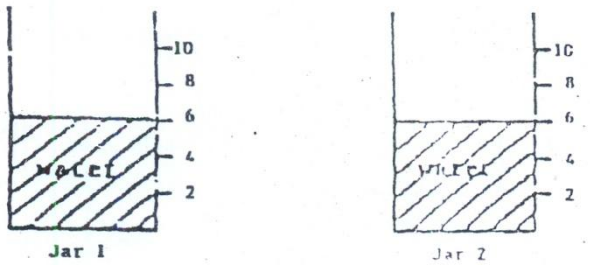
REASON

1. You did not add or take away any clay.
2. When clay 2 was flattened like a pancake, it had a greater area.
3. When something is flattened, it loses weight.
4. Because of its density, the round ball had more clay in it.

Item 2

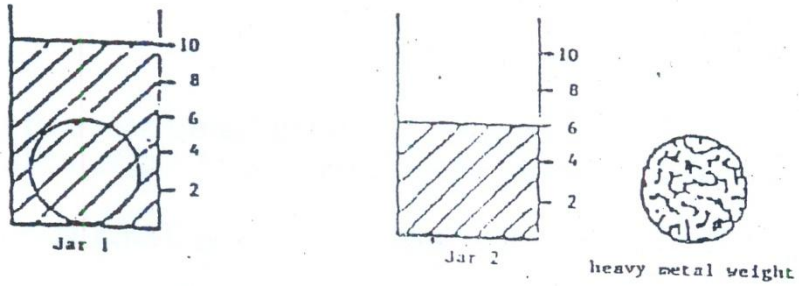
Metal Weight

Linn has two jars. They are the same size and shape. Each is filled with the same amount of water.



She also has two metal weights of the same volume. One weight is light. The other is heavy.

She lowers the light weight into jar 1. The water level in the jar rises and looks like this:



THE HEAVY WEIGHT IS LOWERED INTO JAR 2, WHAT WILL HAPPEN?

a. The water will rise to a higher level than in jar 1.
b. The water will rise to a lower level than in jar 1.
c. The water will rise to the same level as in jar 1.

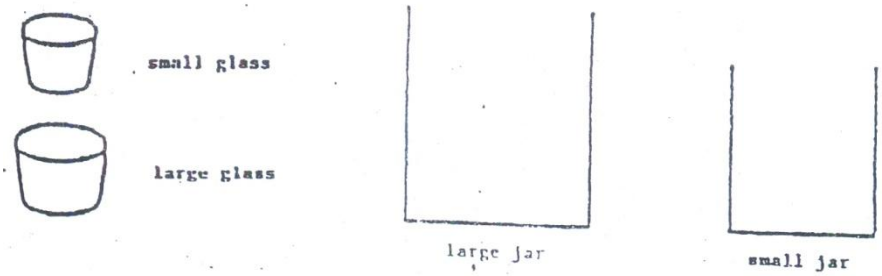
REASON

1. The weights are the same size so they will take up equal amounts of space.
2. The heavier the metal weight, the higher the water will rise.
3. The heavy metal weight has more pressure, therefore the water will rise lower.
4. The heavier the metal weight, the lowerthe water will rise.

Item 3

Glass Size #2

The drawing shows two glasses, a small one and a large one. It also shows two jars, a small one and a large one.



It takes 15 small glasses of water or 9 large glasses of water to fill the large jar. It takes 10 small glasses of water to fill the small jar.

HOW MANY LARGE GLASSES OF WATER DOES IT TAKE TO FILL THE SAME SMALL JAR?

a. 4

b. 5

c. 6

d. other

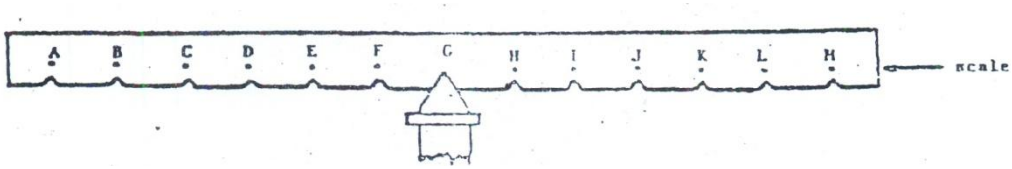
REASON

1. It takes five less small glasses of water to fill the small jar. So it will take five less large glasses of water to fill the same jar.
2. The ratio of small to large glasses will always be 5 to 3.
3. The small glass is half size of the large glass. So it will take about half the number of small glasses of water to fill up the same small jar.
4. There is no way of predicting.

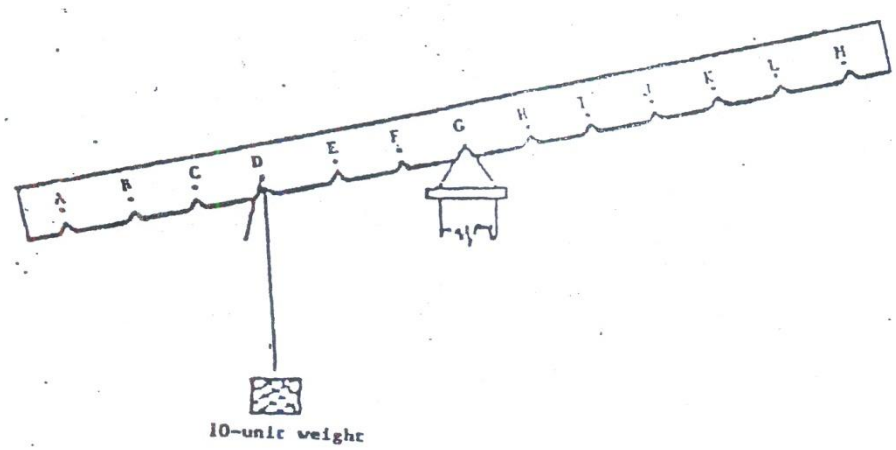
Item 4

Scale #1

Joe has a scale like the one below.



When he hangs a 10-unit weight at point D, the scale looks like this:



WHERE WOULD HE HANG A 5-UNIT WEIGHT TO MAKE THE SCALE BALANCE AGAIN?

a. at point J

b. between K and L

c. at point L

d. between L and M

e. at point M

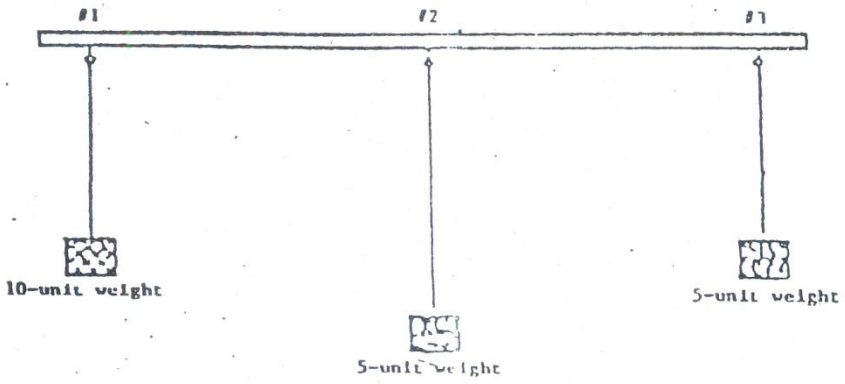
REASON

1. It is half the weight so it should be put at twice the distance.
2. The same distance as 10-unit weight, but in the opposite direction.
3. Hang the 5-unit weight further out, to make up its being smaller.
4. All the way at the end gives more power to make the scale balance.
5. The lighter the weight, the further out it should be hung.

Item 5

Pendulum Length

Three strings are hung from a bar. String #1 and #3 are of equal length. String #2 is longer. Charlie attaches a 5-unit weight at the end of string #2 and at the end of #3. A 10-unit weight is attached at the end of string #1. Each string with a weight can be swung.



Charlie wants to find out if the length of the string has an effect on the amount of time it takes the string to swing back and forth.

WHICH STRING AND WEIGHT WOULD HE USE FOR HIS EXPERIMENT?

a. string #1 and #2
b. string #1 and #3
c. string #2 and #3
d. string #1, #2, and #3
e. string #2 only

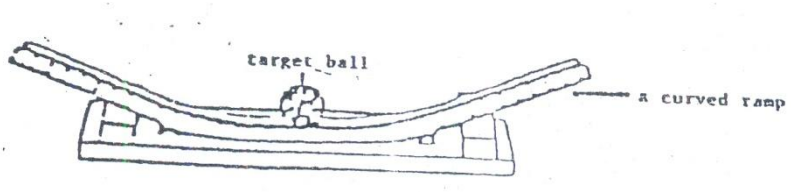
REASON

1. The length of the strings should be the same. The weights should be different.
2. Different lengths with different weights should be tested.
3. All strings and their weights should be tested against all others.
4. Only the longest string should be tested. The experiment is concerned with length not weight.
5. Everything needs to be the same except the length so you can tell if length makes a difference.

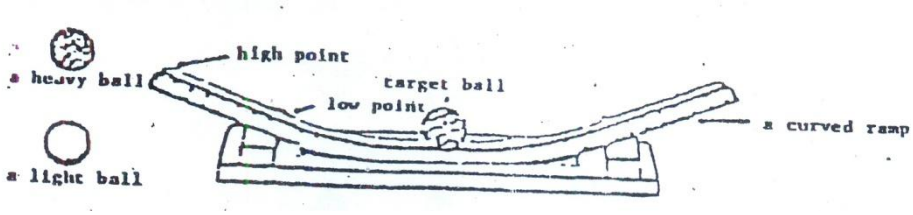
Item 6

Ball #1

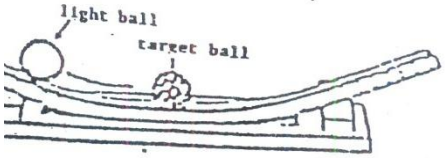
Eddie has a curved ramp. At the bottom of the ramp there is one ball called the target ball.

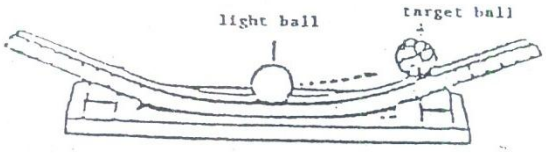


There are two other balls, a heavy and a light one. He can roll one ball down the ramp and hit the target ball. This causes the target ball to move up the other side of the ramp. He can roll the balls from two different points, a low point and a high point.



Eddie released the light ball from the low point. It rolled down the lamp. It hit and pushed the target ball up the other side of the ramp.





He wants to find out if the point a ball is released from makes a difference in how far the target goes.

TEST THIS WHICH BALL WOULD HE NOW RELEASE FROM THE HIGH POINT?

a. the heavy ball
b. the light ball

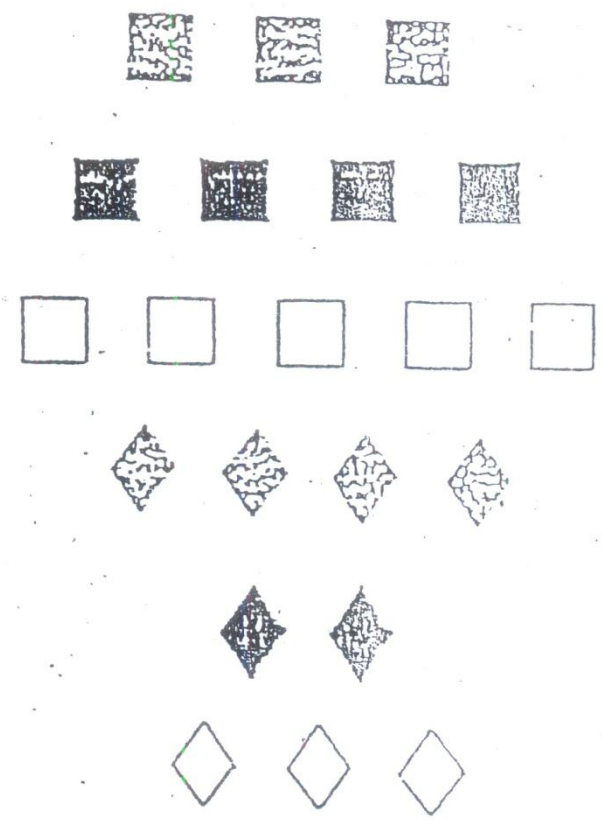
REASON

1. He started with the light ball he should finish with it.
2. He used the light ball the first time. The next time he should use the heavy ball.
3. The heavy ball would have more force to hit the target ball farther.
4. The light ball would have to be released from the high point in order to make a fair comparison.
5. The same ball must be used as the weight of the ball does not count.

Item 7

Squares and Diamonds #1

In a cloth sack, there are



3 spotted wooden squares

4 black wooden squares

5 white wooden squares

4 spotted wooden diamonds

2 black wooden diamonds

3 white wooden diamonds

All of the square pieces are the same size and shape. The diamond pieces are also the same size and shape. One piece is pulled out of the sack. WHAT ARE THE CHANCES THAT IT IS A SPOTTED PIECE?

a. 1 out of 3
b. 1 out of 4
c. 1 out of 7
d. 1 out of 21
e. other

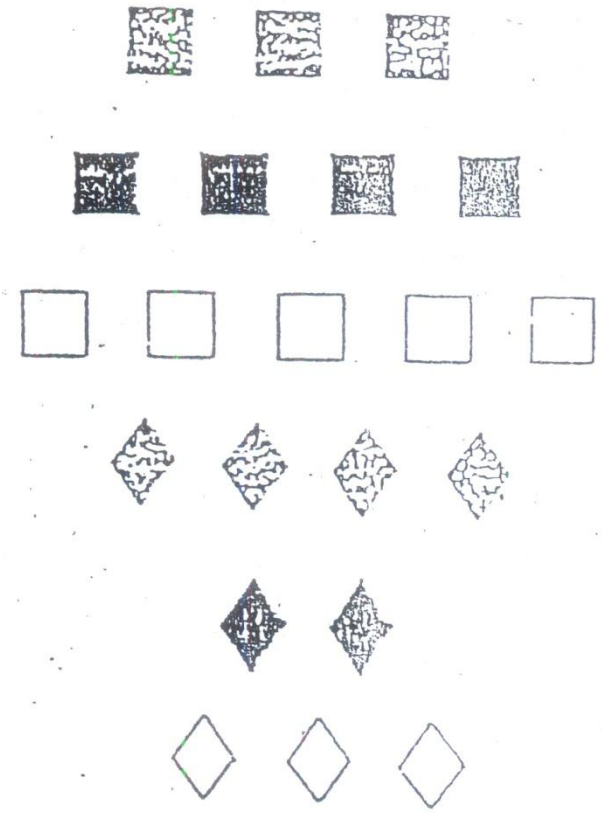
REASON

1. There are twenty one pieces in the cloth sack. One spotted piece must be chosen from these.
2. One spotted piece needs to be selected from a total of seven spotted pieces.
3. Seven of the twenty-one pieces are spotted pieces.
4. There are three sets in the cloth sack. One of them is spotted.
5. 1/4 of the square pieces and 4/9 of the diamond pieces are spotted.

Item 8

Squares and Diamonds #2

In a cloth sack, there are



3 spotted wooden squares

4 black wooden squares

5 white wooden squares

4 spotted wooden diamonds

2 black wooden diamonds

3 white wooden diamonds

All of the square pieces are the same size and shape. The diamond pieces are also the same size and shape. Reach in and take the first piece you touch.

WHAT ARE THE CHANCES OF PULLING OUT A SPOTTED DIAMOND OR A WHITE DIAMOND?

a. 1 out of 3
b. 1 out of 9
c. 1 out of 21
d. 1 out of 21
e. other

REASON

1. Seven of the twenty-one pieces are spotted or white diamonds.
2. 4/7 of the spotted and 3/8 of the white are diamonds.
3. Nine of the twenty-one pieces are diamonds.
4. One diamond piece needs to be selected from a total of twenty-one pieces in the cloth sack.
5. There are 9 diamond pieces in the cloth sack. One piece must be chosen from these.

Item 9

The Mice

A farmer observed the mice that live in his field. He found that the mice were either fat or thin. Also, the mice had either black tails or white tails.

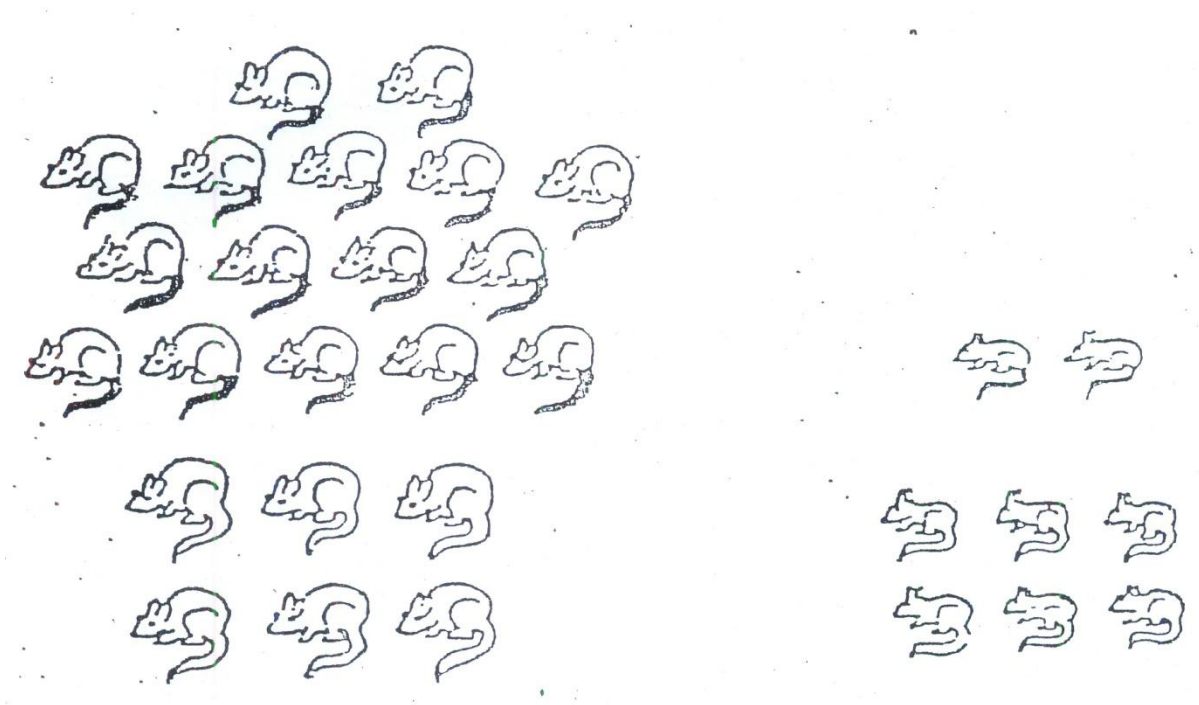
This made him wonder if there might be a relation between the size of a mouse and the color of its tail. So he decided to capture all of the mice in one part of his field and observe them. The mice that he captured are shown below.

DO YOU THINK THERE IS A RELATION BETWEEN THE SIZE OF THE MICE AND THE COLOR OF THEIR TAILS (THAT IS, IS ONE SIZE OF MOUSE MORE LIKELY TO HAVE A CERTAIN COLOR TAIL AND VICE VERSA)?

a. Yes
b. No

REASON

1. 8/11 of the fat mice have black tails and 3/4 of the thin mice have white tails.
2. Fat and thin mice can have either a black or a white tail.
3. Not all fat mice have black tails. Not all thin mice have white tails.
4. 18 mice have black tails and 12 have white tails.
5. 22 mice are fat and 8 mice are thin.



Item 10

The Fish

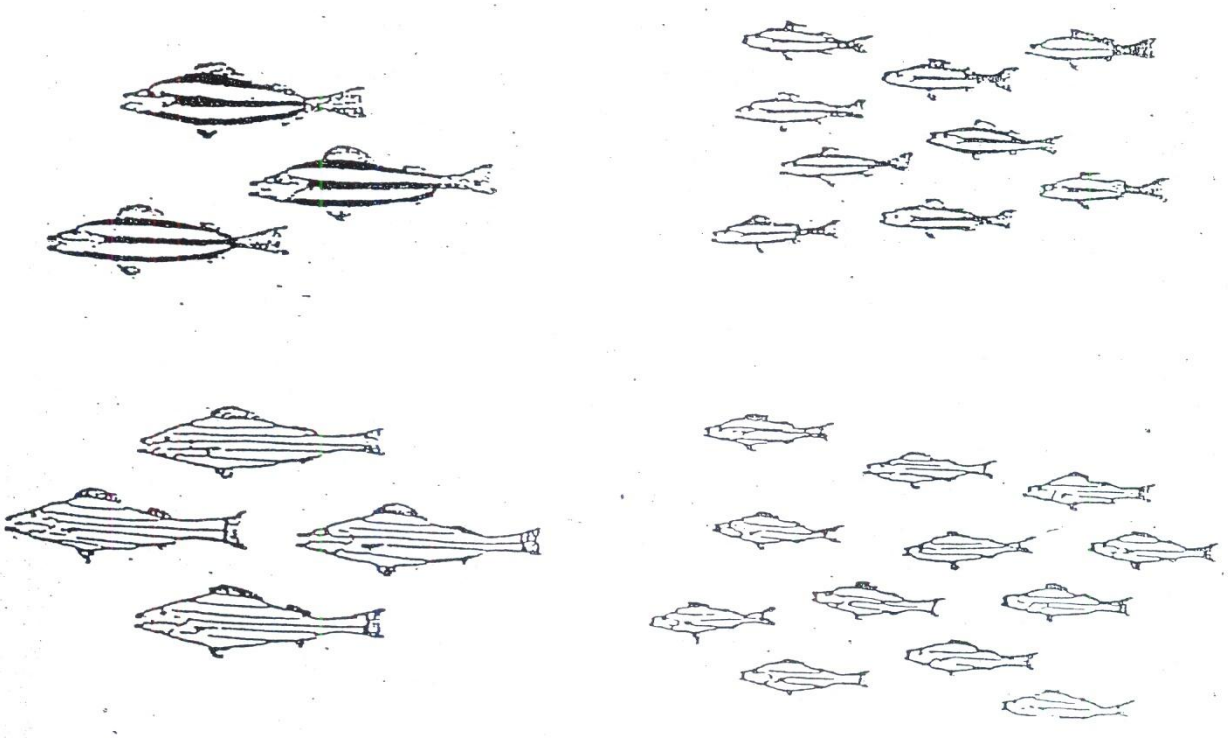
Some of the fish below are big and some are small. Also some of the fish have wide stripes on their sides. Others have narrow stripes.

IS THERE A RELATIONSHIP BETWEEN THE SIZE OF THE FISH AND THE KIND OF STRIPES IT HAS (THAT IS, IS ONE SIZE OF FISH MORE LIKELY TO HAVE A CERTAIN TYPE OF STRIPES AND VICE VERSA)?

a. Yes
b. No

REASON

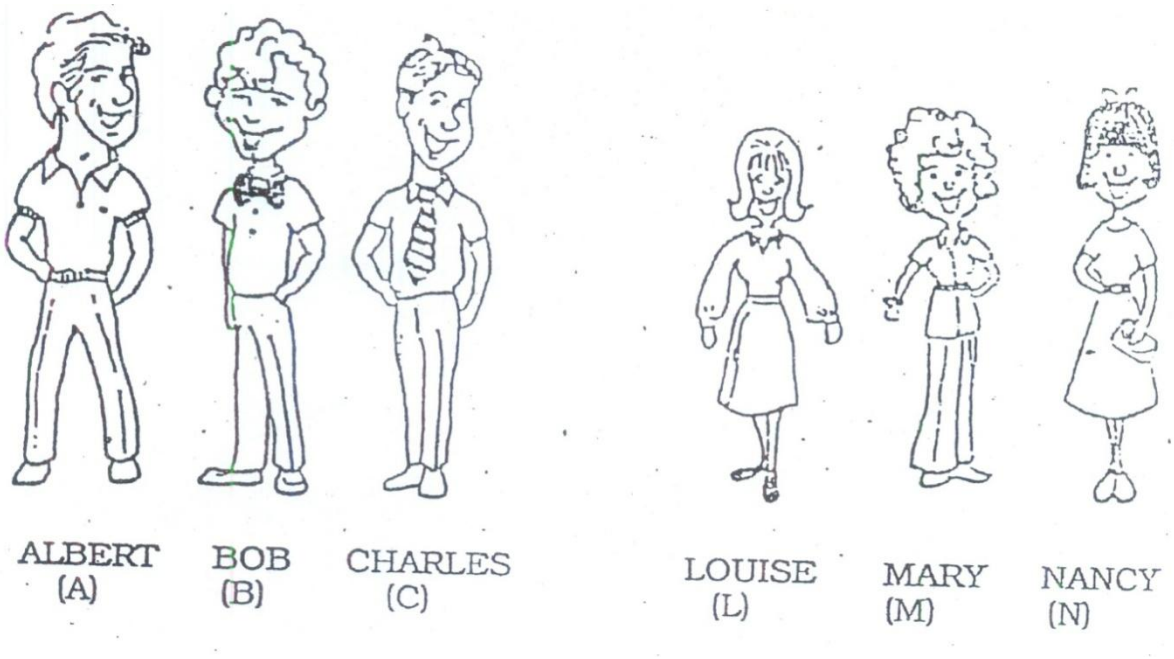
1. Big and small fish can have either wide or narrow stripes.
2. 3/7 of the big fish and 9/21 of the small fish have wide stripes.
3. 7 fish are big and 21 are small.
4. Not all big fish have wide stripes and not all small fish have narrow stripes.
5. 12/28 of fish have wide stripes and 16/28 of fish have narrow stripes.



Item 11

The Dance

After supper, some students decide to go dancing. There are three boys: ALBERT (A), BOB (B), and CHARLES (C), and three girls: LOUISE (L), MARY (M), and NANCY (N).



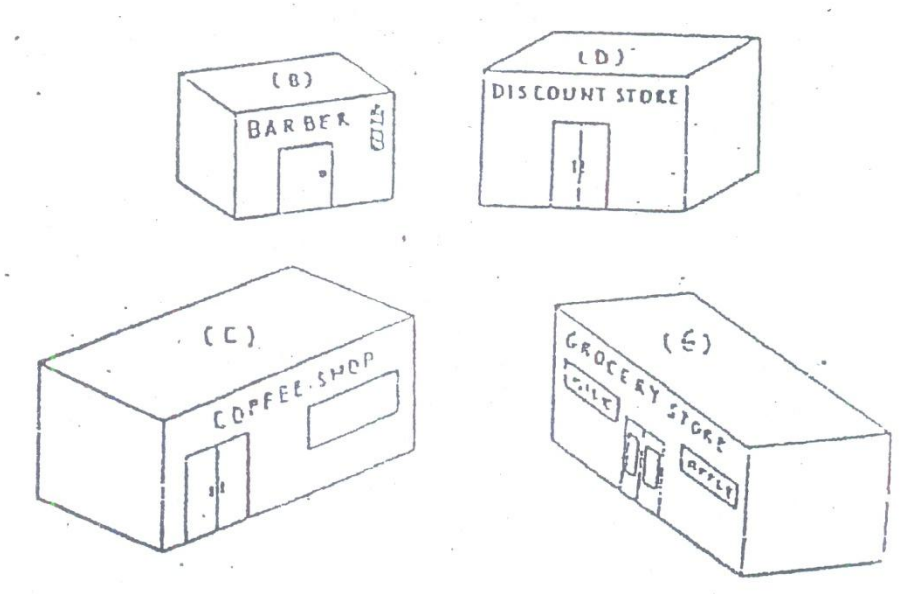
One possible pair of dance partners is A-L, which means ALBERT and LOUISE.

LIST ALL OTHER POSSIBLE COUPLES OF DANCERS. BOYS DO NOT DANCE WITH BOYS, AND GIRLS DO NOT DANCE WITH GIRLS.

Item 12

The Shopping Centre

In a new shopping center, 4 stores are going to be placed on the ground floor. A BARBER SHOP (B), a DISCOUNT STORE (D), a GROCERY STORE (G), and a COFFEE SHOP (C) want to locate there.



One possible way that the stores could be arranged in the 4 locations is BDGC. Which means the BARBER SHOP first, the DISCOUNT STORE next, then the GROCERY STORE and the COFFEE SHOP last.

LIST ALL THE OTHER POSSIBLE WAYS THAT THE STORES CAN BE LINED UP IN THE FOUR LOCATIONS.

APPENDIX C

GROUP ASSESSMENT OF LOGICAL THINKING (GALT)

MARKING SCHEME

1.	A	(1 Reason)	6.	B	(4 Reason)
2.	C	(1 Reason)	7.	A	(3 Reason)
3.	C	(2 Reason)	8.	A	(1 Reason)
4.	E	(1 Reason)	9.	A	(1 Reason)
5.	C	(5 Reason)	10.	B	(2 Reason)

TOTAL = 10 Marks

NOTE:

- One mark for each correct option and correct reason.
- No mark for correct option and wrong reason.
- No mark for wrong option and correct reason.

11.	AL	BL	CL
	AM	BM	CM
	AN	BN	CN

NOTE:

- One mark for the above correct combinations.
- One mark for **ONLY** one mistake.
- No mark for two or more mistakes.

12. **B D G C**

BDGC	CBDG
BGDC	CBGD
BCDG	CDBG
BGCD	CDGB
BDCG	CGBD
BCGD	CGDB
DBGC	GBDC
DBCG	GBCD
DGBC	GDBC
DGCB	GDCB
DCBG	GCBD
DCGB	GCDB

(24 Combinations)

NOTE:

- One mark for the above correct combinations.
- One mark for **ONLY** one mistake.
- No mark for two or more mistakes.

APPENDIX D

CHEMISTRY SELF-EFFICACY INSTRUMENT FOR CHEMISTRY STUDENTS

School:

……

Sex: Male: …….. Female: ……

Age:……Class: ……

This survey contains 15 statements about your confident in doing things related to chemistry. For each question, think about how confident you would be in carrying out a given task. There is no right or wrong answers. These are just your own thoughts and feeling about these statements for each statement in the survey, circle the letter next to each question. The examination has nothing to do with your result. All information you will provide will be regarded as highly confidential and will be treated as such.

A. if you are TOTALLY CONFIDENT that you can do the task.

B. if you are VERY CONFIDENT that you can do the task.

C. if you are FAIRY CONFIDENT that you can do the task.

D. if you are ONLY A LITTLE CONFIDENT that you can do the task.

E. if you are NOT AT ALL CONFIDENT that you can do the task.

Practice item.

How confident are you that you could give a presentation of how hydrogen gas is prepared in the laboratory? suppose that you were ‘’fairy confident’’ that you could give a presentation about how hydrogen gas in the laboratory. You would circle the letter ‘’C’’ in the box next to the question. Thank you for your participation.

1. How confident are you that after reading an article about chemistry experiment, you can write a summary of its main points?	A	B	C	D	E
2. How confident are you that after reading an article about chemistry experiment, you could explain its main ideas to another person?	A	B	C	D	E
3. How confident are you that after watching a television documentary dealing with some aspect of chemistry, you could write a summary of its main points?	A	B	C	D	E
4. How confident are you that you will be successful in this chemistry course?	A	B	C	D	E
5. How confident are you that after watching a television documentary dealing with some aspect of chemistry you	A	B	C	D	E

could explain its main ideas to another person?					
6. How confident are you that you will be successful in every branch of chemistry course you are doing?	A	B	C	D	E
7. How confident are you that after listening to a public lecture regarding some chemistry topics, you could write a summary of its main points?	A	B	C	D	E
8. How confident are you that you would be successful in an organic chemistry course?	A	B	C	D	E
9. How confident are you that you could analyze a set of data (i.e. look at the relationship between variables)?	A	B	C	D	E
10. How confident are you that after listening to a public lecture regarding some chemistry topics, you could explain its main ideas to another person?	A	B	C	D	E
11. How confident are you that you could tutor another student for this chemistry course you are doing?	A	B	C	D	E
12. How confident are you that you would be successful in physical chemistry course?	A	B	C	D	E
13. How confident are you that you could ask a meaningful question that could be answered experimentally	A	B	C	D	E
14. How confident are you that you could explain something that you learned in this chemistry course to another person?	A	B	C	D	E
15. How confident are you that you could use a scientific approach to solve a problem at home?	A	B	C	D	E

APPENDIX E
DESCRIPTIVE STATISTICS OF MALE AND FEMALE

```
CORRELATIONS
  /VARIABLES=temint tresability tsefficacy ChemistryAtest
  /PRINT=TWOTAIL NOSIG
  /STATISTICS DESCRIPTIVES
  /MISSING=PAIRWISE.
```

Correlations

Descriptive Statistics

	Mean	Std. Deviation	N
total emotional intelligence	130.18	32.401	152
total reasoning ability	4.53	1.675	152
total self efficacy	34.32	9.657	152
ChemistryAtest	47.95	8.432	152

Correlations

		total emotional intelligence	total reasoning ability	total self efficacy	ChemistryAtest
total emotional intelligence	Pearson Correlation	1	.698**	.728**	.803**
	Sig. (2-tailed)		.000	.000	.000
	N	152	152	152	152
total reasoning ability	Pearson Correlation	.698**	1	.659**	.797**
	Sig. (2-tailed)	.000		.000	.000
	N	152	152	152	152
total self efficacy	Pearson Correlation	.728**	.659**	1	.851**
	Sig. (2-tailed)	.000	.000		.000
	N	152	152	152	152
ChemistryAtest	Pearson Correlation	.803**	.797**	.851**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	152	152	152	152

**. Correlation is significant at the 0.05 level (2-tailed).

APPENDIX F
DESCRIPTIVE STATISTICS OF MALE

```
CORRELATIONS
  /VARIABLES=ChemistryAtest temint tresability tsefficacy
  /PRINT=TWOTAIL NOSIG
  /STATISTICS DESCRIPTIVES
  /MISSING=PAIRWISE.
```

Correlations

[DataSet1] C:\Users\umar\Documents\Amos Kwasau's Data.sav

sex = male

Descriptive Statistics[a]

	Mean	Std. Deviation	N
ChemistryAtest	47.49	8.301	89
total emotional intelligence	129.60	34.121	89
total reasoning ability	4.45	1.752	89
total self efficacy	33.67	9.546	89

a. sex = 1 male

Correlations[a]

		ChemistryAtest	total emotional intelligence	total reasoning ability	total self efficacy
ChemistryAtest	Pearson Correlation	1	.804**	.800**	.813**
	Sig. (2-tailed)		.000	.000	.000
	N	89	89	89	89
total emotional intelligence	Pearson Correlation	.804**	1	.701**	.682**
	Sig. (2-tailed)	.000		.000	.000
	N	89	89	89	89
total reasoning ability	Pearson Correlation	.800**	.701**	1	.614**
	Sig. (2-tailed)	.000	.000		.000
	N	89	89	89	89
total self efficacy	Pearson Correlation	.813**	.682**	.614**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	89	89	89	89

**. Correlation is significant at the 0.05 level (2-tailed).

a. sex = 1 male

APPENDIX G
DESCRIPTIVE STATISTICS OF FEMALE

```
CORRELATIONS
  /VARIABLES=ChemistryAtest temint tresability tsefficacy
  /PRINT=TWOTAIL NOSIG
  /STATISTICS DESCRIPTIVES
  /MISSING=PAIRWISE.
```

Correlations

[DataSet1] C:\Users\umar\Documents\Amos Kwasau's Data.sav

sex = female

Descriptive Statistics[a]

	Mean	Std. Deviation	N
ChemistryAtest	48.60	8.637	63
total emotional intelligence	131.00	30.054	63
total reasoning ability	4.63	1.569	63
total self efficacy	35.24	9.816	63

a. sex = 2 female

Correlations[a]

		ChemistryAtest	total emotional intelligence	total reasoning ability	total self efficacy
ChemistryAtest	Pearson Correlation	1	.810**	.796**	.899**
	Sig. (2-tailed)		.000	.000	.000
	N	63	63	63	63
total emotional intelligence	Pearson Correlation	.810**	1	.693**	.807**
	Sig. (2-tailed)	.000		.000	.000
	N	63	63	63	63
total reasoning ability	Pearson Correlation	.796**	.693**	1	.728**
	Sig. (2-tailed)	.000	.000		.000
	N	63	63	63	63
total self efficacy	Pearson Correlation	.899**	.807**	.728**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	63	63	63	63

**. Correlation is significant at the 0.05 level (2-tailed).

a. sex = 2 female

APPENDIX H
DESCRIPTIVE ANALYSIS OF ONE WAY MANOVA

```
GET
  FILE="C:\Users\umar\Documents\Amos Kwasau's Data.sav".
DATASET NAME DataSet1 WINDOW=FRONT.
GLM ChemistryAtest temint tresability tsefficacy BY sex
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(.05)
  /DESIGN= sex.
```

General Linear Model

[DataSet1] C:\Users\umar\Documents\Amos Kwasau's Data.sav

Between-Subjects Factors

		Value Label	N
sex	1	Male	89
	2	Female	63

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.979	1744.140[a]	4.000	147.000	.000
	Wilks' Lambda	.021	1744.140[a]	4.000	147.000	.000
	Hotelling's Trace	47.460	1744.140[a]	4.000	147.000	.000
	Roy's Largest Root	47.460	1744.140[a]	4.000	147.000	.000
sex	Pillai's Trace	.010	.380[a]	4.000	147.000	.822
	Wilks' Lambda	.990	.380[a]	4.000	147.000	.822
	Hotelling's Trace	.010	.380[a]	4.000	147.000	.822
	Roy's Largest Root	.010	.380[a]	4.000	147.000	.822

a. Exact statistic

b. Design: Intercept + sex

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	ChemistryAtest	45.351[a]	1	45.351	.636	.426
	total emotional intelligence	72.766[b]	1	72.766	.069	.793
	total reasoning ability	1.269[c]	1	1.269	.450	.503
	total self efficacy	90.225[d]	1	90.225	.967	.327
Intercept	ChemistryAtest	340652.562	1	340652.562	4780.272	.000
	total emotional intelligence	2505075.450	1	2505075.450	2371.401	.000
	total reasoning ability	3044.216	1	3044.216	1080.466	.000
	total self efficacy	175178.120	1	175178.120	1877.850	.000
sex	ChemistryAtest	45.351	1	45.351	.636	.426
	total emotional intelligence	72.766	1	72.766	.069	.793
	total reasoning ability	1.269	1	1.269	.450	.503
	total self efficacy	90.225	1	90.225	.967	.327
Error	ChemistryAtest	10689.327	150	71.262		
	total emotional intelligence	158455.438	150	1056.370		
	total reasoning ability	422.626	150	2.818		
	total self efficacy	13992.979	150	93.287		
Total	ChemistryAtest	360271.000	152			
	total emotional intelligence	2734353.000	152			
	total reasoning ability	3538.000	152			
	total self efficacy	193143.000	152			
Corrected Total	ChemistryAtest	10734.678	151			
	total emotional intelligence	158528.204	151			
	total reasoning ability	423.895	151			
	total self efficacy	14083.204	151			

a. R Squared = .004 (Adjusted R Squared = -.002)

b. R Squared = .000 (Adjusted R Squared = -.006)

c. R Squared = .003 (Adjusted R Squared = -.004)

d. R Squared = .006 (Adjusted R Squared = .000)