UNIVERSITY OF CAPE COAST

CAUSES, EFFECTS AND MANAGEMENT OF SCIENCE ANXIETY

AMONG SENIOR HIGH SCHOOL STUDENTS IN OLD TAFO

MUNICIPALITY OF GHANA

BY

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Philosophy Degree in Guidance and Counselling

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DECLARATIONS

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.
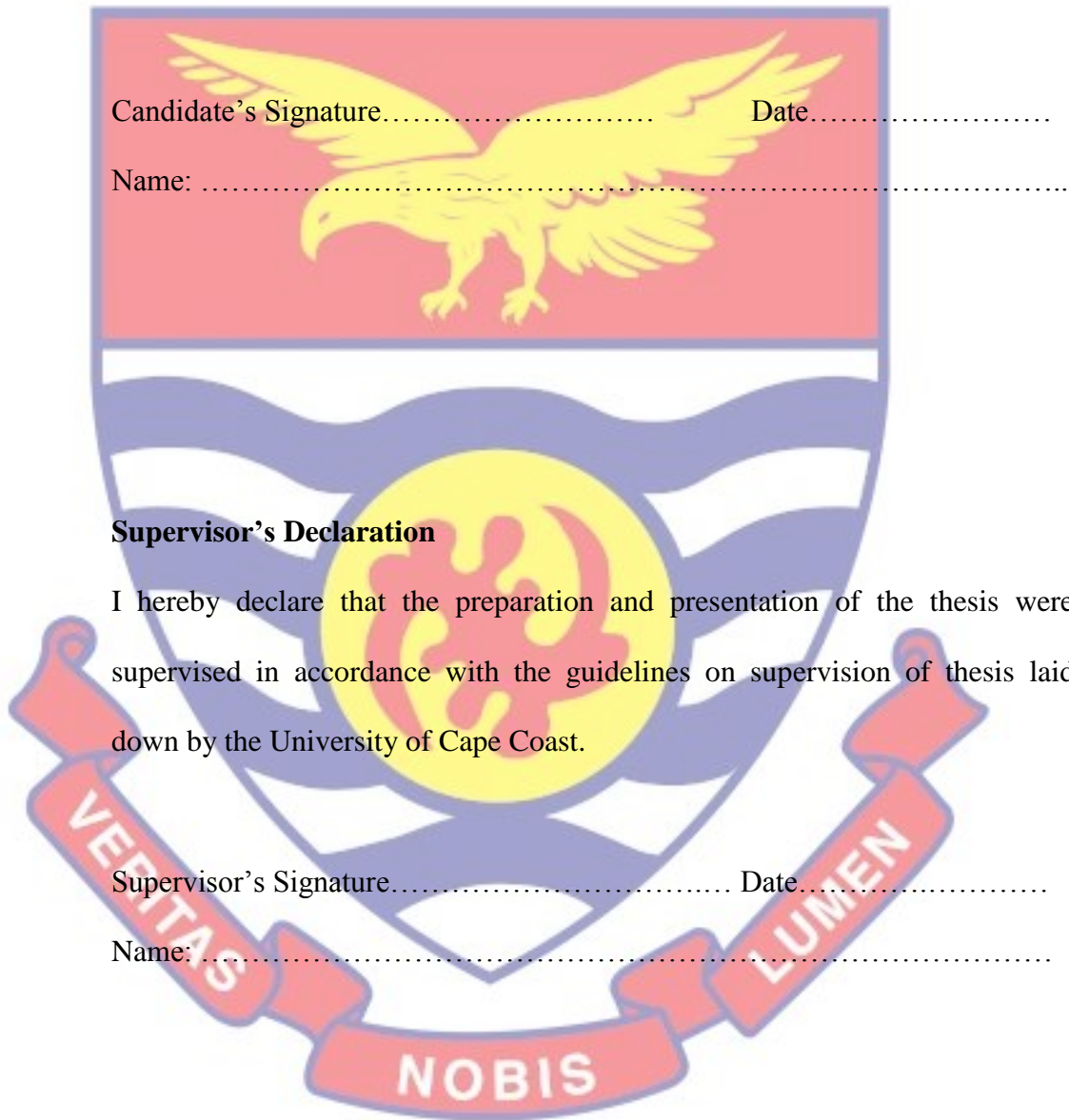
Candidate's Signature……………………… Date……………………

Name: ………………………………………………………………………..

Supervisor's Declaration

I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

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Name: ………………………………………………………………………

ABSTRACT

The study investigated causes, effects and management of science anxiety among senior high school students in the Old Tafo Municipality of the Ashanti Region of Ghana. The descriptive survey research design was adopted. The sample was made up of 337 students selected from a population of 2700 students from Osei Kyeretwie Senior High School and Al Azhariya Islamic Senior High School, using stratified random sampling procedure. Data were collected through Science Anxiety Scale (Güzeller & Doğru, 2012) and analysed using descriptive and inferential statistics. The study revealed that the respondents had moderate level of science anxiety in relation to doing science homework, getting low position in class, the attitude of the science teacher, entering science class and solving problems related to science. The study also revealed that the causes of science anxiety revolve around the demands of the content and the lack of infrastructure and teaching materials to make the content practical and easy to understand. The study showed that science anxiety affects performance negatively, reduces interest of students in science, prevents students from pursuing science subjects in future and affects school attendance. Finally, the strategies which can help reduce science anxiety included providing facilities and infrastructure and teachers making the study of science easier and interesting. From the findings, it was recommended that school counsellors in various schools should conduct science anxiety assessments for their students to identify the level of science anxiety of individual students so that measures can be taken to assist individual students.

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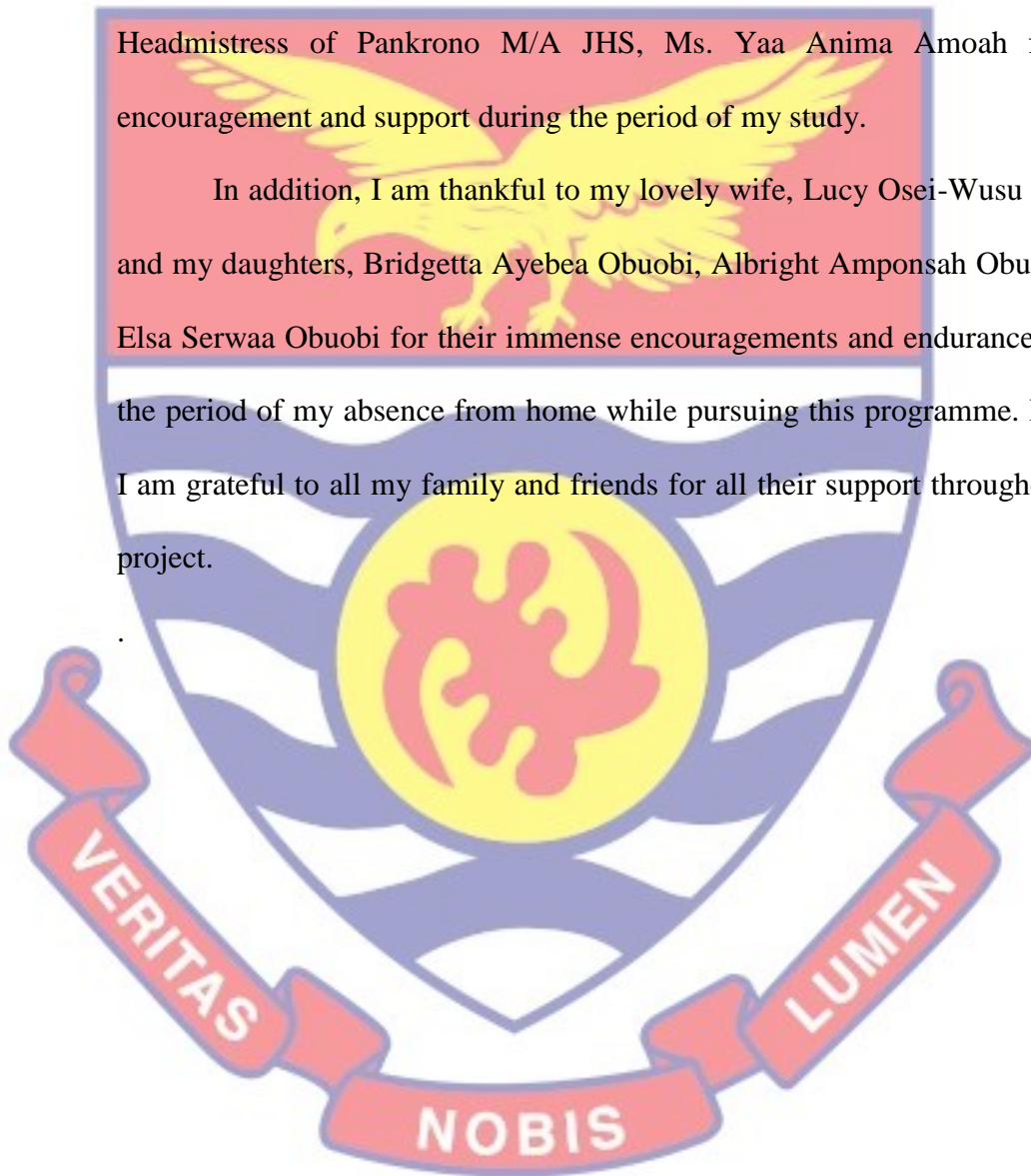
DEDICATION

To my lovely wife and daughters.

TABLE OF CONTENTS

LIST OF TABLES

x

LIST OF FIGURES

xi

CHAPTER ONE

INTRODUCTION

Schools in general can be stressful for children due to increased academic demand and additional obligations (Misra & McKean, 2000), and science classes have been found to be especially demanding for some students (Hanson, 2009; Koul, Roy & Lerdpornkulrat, 2012). The intensity and difficulty of science-related materials is a significant source of anxiety among students (Mallow, 2006; Udo, Ramsey & Mallow, 2004). The experience of science anxiety is able to affect the overall performance of students (Dede & Yaman, 2008). This study therefore investigated the causes, effects and management of science anxiety among students in senior high schools in the Old Tafo Municipality of the Ashanti Region of Ghana. This chapter dealt with the background to the study, statement of the problem, purpose of the study, research hypothesis, significance of the study, delimitations of the study, limitations of the study, definition of terms and organisation of the study.

Background to the Study

Science Education provided at the Senior High School is very important since it prepares the individual student to a higher level in education to become a valuable person and to fit well into the Society in all spheres of life. Teaching science therefore provides students with science experiences that give them enough opportunities for precise and rightful observation and to draw conclusions from adequate evidence. It is therefore important to develop concepts that are in line with the aims of teaching science curriculum, skills and habit that are vital in dealing with everyday problems of personal and

1

social living (Britner, 2010). However, it seems that students at the senior high school level experience anxiety in science subject whenever a lesson is going on, when students are writing class test, and also writing their final West African Secondary School Certificate Examination (WASSCE). Mallow (2006) asserts that science anxiety appears to be a substantial barrier for students in science education.

Many students perceive science to be a difficult topic to master, which hinders their performance in science. Science is recognized as an important course that enhances students' cognitive growth and increases their inventiveness (Mallow, 2006). Due to the voluminous nature of content of science, it puts students off from developing interest in the subject and sometimes leads them to develop negative attitudes towards it. In addition, it demands practical or experimental work which makes students not to like or have interest in the subject. Dede and Yaman (2008) stated that Science anxiety is one major element which affects the accomplishments of students in Science. According to Oludipe and Awokoya (2010), Science anxiety is a disruptive scenario that occurs as a result of a person's reaction to events that threaten their self-esteem, such as scientific investigations. According to some studies, students with scientific anxiety are scared of pursuing science courses and fields connected to science (Raymond, 2003; Udo, Ramsey & Mallow, 2004).

Moreover, science courses are very competitive and can create "chilly," even "hostile" situations, which can lead to increased anxiety among students (Wyer, Barbercheck, Geisman, Ozturk & Wayne, 2001). In some situations, most students after being admitted to pursue science programmes

opt not to pursue it again because of science anxiety. Science anxiety is described as emotions of tension and stress that obstruct the interest and generation of scientific knowledge, the advancement of scientific skills and capabilities, and the application of scientific information and abilties in a wide range of everyday and academic settings (Udo, Ramsey & Mallow, 2004) and can negatively impact cognitive processing (Britner, 2010). In fact, science anxiety can decrease one's interest, zeal and commitment towards science subjects, and possibly have negative impact on the individual student.

In the field of science both male and female students experience science anxiety sometimes even when lessons are in progress. However, some studies have proven that gender differences in science anxiety varies on the basis of science subjects or courses and science self-efficacy therefore science courses such as "Life Science", "Earth Science" and Physics could be studied independently (Britner, 2008; Lau & Roeser, 2002). Some studies have revealed that female students generally experience higher level of science anxiety than male studies (Mallow, 1994; Udo, Ramsey, Reynolds–Alpert & Mallow, 2001; Udo, Ramsey & Mallow, 2004).

Several personal factors such as motivation determine whether a student will like science subjects or courses. If both intrinsic and extrinsic motivation is not there, the student will not have the urge to have the interest in the science subject. Motivation is widely used word that encompasses several categories such as goal-directed acts, intrinsic and extrinsic satisfaction, and self-efficacy beliefs, and it defines people's objectives, wishes, and the reasons that guide their behaviours (Eccles & Wigfield, 2002) and emotions (Frederickson, 2004). Thus, the absence of motivation makes the

3

study of science a difficult task for students. There have been several other causes of science anxiety including being taught by a teacher who does not have enough confidence, lack of positive role models, uncomfortable past experience with Science and negative stereotypes associated with people in Science (Mallow & McDermott, 1988; Ali, 2015).

Globally, numerous studies have shown that anxiety and poor attitudes often inhibit students' engagement in the teaching and learning process, lowering their performance and success levels in Science (Eysenck, 2001; Osborne, Simon & Collins, 2003; Masson et al., 2004; Jegede, 2007). In Africa, similar reports have been made that science anxiety is prevalent among students and affects the performance of students in science in a very negative sense (Woldeamanuel, Atagana & Engida, 2013). It is evident that science anxiety can cause students not to take part in science lessons, cause students to be truants and even drop out from school. As a researcher, I see the need to research into what actually causes students at the senior high school level to be anxious about science subject.

In dealing with science anxiety among students, several measures have been found to be effective. For instance, Saravanan and Kingston (2014) revealed that psychological interventions can help reduce the extent of science anxiety among students. Such interventions could include "cognitive restructuring" (Frojan–Parga, Calero–Elvira & Mantano–Fidalgo, 2009); "relaxation techniques" (Payne & Donaghy, 2010) and "social skills training" (Sheldon, 1998). Other interventions include "assertiveness training" and "problem-solving skills" (O'Donoghue, 2003); "systematic desensitization" (Sharf, 2012); and "reinforcement", "modeling" and "role–plays" (Sutton &

4

Barto, 1998). Cooper, Downing and Brownell (2018) also revealed that creating more active science classes by implementing active learning strategies can help minimize students' anxiety.

Several authors, both local and international have noted that science anxiety tends to be a persistent problem for students in the contemporary learning institutions (Ezeokana, Obi-Nwosu, & Okoye, 2014; Gömleksiz & Yuksel, 2003). This is affecting students' academic pursuit in science negatively. In most instances, students enter into the examination hall with fear and anxiety for science paper resulting in poor performance in the subject (Gasa, 2011). Mallow (1994) argued that science anxiety is a disturbing blend of worry and stress that occurs while studying science. Panic, anxiety, helplessness, dread, anguish, embarrassment, difficulty coping, sweaty palms, difficulty with breath and a loss of capacity to focus have all been demonstrated to impede science accomplishment (Seligman-Walkman, Walker & Rossenhan, 2001).

Science anxiety is still a severe canker for many students, affecting their academic performance negatively (Yusuf, 2012). Several second cycle students lost interest in science education and are unable to further their education to a higher level because of the inability to overcome their anxiety in the subject. This problem has long been in existence and this needs to be addressed (Kaya & Yildirim, 2014). Most of the students who pursue science courses in one way or the other, drop out of the course and this has been reported to be partly due to their anxiety of the subject.

In recent times, there has been a great interest in improving science and technology education in Ghana. This has been a major part of the

5

education agenda of the government of Ghana. Speaking at the 4th Ghana Science Olympiad, the Deputy Minister of Education, Reverend Ntim Fordjour indicated the government is putting in place tenable measures to have a 60:40 science to humanities students' ratio (Quaicoe, 2021). Thus, the government of Ghana aims to improve the number of students pursuing the study of science. The Deputy Minister stressed that Ghana has just about 12% of students at the pre-tertiary level participating in STEM education, which has to be turned around (Quaicoe, 2021). In achieving this, the government has been investing in science facilities while at the same providing more training to teachers and other educational stakeholders to equip them in improving science education (Winn, 2022).

Overall, it is clear that Science is an important subject for several career paths. Despite this, the disinterest of students in science which is mainly due to the level of science anxiety has been seen to be very common among students in senior high schools (Woldeamanuel, Atagana & Engida, 2013). All the anxiety issues can affect performance negatively and having a dent on the academic lives of students and their future career paths (Woodley, 2004). It is therefore essential that all stakeholders of education do their best to ensure that students do not continue to avoid the study of science (Jegede, 2003).

Statement of the Problem

There have been several studies which have found science anxiety to be common among senior high school students. For instance, Agboola and Evans (2015) found science anxiety to be common in the UK. Similar results were found by Singh (2015) as well as Shibli (2015). These reports on science anxiety imply that students may struggle to perform in science. Even though

these studies are foreign they did not really address the causes of science anxiety. This presented a gap that the current study addresses.

In Ghana, a search through literature showed that there are a few studies on Science anxiety among senior high school students. In spite of this, it is a common knowledge that students have a sense of fear of science programmes in senior high schools. In senior high schools in the Old Tafo Municipality as well as several municipalities and districts in the Ashanti region, there has been lack of interest of students in science (Adu-Gyamfi, 2013). Adu-Gyamfi revealed that students' lack of interest in school science has been caused by higher demands of students' time in learning science, less practical nature of science teaching and learning, too broad nature of science content, and seeing science to be difficult subject compared to others. These problems are not peculiar to the Old Tafo Municipality and Ashanti Region, but common to most parts of Ghana (Abreh, Owusu & Amedahe, 2018).

The lack of interest in science and the difficulties experienced create some anxiety towards the study of science which can affect performance of students in science (Bostani, Nadri & Nasab, 2014; Singh, 2015). The performance of students in science in Ghana has been found to be poor in recent times (Nyabor, 2019). This is not different for senior high schools in the Old Tafo Municipality and Ashanti Region as a whole (Adu-Gyamfi, 2013). In spite of this, it appears there is no study exploring the level of anxiety of students in science. By identifying issues relating to science anxiety, recommendations can be made to assist students overcome science anxiety and thus improve performance in the subject. This is because excessive anxiety

7

towards a subject can affect students' performance negatively (Vitasari, Abdul-Wahab, Othman & Awang, 2010).

Purpose of the Study

The purpose of the study was to examine the causes, effects and ways of reducing science anxiety among Senior High School (SHS) students in the Old Tafo Municipality of the Ashanti Region of Ghana.

Objectives of the study

Specifically, the study sought to:

1. Identify the extent of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana,

2. Explore the causes of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana,

3. Examine the effects of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana,

4. Identify measures that can help reduce science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana,

5. Find out the difference in the level of science anxiety between male and female SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana, and

6. Find out if age affects the level of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana.

Research Questions

The following research questions guided the study:

1. What is the extent of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana?

2. What are the causes of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana?

3. What are the effects of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana?

4. Which measures can help reduce science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana?

Hypotheses

The following hypotheses were tested in this study:

$H_0 1$:   There is no significant difference in the level of science anxiety   of male and female SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana.

$H_1 1$:   There is a significant difference in the level of science anxiety   of male and female SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana.

$H_0 2$:   Age does not significantly affect the level of science anxiety among SHS students in the Old Tafo Municipality in the   Ashanti Region of Ghana.

$H_1 2$:   Age significantly affects the level of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana.

Significance of the Study

The results of the study will be significant in several ways. Firstly, the results will bring to light issues relating to science anxiety in senior high schools which can help the Ghana Education Service and Ministry of Education in their plans and policies to improve the study of Science in Ghana. Secondly, the results of the study will enlighten science teachers about

9

science anxiety among students. Such knowledge will equip teachers with the knowledge required to assist students to deal with science anxiety. Finally, the results of the study will serve as reference for future research.

Delimitation of the Study

The study was delimited in its coverage. Specifically, the study covered the causes and effects of science anxiety as well as measures to reduce science anxiety among senior high school students. Aside these issues, the study examined the differences in science anxiety of students on the basis of gender and age. Finally, the study focuses on senior high school students in the Old Tafo Municipality in the Ashanti Region of Ghana.

Limitations of the Study

The study was limited in some ways. Students may not have the opportunity to express themselves freely since the study used only a questionnaire in collecting the data. Thus, it was likely that the data obtained may not have enough depth as would have been obtained through an interview. Also, the focus on senior high schools in the Old Tafo Municipality in the Ashanti Region of Ghana means that the results may not be generalized beyond the population of the study.

Definitions of terms

The key terms used in this study are defined operationally in this section.

Anxiety: A sensation of worry, uncertainty, or uneasiness regarding an uncertain conclusion.

Science Anxiety: Tension and stress can negatively influence cognitive processing by interfering with the creation of science knowledge, the development of science skills and abilities, and the application of science

10

information, skills, and abilities in a range of everyday and academic circumstances.

Organisation of the Study

The study has five chapters. Chapter one presents the background to the study, statement of the problem, purpose of the study, research questions, research hypotheses, significance of the study, delimitation, limitation and definition of terms.

Chapter two reviews literature related to the study. It covers the theoretical framework, conceptual frame work and the empirical review. Chapter three gave a detailed outline of the research methods that was used in the study. It covers the research design, study area, population, sample and sampling procedures, data collection instrument, data collection procedures and the data processing and analysis.

Chapter four focuses on the results and discussion of the study. Finally, Chapter five deals with the summary of research findings, conclusions, recommendations, implications for counselling and suggestions for further studies.

11
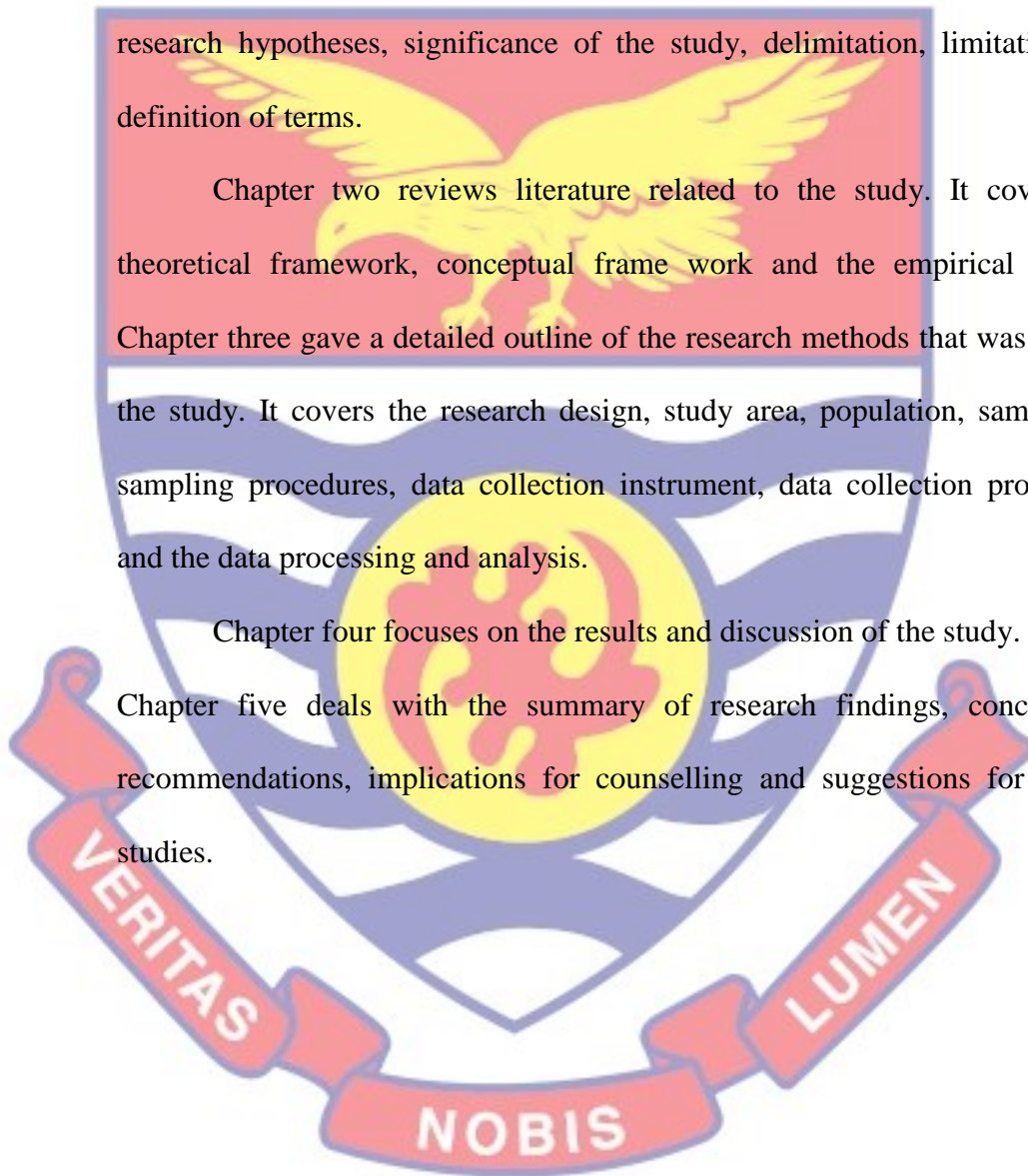
CHAPTER TWO

LITERATURE REVIEW

The purpose of the study was to examine the causes, effects and ways of managing science anxiety among senior high school students in the Old Tafo Municipality in the Ashanti Region of Ghana. This chapter presents the literature review of the study. The review is done under three main sub-areas. These are the theoretical framework, conceptual frame work and the empirical review.

Theoretical Framework of the Study

In this part of the study, some theories related to the study were reviewed. The theories include Cognitive Behavioural Therapy (CBT), Rational Emotive Behaviour Therapy (REBT) and Rachman's Theory of Fear. These theories are discussed in detail in this section.

Cognitive Behavioural Therapy (CBT)

Cognitive Behavioural Therapy (CBT) propounded by Aaron T. Beck in 1964 underpinned the current study. The theory was founded on the relationship between thoughts, emotions and behaviour. Cognitive Behavioural Therapy (CBT) is a form of psychological therapy that dwells on the cognitive, in the expression of emotions and behaviours. The theory hinges most on maladaptive feelings and behaviours that develop through cognitive processes which comes from the interactions in the environment (Beck, 2004). The main objective of CBT is to recognize the maladaptive cognitive process and to identify new route of perceiving and thinking about issues which could lead to more positive behaviour and emotional responses (Beck, 2011). Cognitive Behavioural Therapy involves several kinds of approaches that have

or share similar theoretical foundations. These approaches comprise Rational Emotive Behaviour Therapy, Dialectical Behaviour Therapy, Rational Behaviour Therapy, Rational Living Therapy, Cognitive Therapy and Schema Focused Therapy (Turner & Swearer, 2010). The CBT is also a psychotherapy founded on Social Learning Theory, which stresses how our thoughts interact with our feelings and actions. It is assumed that when a person is depressed, anxious, or angry, these stresses are sustained by exaggerated or biased thinking patterns, and that these patterns may be changed by lowering erroneous and maladaptive beliefs (Teater, 2010).

The CBT goes on to say that it is people's interpretation of a situation, not the situation itself, which influences how they feel. The way individuals perceive circumstances, rather than the situations themselves, determines how they feel (Beck, 2005). As individuals learn to assess their ideas in a realistic and flexible manner, their emotional states and actions improve (Rector & Beck, 2001). Modification of underlying dysfunctional beliefs results in long-term transformation in CBT.

Cognitive Behavioural Therapy seeks to reduce psychological discomfort and dysfunction by finding out which thoughts and feelings contribute to the issues of the individual (Teater, 2010). Its objective is to change and replace negative or distorted ideas, attitudes, and behaviours with positive and appropriate ones in order to alleviate the situation at hand (Teater, 2010).

13

Assumptions of CBT

CBT has some basic assumptions. Rector and Beck (2001) outline the following:

1.   People may exert control over how they feel and think about their inner ideas and beliefs, as well as how they are influenced on the outside.

2.   Clients dysfunctional thinking can be derived from an erroneous internal process or bias.

3.   Cognitions affect and cause behaviour. Because how we understand events impacts how we react to them, it is our cognitions that cause behaviour.

4.   Cognitions are also not transitory, enigmatic processes; they can be monitored, measured, and changed. When adaptive behaviour and cognition are present, people's perceptions of the environment and of themselves can be altered.

5.   To achieve long-term behavioral change, it is critical to alter cognitions. When events and external effects on behaviour do not, cannot, or will not change, cognitive transformation is critical.

Relevance of CBT to the study

CBT is considered relevant in the study because it focuses on the thinking patterns of individuals. Using CBT to assist individuals who have issues, the thoughts and beliefs of the individual are assessed to find out the type of intervention that can help create a change in the individual. Such interventions could include cognitive restructuring, relaxation techniques and social skills training (Frojan–Parga, Calero–Elvira & Mantano–Fidalgo, 2009; Payne & Donaghy, 2010; Sheldon, 1998). Other interventions include

14

assertiveness training and skills in solving problems, systematic desensitization, reinforcement and other social learning techniques (O'Donoghue, 2003; Sharf, 2012; Sutton & Barto, 1998). By employing some of these interventions, the thoughts and beliefs of the individual can be altered thereby causing a positive change in the individual.

Since the current study focuses on the causes, effects and ways to assist students with science anxiety, CBT was considered relevant for the study. Also, in connection to the current study, it can be said that CBT can help reorient students in terms of their mentality, attitude and behaviour towards Science as a subject of study. For students who are afraid of science, CBT can help them adopt a different and more appropriate attitude towards science. This is connected to the behavioural element of CBT.

Rational Emotive Behaviour Therapy (REBT)

Albert Ellis created Rational Emotive Behaviour Therapy (REBT) in 1955. It claims that psychological issues and difficulties are caused by our interpretation of events rather than the events themselves. REBT aims to improve our mental health by replacing self-defeating beliefs with more positive ones. REBT focuses on helping people gain insight into the extent to which harmful thoughts and beliefs can lead to emotional discomfort creating unhealthy attitudes and behaviours which can affect an individual's life negatively. According to Ellis (2001), cognitive elements are a significant part of REBT. It is concerned with the client's irrational feelings and actions, as well as the thoughts that cause them. The theory assumes that, human beings have the capability to be both rational and irrational to act in their own best interest as well as to be self-destructive (Ellis, 2001). According to Ellis,

individuals tend to think, feel, and act simultaneously, therefore any intervention directed at one of this behavioural elements affects the other. Ellis viewed the rational behaviour effectively and potentially productive, whereas the irrational behaviour result in unhappiness and it is non-productive.

According to Ellis (2004), the theory is based on the idea that humans can think both rationally and irrationally. Self-preservation, self–actualization, communication with others, growth, loving and happy thinking and verbalizing are all predispositions. They are also prone to self-destruction, avoidance, thinking procrastination, repetitive repeating of mistakes, superstitions, intolerance, perfectionalism, self-blame, and avoidance of actualizing growth potentials, assuming that humans are flawed.

According to the notion, blame lies at the root of most emotional problems. As a result, in order to heal from neurosis or a personality disorder, one must cease blaming oneself and others. Instead, it is critical that people learn to accept themselves completely, flaws and all. Individuals have significant propensity to elevate their wishes and preferences into dogmatic demands and mandates, according to Ellis and Blau (1998) and Ellis and Harper (1997). It's a good idea to dig into people's concealed dogmatic "must" and absolutist "should" if they're unhappy. Disruptive sentiments and destructive behaviors result from such pressures (Ellis, 2001).

Corey (2009) gave the following assumptions of REBT:

1. Thoughts, emotions, and behaviours are always in conversation with one another and impact one another.

2. Emotional disorders manifest themselves in a complicated manner as a result of the interaction of environmental and biological elements.

3. Individuals are in charge of their own cognitive, emotional, and behavioral problems.

4. When people are confronted with adversity, they are more likely to form illogical views that are regarded dogmatic and consistent.

5. It is the individual's erroneous ideas about these occurrences, not the unpleasant events themselves, that lead to emotional collapse.

6. Many people have a remarkable proclivity for bringing themselves to emotional breakdown. As a result, individuals find it nearly hard to maintain their sanity.

7. People have the ability to see how their ideas have a detrimental impact on them. They will be able to discuss their illogical views and replace them with sensible ones once they recognize this. People can modify their bad emotions and disruptive behavior by changing their beliefs.

8. A mix of cognitive, emotional, and behavioural strategies can be used to debunk irrational ideas.

The ABCDE Model of REBT

According to Ellis (2001), REBT is based on the ABCDE model. It aids in the discovery of illogical ideas and gives a method for contesting them and replacing them with more sensible ones. The model's components are as follows:

A–Activating Event: An individual's unpleasant or unfavorable experiences.

B–Beliefs: The irrational beliefs that develop as a result of the stimulating event.

17

C–Consequences: The effects of one's views about the triggering event on one's emotions, behaviour, and cognition. Irrational ideas have negative psychological repercussions.

D–Disputes: REBT clients are trained to actively challenge their illogical ideas in order to remodel them into healthier ones.

E –Effect: The result of modifying one's belief about a circumstance to make it more adaptable and reasonable, which enhances one's emotions, behaviour, and cognition (Ellis, 2001).

From the model, while many people would blame the activating event (A) for the bad consequences (C), REBT reveals that it is the beliefs (B) that individuals construct about the activating event (A) that truly cause the consequences (C). As a result, it reveals the ideas that are crucial to affecting emotional, behavioral, and cognitive outcomes. For instance, supposing a person's significant other rejects him. This is the activating event (A), which is a reality of life to which an individual might react in a variety of ways. In this instance, the rejected individual develops the conviction (B) that he is unlovable and will never have another romantic connection since he was rejected. This notion has the unintended effect (C) of the guy never dating, being alone, and becoming progressively miserable and alone.

REBT employs a process called arguing to confront and reorganize an individual's illogical ideas after they have been revealed. If a guy who had been rejected by his significant other went to visit a REBT therapist, the therapist would refute the notion that he was unlovable. REBT practitioners engage with their clients to confront their irrational emotional and behavioral responses as well as their faulty cognitive processes concerning various

scenarios. Clients are encouraged to acquire new, healthier viewpoints by practitioners using methods such as guided imagery, meditation and journaling.
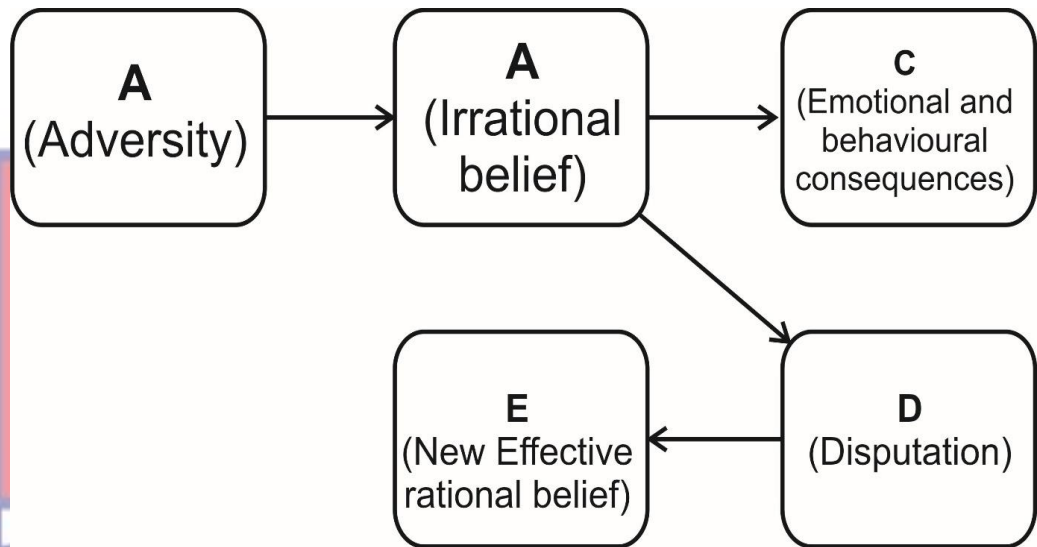
Figure 1: Diagram of the ABCDE framework used within the REBT process.

Source: The sport psychologist (TSP) Vol. 31, No.1, 2017.

In the ABCDE Model, change is possible when individuals gain three levels of insights. These insights are outlined by several researchers as fundamental in challenging irrational thinking to eliminate psychological dysfunction (Dryden, David & Ellis, 2010; Raypole, 2015).

Insight 1: Psychological disturbances are primarily caused by strict views about bad occurrences.

Insight 2: Individuals stay mentally distressed because they refuse to adjust their inflexible ideas.

Insight 3: People can only achieve psychological wellness if they strive hard to overcome their reasonable ideas. It is a practice that has to begin now and continue in the future.

19

Relevance of the REBT to study

REBT has been considered relevant in this study because the current study sought to investigate the causes, effects and ways of managing Science anxiety among students. This is founded on the assumption that REBT is concerned with how individuals' disturbed emotions and behaviours are caused by their thoughts and so these disturbed emotions and behaviours can be changed by disputing the thoughts that created them (Ellis, 2001). Since, REBT assumes that, human beings have the capability to be both rational and irrational to act in their own best interest as well as to be self-destructive, the theory has a close bearing on the focus of study in changing the thoughts of students so as to reduce their science anxiety.

Also, from the view of REBT it can be said that the anxiety that students have towards is mainly because of the thoughts and perceptions that they have about science. If a student perceives science to be difficult to study then he or she is likely to be anxious towards the science subject. In this sense, it can be indicated that REBT is relevant in the study.

Rachman's Theory of Fear

Rachman (1976) propounded a theory of fear. Rachman believed that the theory can only provide partial information on the etiology of fear. He proposed however that this theory was unable to explain why some individuals fail to develop fear in fear-generating circumstances and why there is an uneven distribution of fears in the fear facing population. This theory was also unable to explain the finding that fears could be developed vicariously or by receiving symbolic information (Rachman, 1998).

20

In a quest to answer such questions Rachman (1998) anticipated that there are three pathways regarding fear acquisition. These three pathways are vicarious acquisition, informational acquisition and classical conditioning. Numerous studies have supported Rachman's theory in which a high percentage of individuals link the emergence of their fear to a single or multiply pathways (Muris & Field, 2010). According to Ollendick (1979), most phobias and fears are determined by multiple factors.

Direct experience with the critical object is not the only way in which fears are learned. Observation of the emotional responses of other people to environmental events will often form the onlookers' reactions to these events. In an experiment, Venn (1970) exposed nursery-school-age children to a film, showing a 5-year-old male model scream and withdraw when the mother presented a plastic figure of Mickey Mouse; in response to another previously neutral stimulus a plastic figure of Donald Duck, the film model presents only a neutral reaction. A later test disclosed that the children avoided Mickey Mouse, the fearful stimulus, more than Donald Duck, the neutral stimulus. In this study, a classical conditioning had been achieved, but only through observation. A similar phenomenon may occur in other naturalistic situations as well. Parents, for example, may be unintentionally teaching their children to fear certain objects by showing marked fear themselves in the measure of the object. Studies have found that persons often have parents with the same fears. The transmission of fear-inducing information by parents and others is important in the acquisition of fears (Field, Lawson, & Banerjee, 2008; Hadwin, Garner & Perez-Olivas, 2006; McLeod, Wood, & Weisz, 2007).

21

Relevance of Rachman's Theory of Fear in the study

This theory is considered relevant in the current study because it attempts, albeit, not completely to explain some of the factors that can create fear in people. For instance, in the theory, it is shown that fear can be acquired vicariously by observing other people and through information. In this regard, some students may have science anxiety because of the experiences of other people in science and through what they are told by other people. In this regard, the theory gives a good explanation for science anxiety. Also, since the study addresses the causes of science anxiety, the theory was deemed appropriate.

Conceptual Framework of the Study

The conceptual framework of the study is shown in Figure 2. The framework is based on the key variables in the study.
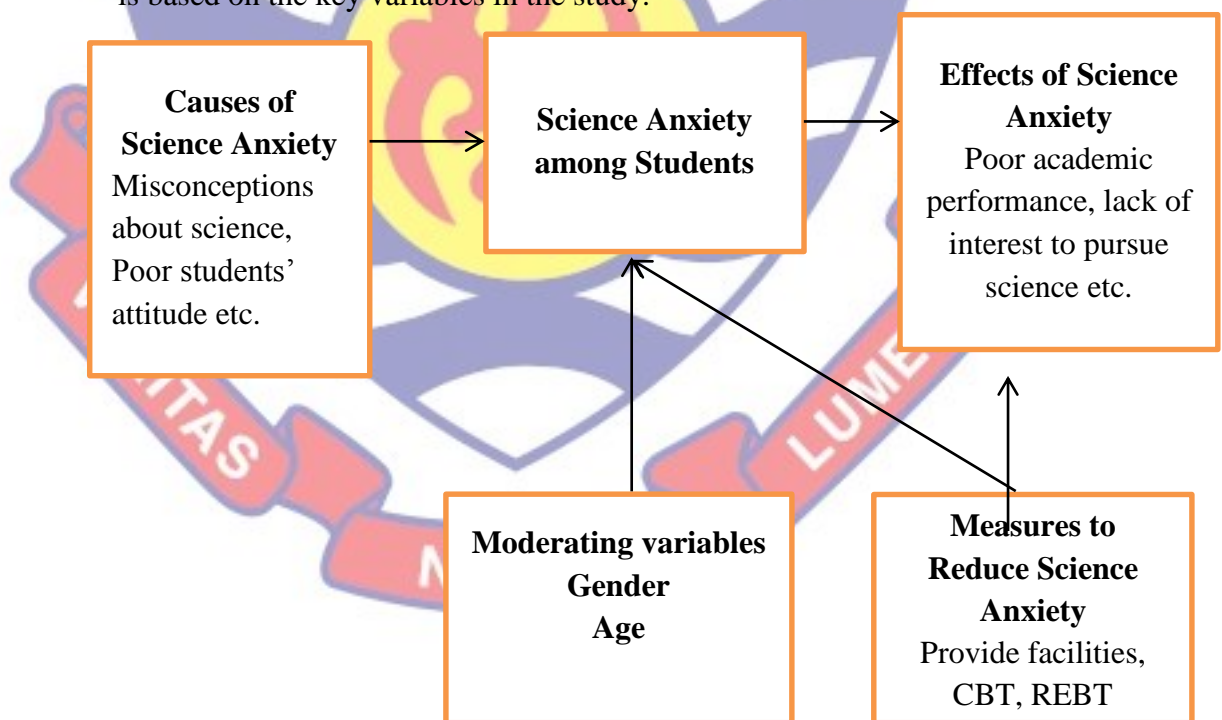
Figure 2: Conceptual Framework of Science Anxiety among Students

Source: Researcher's Construct

From Figure 2, it can be seen that science anxiety can be caused by several factors. Some of these factors can have to do with the misconceptions about science, poor attitude towards science, the teaching methods of teachers and the lack of facilities to aid in teaching. The level of science anxiety can have detrimental effects on students. The effects can particularly be in terms of their academic performance and their lack of desire to pursue science related programmes. It can also be seen in the conceptual framework that gender and age can moderate the experience of science anxiety. Finally, some interventions and measures can be outlined to help reduce the level of science anxiety among students. This is where the theories reviewed in the study are related to the framework. In reducing science anxiety, therapeutic approaches like CBT and REBT can be helpful. This framework therefore illustrates the current study.

Conceptual Review

The main concepts in the study are discussed in this section.

The Concept of Science Anxiety

Science anxiety is described as a sensation of stress and anxiety that makes it difficult to manipulate scientific equipment in a range of everyday and academic situations. In the view of Avci and Kirbaşlar (2017), science anxiety as an emotion of unease that comes when faced with scientific activities that are seen as damaging to one's self-esteem. Panic, tension, helplessness, anxiety, anguish, embarrassment, difficulty breathing, sweaty hands, anxious stomach, inability to cope and inability to concentrate are all symptoms of such sentiments. Students' concern about studying any science

23

topic leads to a reduction in interest in science at all stages of the educational system (Zhang & Tang, 2017).

Scientific anxiety has also surfaced as a significant barrier to learning for students in science classes (Mallow, 2006). Science anxiety is thus a dislike or fear of science, individuals who work in science and science-related tasks. Science anxiety, according to studies, stops people from achieving success in the area of science (Cheng & Wan, 2016; Kennedy, Quinn & Taylor, 2016). Most persons who had scientific anxiety as students carried it into adulthood with them, along with a slew of bad repercussions. Science anxiety, an issue deemed to be extremely serious, in science education also hinders people from pursuing careers in science-related fields (Potvin & Hasni, 2014).

Generally, any form of fear towards science-related conceptions, scientists, and science-based activities is known as science anxiety (Bryant, Kastrup, Udo, Hislop, Shefner & Mallow, 2013). To put it another way, it's a crippling combination of feelings (fear) and thoughts. This is caused by the link between students' emotions and their capacity to grasp the material (Udo, Ramsey, Reynolds-Alpert & Mallow, 2001). Students with science anxiety are often cool, composed and effective in non-science classes, such as mathematics courses, implying that science anxiety and mathematics anxiety are two distinct phenomena (Mallow, 2010; Kaya & Yildirim, 2014). Freeman et al. (2014) argue that children with scientific anxiety may perform well in other subjects, such as mathematics, but are so concerned about science classes that they are unable to function successfully in them. This concern over science courses eventually leads to fear and fright during science

examinations and, as a result, making students perform poorly in science disciplines or courses.

Causes of Science Anxiety

Science anxiety has consistently being a major problem for students who are pursuing science courses. It is a "love-hate" subject that stimulates strong emotions in students (Osborne, Simon & Collins, 2003). Development of interest in science therefore seems to be a significant and actual challenge. Science anxiety has been attributed to a lot of reasons.

One of the causes of science anxiety is students' attitude towards science subjects or courses. Attitudes can affect an individual student's academic progress by reinforcing greater or worse performance (Vilia & Candeias, 2020). Cooper, Downing and Brownell (2018) have opined that students' scientific accomplishments are linked to their attitudes toward science in a significant way. In this regard, pupils must be given a good attitude toward science, as well as scientific information, comprehension, and abilities (Ministry of National Education, 2005). The perception students have about science, that it is a difficult subject, is an attitude portrayed by students. This has created fear and worry for students over the years.

Another area of students' attitudes is not paying attention to the teacher whiles the teacher is teaching, failure to do homework or assignments, failure to take part in science lessons, low self-esteem in respect to science and lack of intrinsic motivation on the part of students. Only a good attitude can lead to a student performing well in science because positivity in terms of attitude generates interest which makes students committed to learn and achieve excellence in their academic work (Kennedy, Quinn & Taylor, 2016).

25

Another student's attitude toward science that causes science anxiety is the fear of test. This involves the fear of obtaining low grade and being a failure, response to science examinations such as being sad, sweating, crying, shaking and faster heartbeats (Kaya & Yildirim, 2014). Students also perceive science courses as unreasonable, disliking, boring and incomprehensible. Also, Science requires a lot of computation as well as memorization and reasoning which make it tiring for some students (Kaya & Yildirim, 2014).

Another cause of science anxiety is the teacher's attitude. A cause of anxiety for students is accessibility. If a teacher is not easy to approach, strict in his or her approach to teaching or relating with students may experience some form anxiety. If a teacher is inflexible, stern in discipline and shout at students in the course of lesson delivery, students will develop anxiety towards the subject (Mallow et al., 2010; Ulutan & Aktan, 2019). Students are also scared and this prevents them from answering or asking questions when the needs arise during instructional time. Moreso, the teacher's teaching style, skills, strategies and methodology can also cause anxiety among students. If a teacher's teaching style and methodology is not properly utilized in the course of teaching, this can make students unable to understand the concept the teacher is trying to put across. Wrong and incorrect method of teaching including lack of teaching skills can enhance student's science anxiety (Kaya & Yildirim, 2014; Mallow et al., 2010; Kennedy et al., 2016).

Teachers' Professional Development (PD) has foretold its relevance in the causes of science related anxiety. The teacher or facilitator plays a functionally significant part in the development of a student. It is therefore imperative to consider the training and professional development of such a

26

relevant stakeholder, teacher in the prepping of students in the area of science as microcosm of the educational fraternity.

Professional Development usually focuses on knowledge regarding the subject matter and pedagogical knowledge of teachers (Yangambi, 2021). In the view of Amiri (2021), teachers mostly report that they enjoy relevant Professional Development (PD) for their work. Additionally, Amiri claimed that teachers' attitudes about PD were influenced by their beliefs, backgrounds, social pressures, and practical realities, which have direct consequences on the tutoring of a student.

The traditional PD experience for science and mathematics instructors is not geared toward the needs of teachers. This reality is affected by several factors. To begin with, the investment in professional development has been minimal; schools spend just 1-3 percent of their operational budgets on professional development (Yangambi, 2021). In addition, Metzler and Woessman (2012) argued that equipping of teachers to be effective on delivery of their mandate efficiently requires spending wisely on the professional development of the teacher.

However, the majority of professional development sessions for teachers are fragmented and detached from real classroom work (Schmidt, Burroughs, Cogan & Houang, 2017). Finally, teachers usually consider Professional Development as having little influence on their ability to discharage their duties and as such, irrelevant and an abrupt waste of time (Prasetio, Azis, Fadhilah & Fauziah, 2017), but has dire consequences on the students under their tutelage.

27

Parents' attitude towards their wards is also another cause of science anxiety. The attention of parents is very important for students to be successful in science courses or subjects. The student is likely to be affected negatively if his or her parents do not care about his or her academic work and are unable to provide the necessary materials for academic work. Also, unpleasant classroom activities and bad perceptions about teachers can cause Science anxiety. Students may also experience anxiety during laboratory sessions since they are afraid of carrying out experiments (Kaya & Yildirim, 2014).

People also hold misconceptions about science itself and these myths contribute to science anxiety. One of these is that science is a rigid, linear, uncreative process. This is due to misunderstanding about the scientific method that is, a belief that this is the only way science is done, whereas science is a tremendously creative endeavour (Mallow, 2006). The procedural method known as the scientific method is the way science is reported rather than a lock-step method on how scientific knowledge is produced. Unluckily, one source of this misconception is traditional science instruction in schools, although some progress is being made in changing to a more constructivist, inquiry-oriented model (Edgecomb, Britner, McConnaughay, & Wolffe, 2008). Apart from this, many people also fail to distinguish between science and technology and attribute the negative or controversial aspects of technology as foiling of science, thus increasing their anxieties associated with science.

The Effect of Science Anxiety on Students

Largely, anxiety is a psychological and physiological disorder with physical, emotional, cognitive, and behavioural manifestations. When anxiety

is in its severe form there is possibility of some students experiencing genuine problems in their academic work. Science anxiety can prevent students or people from seeking a successful career (Potvin & Hasni, 2014). Studies carried out have proven that science courses with a high level of science anxiety produce low science performance, discourage students from contributing their educations in science-related fields, and impede their success in these fields (Cheng & Wan, 2016; Kennedy, Lyons & Quinn, 2014; Udo, Ramsey & Mallow, 2004). According to Vilia and Candeias (2020), anxiety has a negative impact on students in their classes. Students who are anxious are more likely to struggle in class. Students who have science anxiety tend to get low grade in science causes (Bati, Yetişir & Gunes, 2019).

In the study carried out by Mallow et al. (2010), it was shown that science anxiety nearly always leads to science avoidance, which has an influence on students' self-esteem as well as their capacity to make educated political decisions involving science and technology as adults. Kaya and Yildirim (2014) assert that science anxiety can have great adverse effect on the teaching and learning process in science classrooms. In addition, science anxiety can make students to lose interest in science courses or subject (Zhang & Tang, 2017).

Attempt is being made to reduce science anxiety but it is still prevalent among students and associated with number of negative consequences. These include low self-efficacy; low achievement in science; avoidance of science courses; and low numbers of students, especially among women and people of colour, preparing for science related careers (Britner, 2008; Mallow, 2006; Udo, Ramsey & Mallow, 2004). Anxiety in relation to science is common and

can obstruct with cognitive activities and lead people to avoid opportunities to participate in science-related activities (Britner, 2008).

In studying the effects of test anxiety on students, Akinsola and Nwajei (2013) advanced evidences that there was a substantial link between test anxiety and academic performance, and that test anxiety had a significant impact on test performance. Fear of exams and test scenarios was also shown to be widespread and becoming more common.

A research study was conducted by Kaya (2004), to ascertain the association between test anxiety and academic success among Turkish fifth-graders in elementary school. The nature of the association was revealed to be a negative one and as such it was clear that test anxiety had a detrimental influence on academic attainment. This means that students who had significant test anxiety had poor grades, while students who had less test anxiety had high grades.

Chapell et al. (2005) carried out a study which focused on "undergraduate and graduate students in terms of the relationship between test anxiety and academic performance". The "Test Anxiety Inventory (TAI)" was used to assess the association between test anxiety and student performance in science. The exam anxiety and performance of 101 students were assessed using their Grade Point Average (GPA). It was made known that for female students having low level of anxiety performed better in comparison with female students having high levels of anxiety. For male students, the performance of students with low and high exam anxiety was unaffected.

The impacts of test anxiety on student success were highlighted by Nicholson (2010). A total of "200 eleventh-grade students from a high school"

30

provided the data. The Test Anxiety Inventory was given to these students to measure their degrees of test anxiety. After analysis of data obtained through the studies, it was evident that test anxiety significantly influenced the academic performance of students.

Ways of Managing Science Anxiety

The following are some of the interventions to assist students with Science anxiety:

Science skills learning

It is a way of using science skills used in learning science in order to reduce anxiety. These skills include how science is studied as opposed to history or literature, organising and solving problems in science, taking notes in scientific classrooms, performing well in science laboratories, and taking science tests and examinations.

Cognitive restructuring

It is a psychological strategy used to reduce anxiety on the basis of the realization that issues relating to physics and chemistry laboratories are not anxiety-inducing by nature. Rather, they serve as triggers for kids to make negative self-statements (mostly unconscious, like, "No matter how hard I study, I will never understand science." "Science is not for girls," "Everyone understands but me". Some of these negative-statements are the actual triggers that cause worry. Cognitive restructuring is a method for students to notice their damaging self-assertions, centres on the illogical assumptions that underpin them, and substitute them with independent, dispassionate and emotionally neutral statements "coping statements" (Ellis, 2010).

31

Systematic desensitization

This is a behavioural modification approach that teaches pupils to relax their bodies in situations that cause anxiety. Progressive relaxation and desensitization to anxiety caused by the individual's own self can have two domains. Progressive relaxation entails teaching pupils to relax a wide range of muscle groups in response to a command from a physical facilitator or an audiotape. Students study these techniques and engage them in their houses to develop a "science anxiety hierarchy": This can be a list of roughly "10–12 science-related events", ranked from low to high in terms of anxiety. Typically, events that elicit low anxiety would be "You look through your science textbook". On the other hand, events that elicit medium anxiety may be "You read a chapter and you can't relate it to the class teacher". Events that bring about high levels of anxiety could be "You look at the exams and can't think of how to solve any of the problems". The instructor instructs the students to engage in relaxing their muscles at each session, then present two or three of the activities, beginning with the least relaxing and measuring whether the relaxation is sustained. Before the facilitator moves on to the next higher item, this must be completed. In 4–6 weeks, a 12-item hierarchy may be finished.

Developing or enhancing co-operative learning among students

Cooperative learning is an A method of education that permits small groups of pupils to work together on a similar project. Because students can interact on a wide range of themes, the settings change regularly, from easy to complex tasks. Students are held accountable for their individual roles in the task at times, and as a group at other times. Co-operative learning when

32

applied as a strategy can be used to reduce science anxiety among students (Oludipe & Awokoy, 2010). Students have more influence over their learning via co-operative learning, which leads to a better grasp of the material (Oludipe & Awokoy, 2010). In co-operative learning the emphasis is on the group and this decreases students' anxiety in science. Co-operative learning brings positive interdependence, social skills, group processing, individual and group accountability and deeper learning among students.

Increasing self-efficacy of students

Self-efficacy is viewed as the trust and confidence in an individual's ability to accomplish a goal or obtain a desired result. Self-efficacy, according to Chowdhury (2021), is the belief in one's own talents and capabilities. Students who had a high feeling of efficacy have the high likelihood to set ambitious goals for themselves and to be naturally driven. As a result, they are likely to exert greater effort in engaging in specific tasks. Students who have high self-efficacy recover fast from failures, and have high likelihood to accomplish their own goals in the long run. Contrary to this, students with low self-efficacy, feel they will fail and are have a low likelihood to put up a deliberate, persistent effort, and may regard difficult assignments as dangers to be evaded (Kaya & Bozdag, 2016). Therefore, students with low self-efficacy have low goals, which can lead to poor academic achievement, creating a self-fulfilling feedback loop (Kirbulut & Uzuntiryaki-Kondakci, 2019).

According to Chowdhury (2021), the self-efficacy of students can be improved in some ways. For instance, through the mastery of experiences, self-efficacy can be improved. Our degree of achievement has a big impact on how we think about ourselves. When you successfully accomplish a work, you

33

gain confidence and have high likelihood to embark on similar undertakings in the time to come. Self-mastery requires the capacity to regulate success expectations and accept failure constructively in order to build effectiveness. Also, through vicarious experiences, self-efficacy can be improved. Thus, students seeing others around them succeed can motivate them to believe they can succeed too. These can be helpful in improving self-efficacy towards science.

Parents providing needed academic materials and support

According to Gwija (2016), the roles of parents in education can include paying school fees, purchasing learning materials for the child, interacting with the school, preparing school uniform, helping a child with homework, taking part in school activities which have a bearing on performance of their children, and having high level of expectations for children to pursue. The parental role entails parental support for the school, as well as any activity that has an impact on a child's current or future circumstances within or out of the classroom. The involvement of parents in education is linked to a variety of improved school performance across all academic levels, including a wide range of achievement pointers and the development of student qualities that assist academic progress (Sule, 2017). From these, it is evident that parental support can help students in their study of science and as such reducing science anxiety.

Teachers changing their teaching methods to aid students

Regularly, teachers essentially relate the majority of students' low academic performance to the use of inadequate teaching techniques, which has a significant influence on learners' knowledge (Adunola, 2011). In most

34

situations, the performance of students gives an indication of whether the teaching process was effective and if the teaching methods were appropriate. According to Ayeni (2011, p. 144), "teaching is a process that involves generating desired changes in learners in order to achieve certain outcomes". Adunola (2011) argued that instructors must be knowledgeable with a diversity of teaching techniques that understand the scale of complexity of the topics to be taught so as to be effective in the process of teaching.

According to a report by Walden University (2017), there is a growing need for teachers to involve children in science topics so as to enable them perceive themselves as scientists and engineers rather than passively watching others conduct science work. It's all about giving children opportunity to observe science in action rather than simply reading about it in textbooks. Specifically, problem-based learning, infusing technology in the teaching and learning process and project-based learning are some of the teaching procedures that instructors may utilize to promote science.

Schools providing the needed learning materials to make the learning of science easier

According to Yeboah, Abonyi and Luguterah (2019), teaching and learning aids are instructional materials. They are products that aid in the transition of teaching and learning from verbal to practical, ensuring that learning is more real and relevant to students (Okobia, 2011). This means they aid in the concretization of notions, abstractions, and thoughts in the teaching and learning activities (Olawale, 2013). Instructional resources, in the view of Yildirim (2008), are supporting factors that make teaching and learning simple, vibrant, and fascinating, enhance the education setting, encourage

35

learning, and communicate materials in a simple manner to students. They include any tangible tools that a teacher could utilize to provide teaching and assist students in meeting their learning objectives (Sule, 2017). In the process of teaching and learning, instructional resources are critical. This is very particular in the study of science. Therefore, to reduce science anxiety, it is imperative that the needed resources are provided. This will make the teaching and learning of science easier.

The usage of instructional materials allows the instructor to convey abstract topics in a practical way, allowing students to understand what they are being taught more simply (Johnson, Johnson & Smith, 2014). Teachers' horizons are therefore broadened by instructional resources, which provide them with a rich source of communicative resources for teaching and learning (Olawale, 2013; Saglam, 2011). Using instructional tools aids students in understanding things that are too tiny or too large, too slow or too quick due to time, space, and size constraints. Again, using instructional resources "reduces language limitations, saves time, allows teachers to employ a variety of teaching and learning approaches, and allows students to comprehend topics more effectively and quickly" (Olawale, 2013, p. 33).

Empirical Review

This section reviews previous related studies. The review is done under sub-headings.

Prevalence of Science Anxiety among Students

Science anxiety as an area of study has gained some level of attention in literature. Some of the studies, which focused on the rate of science anxiety among students, are discussed in this section. Cooper, Downing and Brownell

(2018) performed "an exploratory interview research with 52 students engaged in large-enrollment active learning college science classes". The effect of the active learning exercise on students' anxiety was influenced by how the activity was executed and how much benefit students perceived from it. Students, on the other hand, felt that being asked to speak at random enhanced their fear. The fear of negative assessment or the danger connected with being harshly assessed when engaging in a social context, was discovered to be the key component behind students' high levels of anxiety linked with science.

The study of Cooper et al. (2018) indicated that science anxiety was high and also showed how science anxiety was demonstrated among the students in their study. This is similar to the current study. However, Cooper et al. dealt with college students while the current study was focused on senior high school students.

Butt, Akram, Gulzar and Yahya (2013) also sought to find out the disparity in anxiety levels between pure scientific and social science students in Pakistan. Data was collected using a targeted sampling technique. Data was obtained from students in the 8th semester of Government College University Lahore, with a sample size of 200 (100 from social science and 100 from pure scientific departments). The participants were between the ages of 21 and 24. The findings of this study supported the notion that pure science students had higher levels of anxiety than social science students. The result further indicated that female students faced more anxiety than males. The study of Butt et al. (2013) was similar to that of the current study except that Butt et al. focused on college students while the current study was senior high school-based.

A study by AcarSesen and Mutlu (2014) sought to "determine and overcome undergraduates' science laboratory anxiety". The researchers developed the "Laboratory Anxiety Questionnaire (LAQ)" to collect data from 92 students, and focus group interviews were conducted to measure their level of lab anxiety. The findings pointed out that students' laboratory anxiety were linked to working with chemicals, particularly acids, utilizing laboratory equipment, laboratory mishaps, and mistakes. These were overcome after intervention. This study was more restricted to anxiety related to laboratory work while the current study was more general and comprehensive.

A study by Wahed and Hassan (2017) aimed at finding out "the prevalence of psychological mood disorders and its association with some factors in the study among science students". A cross-sectional survey of medical students at Fayoum University was undertaken. A short version of the "Depression, Anxiety, and Stress Scale-21 (DASS-21)" was used to measure propensity to psychological mood disorders. In all, 442 students took part in the research. Stress, anxiety, and depression were shown to be prevalent in varied degrees. Specifically, "higher stress and anxiety scores were significantly associated with female sex", "older age", and "BMI $\geqslant$ 25 kg/m^2". Also, "higher depression score was associated with increasing age, low socioeconomic standard and among students from different geographical areas". The researchers concluded that students in the sciences experience some level of anxiety. Even though the study of Wahed and Hassa was focused on university students, it still had a connection to the current study.

Further, Lewis (2015) analysed Responses to the State-Trait Anxiety Inventory (STAI) by "pre-service and in-service" teachers to measure their

levels of general anxiety and anxiety specific to teaching science. The aim of the research was to establish if "pre-service and in-service" teachers are concerned about teaching science. The participants in the pre-service group largely presented as science apprehensive, according to the research.

From the studies reviewed, it has been made clear that students experience a lot of anxiety in relation the study of science. From most of the studies reviewed, science anxiety was experienced at both secondary and university level of education. This means that science anxiety cuts across all levels of education.

Causes of Science Anxiety among Students

Several studies have explored the causes of science anxiety among students. Some of these studies are reviewed in this section. Kaya and Yildirim (2014) investigated the causes of scientific anxiety among failed students. Six ninth-grade kids who had failed their chemistry class made up the sample, which was chosen using criteria sampling. These students were interviewed in semi-structured interviews. Students' thoughts, experiences, and sentiments about chemistry classes were the focus of the interview questions. Students' level of anxiety in relation science was linked to unpleasant classroom activities, test anxiety, and views of chemistry, teacher attitudes, and parent attitudes, according to the data.

The study of Kaya and Yildirim (2014) was purely qualitative and their data were gathered using interview. However, the current study was purely quantitative. Regardless, the studies were similar in terms of content.

Also, Ajmal (2019) aimed at finding out "the anxiety factors among students of distance learning of Allama Iqbal Open University". The study's

39

sample included 322 Master of Education students who were chosen using a purposive sampling approach in this descriptive study. The research tool was a questionnaire that was based on a five-point Likert type scale. SPSS version 21 was used to calculate the mean score and the t-test. The findings revealed that variables such as gaps in the admissions process, book supply, projects, tutorials, and student support services caused anxiety among the students. Male students had somewhat higher overall mean values for all anxiety categories as compared to female students. It was shown that anxiety had a considerable impact on distance learners' academic performance. It was suggested that the university provide counselling and behavioural approaches to help students manage their academic anxiety.

Ajmal's (2019) study dealt with post-graduate students. This was different from the current study which focused on high school students. Regardless, the two studies are related in terms of their objective in examining issues related to science anxiety.

Ali (2015) investigated the "causes of science anxiety (SA) in children as well as approaches and tactics for teachers in grades 4 to 8 in Toronto to support students and minimize science anxiety". In terms of mechanisms for lowering SA, the outcomes were consistent with the literature, with "cooperative learning" and "constructivist approach" being the most effective. Gender disparities were not discovered; however, the participants' educational backgrounds were discovered to have an impact on their methods of teaching. Teachers' perceptions of SA, the impact of educational background, fear, methods and constraints, and lastly passion and gender were all discussed. The

inference is that these were the most important elements influencing students' science anxiety.

A study by Jegede (2007) aimed at finding out students' anxiety about studying chemistry, analyzed the elements that produced the fear, assessed sex attitude toward chemistry learning, and recommended measures to boost their enthusiasm or desire in learning the subjects. The study's data was gathered by sending a questionnaire to 300 people in secondary schools in Nigeria. It was found that students, regardless of their gender and their residential background, had significant levels of worry about learning chemistry, with female and rural students having higher levels of anxiety compared to male and urban students. According to the study, the causes of students' worry included a broad nature of the curriculum, a lack of understanding of employment prospects, teaching styles and disposition of teacher, and a lack of teaching resources.

The study of Jegede (2007) had close resemblance with the current study. They both focused on high school students and were both quantitative. However, there was a slight difference between them in that Jegede only examined anxiety related to only the study of Chemistry while the current study focused on integrated science which comprised Biology, Chemistry and Physics.

In a similar vein, Woldeamanuel, Atagana and Engida (2013) conducted a study to find out students' apprehension about studying chemistry, analyze the elements that underlie the apprehension, assess sex's attitude toward learning chemistry, and offer measures to improve their enthusiasm for the topic. The study's data was gathered by sending out a questionnaire to 300

students in Ethiopian Universities. The findings showed that students had significant levels of anxiety about learning chemistry. However, female and rural students had high levels of anxiety in comparison to male and urban students. Wide range of content, low level of knowledge about career prospects, availability of teaching resources and teaching approaches were cited as causes of anxiety towards Chemistry.

Further, Sule (2017) examined "the causes of anxiety on secondary school students' academic performance in science and mathematics subjects in Karu Local government Area of Nasarawa State, Nigeria". Questionnaire was adopted in collecting the data from the sample of 180 students. The percentage score was calculated using simple percentage analysis. The findings indicated that anxiousness was a factor in students' low performance. It was also revealed that "teachers, parents, boredom and learning difficulty, society, lack of adequate resources, test and examination and lack of confidence" caused the students' anxiety.

From the literature, it is apparent that different studies found out different causes of science anxiety, albeit, with some similarities. These causes were either related to the facilities in the school, the teaching methods and styles of teachers and the attitude of students.

Effects of Science Anxiety among Students

Anxiety in general can be detrimental to the lives of students. For science anxiety, there have been some few studies, which have sought to highlight the effects of science anxiety among students. England, Brigati, Schussler, and Chen (2019) investigated anxiety levels in relation to study of Biology among students The findings revealed that a rise in perceived

42

difficulty at the start to the end of the academic period was related with poorer final results, especially among females, non-Caucasians, and students with less previous knowledge in relation to Biology. Also, higher overall class anxiety early in the semester was linked to a desire to drop out of the major by the end of the semester.

From the study of England et al. (2019), it is evident that science anxiety was connected to dropping out of school. This is a major effect of science anxiety and thus considered relevant in the current study.

Also, Huberty (2009) revealed that anxiety can impact on students' behaviour, cognition and physiology in the study of science. Specifically, high-risk testing might be tough for students who are anxious. Anxious students were more likely to develop depression. Teachers and parents should collaborate to assist youngsters learn to cope with anxiety, according to him. In a similar vein, at the University of Bahawalpur in Pakistan, Nadeem, Ali, and Zaidi (2012) investigated the influence of anxiety on science accomplishment. An in-depth examination of the findings revealed that anxiety had an influence on students' academic accomplishments. The findings demonstrate that as anxiety levels rise, students' academic performance suffers regardless of their gender.

The study of Huberty (2009) dealt with senior high school students while that of Nadeem et al. (2012) focused on university students. They were both similar to the current study in terms of their focus even though they varied in terms of their participants.

Tuncay and Uzunboylu (2010) also focused on student anxiety and resistance to distant education learning. After sampling distance education students from Near Eastern University, it was found that anxiety was a major factor in terms of why students resisted distance learning. This means that essentially science anxiety made students less willing to be in school.

Avci and Kirbaşlar (2017) examined the levels of scientific anxiety among secondary school students in relation to specific factors. The quantitative research approach was applied in this investigation. A relational screening paradigm was used. In all, 480 students from two separate secondary schools in Istanbul, Turkey took part in the study. The "Science Anxiety Scale" created by Güzeller and Doğru (2011) was used to gather data. A statistically significant difference was discovered. between the "science anxiety levels" of students and "class level", "liking science course", "liking science teacher", "weekly period of time for studying science" and "the number of scientific magazines/books at home" variables. From the findings, it was identified that there is a significant negative connection between students' levels of anxiety related to science and their academic success.

Even though the study of Avci and Kirbaşlar (2017) was on relationship and not effect, it still gives indication that science anxiety can significantly be connected to students' academic work. Aside that, the study of Avci and Kirbaşlar was similar to the current study in that both studies explored science anxiety of students using the Science Anxiety Scale of Güzeller and Doğru (2011).

Rukijat and Karimat (2021) examined students' subject preference in the post junior secondary classroom based on science anxiety. One hundred

and sixty-six students drawn from public and private secondary schools in the Kogi State, Nigeria participated in the study. Their level of science anxiety was assessed with the Science Anxiety Scale. The simple regression analysis performed on the data revealed that science anxiety statistically significantly predicted the respondents' subject preference. Thus, the study concluded that science anxiety is a positive determinant of student's choice of subject in the secondary school classroom.

From the study of Rukijat and Karimat (2021), it remains clear that science anxiety affected students' desire to pursue science-related subjects. This would be verified in the current study to establish whether science anxiety could affect the interest of students to pursue science-related subjects in the future.

Moreover, Oludipe and Oludipe (2018) examined the effect of gender and science anxiety on students' academic achievement in basic science at the Junior Secondary School level. The study was a quasi-experimental study. The population for this study comprised the Junior Secondary III (JSIII) students in Ogun State Junior Secondary Schools. A sample of 120 intact class of students drawn from three coeducational Junior Secondary Schools in three Local Government Areas of Ogun state. Achievement Test for Basic Science Students, and Science Anxiety Scale were the main instruments used to collect data. Descriptive statistics, and Univariate Analysis of Variance (ANOVA), were used to analyze the data collected. There was significant main effect of science anxiety on the students' academic achievement in basic science at o.o5 level of significance.

Further, Kaur and Vadhera (2020) explored the effect of an affective variable 'science anxiety' on students' achievement in science subject. The chosen sample comprised 1134 students (532 boys and 602 girls) of class X from 34 schools of Aizawl district of Mizoram. An adapted version of "Science Anxiety Questionnaire" was used to assess the level of science anxiety amongst the sample. The science anxiety scores of students were correlated with their science achievement scores obtained in class X board examination. Kaur and Vadhera argued that even though past researches recognized "science anxiety" as having a negative affect responsible for students' underperformance in science, they found a very low but statistically significant positive relationship. From their results, they indicated that a minimum threshold level of science anxiety positively influences achievement in science. Also, they found a significant difference between science anxiety levels of boys and girls, the latter being more science anxious.

The study of Kaur and Vadhera (2020) was contrary to most of the studies reviewed. They found science anxiety to be positive for academic performance. However, all the other studies found science anxiety to have a negative influence on students. Kaur and Vadhera specified however that it was small level of science anxiety which influenced academic performance positively.

Generally, the literature reviewed have shown that science anxiety affects students' negatively. This was demonstrated in most of the literature reviewed. In the literature, students were affected negatively by science anxiety in terms of their performance and in their desire to pursue science-related subjects.

Measures To Reduce Science Anxiety

Several studies have been conducted on how science anxiety can be reduced. However, most of these studies have focused on how specific strategies can be used to reduce science anxiety. Some of these studies have been reviewed in this section. Rehman (2016) looked at the reasons of anxiety among Indian students in higher education. The study was qualitative in nature using mainly an exploratory approach. Individual, family-based, institution-based, society-based, and political issues were recognized as significant sources of anxiety for students in their academic work. In terms of how to overcome anxiety, it was revealed that clinical and non-clinical methods can be used. The findings also revealed the need to raise student knowledge so that they may receive timely assistance from specialists.

Saravanan and Kingston (2014) aimed to find a psychological intervention for anxiety that lowers psychological distress, improves intrinsic and extrinsic motivation, and boosts intrinsic and extrinsic drive among medical students. In all, 436 medical students in their first year completed the "Westside Anxiety Scale", "Kessler Perceived Stress Scale", and "Academic Motivation Scale" to assess their levels of exam anxiety, psychological discomfort, and motivation. A total of 74 students with moderate to high test anxiety were randomly assigned to one of two groups: experimental or waiting list. In comparison to their pre-assessment ratings, individuals in the intervention group had decreased levels of anxiety, psychological distress, and motivation, as well as high levels of intrinsic and extrinsic motivation in the post-assessment. It was concluded from the findings that psychological psychotherapy is beneficial in reducing anxiety ratings and associated factors.

The study of Saravanan and Kingston (2014) indicated clearly that students struggling with science anxiety could benefit from psychotherapy. Thus, therapeutic approaches could be used to assist students with science anxiety. In the theoretical framework of the current study, two main theoretical approaches (CBT and REBT) have been discussed as approaches which can help reduce science anxiety among students.

Further, Ghani-Hamzah, Motevalli and Garmjani (2019) evaluated the "impact of cognitive restructuring and study skill training on science anxiety and academic accomplishment". In all, 94 high school students were randomly assigned to "Cognitive Restructuring Training (CRT)", "Study Skill Training (SST)", or Psycho-educational Group Therapy". The findings revealed that "cognitive restructuring" and "study skills training" had an impact on science-related anxiety and students' academic performance.

Barrera, Szafranski, Ratcliff, Garnaat, and Norton (2016) tested the "effectiveness of cognitive defusion with in-vivo exposure, cognitive restructuring plus in-vivo exposure, and in-vivo exposure alone in lowering the impact of negative thoughts in persons with Science and Social anxiety". Barrera et al. found that the impact of cognitive restructuring in reducing negative thoughts about Science was confirmed.

Also, Mikaeili, Zare and Alhashem (2010) conducted "a study at Khalkhal High School on the impact of measures such as cognitive reconstruction on students' academic achievement in Science". Using pre-test and post-test experimental design, 30 high school girls were divided into two groups at random. Manova and independent t-tests were utilized in analysing the data. Cognitive reconstructing instruction increased internal, permanent,

and universal attributions for positive experiences while decreasing attributions for negative occurrences such as anxiety in Science according to the findings.

In Khalkhal, Iran, Ghamari-Kivi, Rafeie and Kiani (2015) tested the effectiveness of cognitive restructuring treatment and proper study strategies in lowering exam anxiety among high school students. The study's participants were all third-year high school students in Khalkhal city. The participants responded to a "Spielberger Test Anxiety Questionnaire" and a clinical interview. Following the prevalence determination, 30 participants with high anxiety ratings were assigned in a random manner to one of two 15-subject experimental or control groups. The findings revealed that 36.6 percent of students suffer from exam anxiety. The standard Hostelling test revealed that cognitive restructuring had a substantial influence on lowering exam anxiety symptoms among Science students. Furthermore, the Helmert bound comparison statistics revealed that cognitive restructuring treatment is more successful than acceptable approaches in reducing test anxiety symptoms in students.

The studies reviewed have made it abundantly clear that science anxiety can be reduced when some strategies are put in place. Most of the studies have shown clearly that therapeutic approaches like cognitive restructuring can help reduce science anxiety. This was confirmed in the studies of Barrera et al. (2016), Mikaeili et al. (2010) and Ghamari-Kivi et al. (2015).

Gender and Level of Science Anxiety

Several studies have been carried out on the relationship between science anxiety and gender. Brownlow, Jacobi and Rogers (2000) looked at the impact of gender and other characteristics on scientific anxiety. Students (50 males, 37 females) completed the "Science Anxiety Scale" (Mallow, 1994), provided information on their academic achievements in high school and college, detailed gender-role stereotypes at home, and rated their science teachers and experiences. Even though, female students had higher scores in Science and reported less severe sex-role indoctrination in the home, the study indicated that they were not generally more anxious about science in comparison to males. Students with high scientific anxiety, on the other hand, took less science courses in college, scored worse on the SAT-Q, and said their high school science teachers were unhelpful.

Perchtold et al. (2019) investigated "gender differences in the capacity for generating cognitive reappraisals in adverse situations in a sample of 67 female and 59 male students, using a maximum performance test of the inventiveness in generating reappraisals". After the study, it was shown that gender difference did not exist in terms of anxiety and even coping mechanisms. However, for males, engaging in cognitive reappraisal reduced the experience of anxiety and depression. The same was not reported for females because for females other coping abilities have to be in place to reduce anxiety levels.

Rao and Chaturvedi (2017) also aimed to know if there were any "significant differences in Academic Anxiety between boys and girls in Class IX students from rural and urban secondary schools". A total of 500 students

50

from class IX were chosen and enrolled in the research. Singh and Gupta's "Academic Anxiety Scale" was employed in the research. No significant gender difference was shown between males and females in the study. However, significant difference was seen in the academic anxiety levels of students from rural and urban schools.

The evidence in the study of Rao and Chaturvedi (2017) is that gender difference does not exist in the experience of science anxiety. The study is similar to the current study and as such would be a good source of comparison for the current study.

Further, Avci and Kirbaşlar (2017) examined "science anxiety levels of secondary school students with regard to certain variables". The "gender" variable did not show any significant difference. However, male and female students in Tehran primary schools differed in terms of anxiety in the study of Hosseinia and Khazalib (2013). Using the random cluster selection approach, 1200 participants (600 females and 600 males) from middle schools were chosen and examined using "Reynolds and Richmond's Anxiety Scale (RCMAS)". In terms of the levels of science anxiety, female students had high levels in comparison with male students.

Yohanna (2017) explored "gender difference in the level of academic anxiety among students". The results revealed no significant gender difference was found terms of students' level of anxiety and attitude towards Science after undergoing cognitive restructuring. Khesht- Masjedi et al. (2019) sought to determine how anxiety and depression affected pupils in the north of Iran's academic progress. The study included 666 secondary school students between the ages of 13 and 19 years from the north of Iran. The data for the study was

gathered using the "Beck Anxiety Inventory" and the "Beck Depression Inventory". Female students had high levels of anxiety in comparison to male students but in terms of depression, male students had high levels than female students.

The studies exploring how gender is related to Science anxiety have largely provided inconsistent findings. This is because some studies found that gender was related to Science anxiety while other studies found no relation. The objective of the current study in assessing how Science anxiety relates to gender can therefore help bring some needed insight.

Age and Level of Science Anxiety

Age of students has also been investigated as to its relation with Science anxiety or academic anxiety in general. Some of the studies are reviewed in this section. Saputra (2017) also examined the anxiety of students relating to Science. It was shown that using the cognitive restructuring strategy reduced anxiety significantly. However, on the basis of age, no difference was found. Similarly, Leahy and Rego (2012) conducted a study on the degree to which students experience science anxiety and the factors influencing their experience of anxiety. It was revealed that the level of students' anxiety in science can be affected by several interventions but age does not play any role in this effect.

Generally, it was observed that only a few studies have investigated the effect of age on science anxiety among students. All these studies found no significant difference. Perhaps further studies would help establish or refute some of the already existing findings.

Chapter Summary

This chapter focused on the literature review, which covered the theoretical framework, conceptual framework, conceptual review, and empirical review. The theories reviewed included Cognitive Behavioral Therapy (CBT), Rational Emotive Behavior Therapy (REBT) and Rachman's Theory of Fear. Concepts relating to science anxiety, the causes, effects and ways of reducing were also reviewed. Finally, previous empirical literatures were reviewed under sub-headings related to the main issues in the study. Overall, it was observed there were not many studies in Africa and Ghana about science anxiety among students.

53
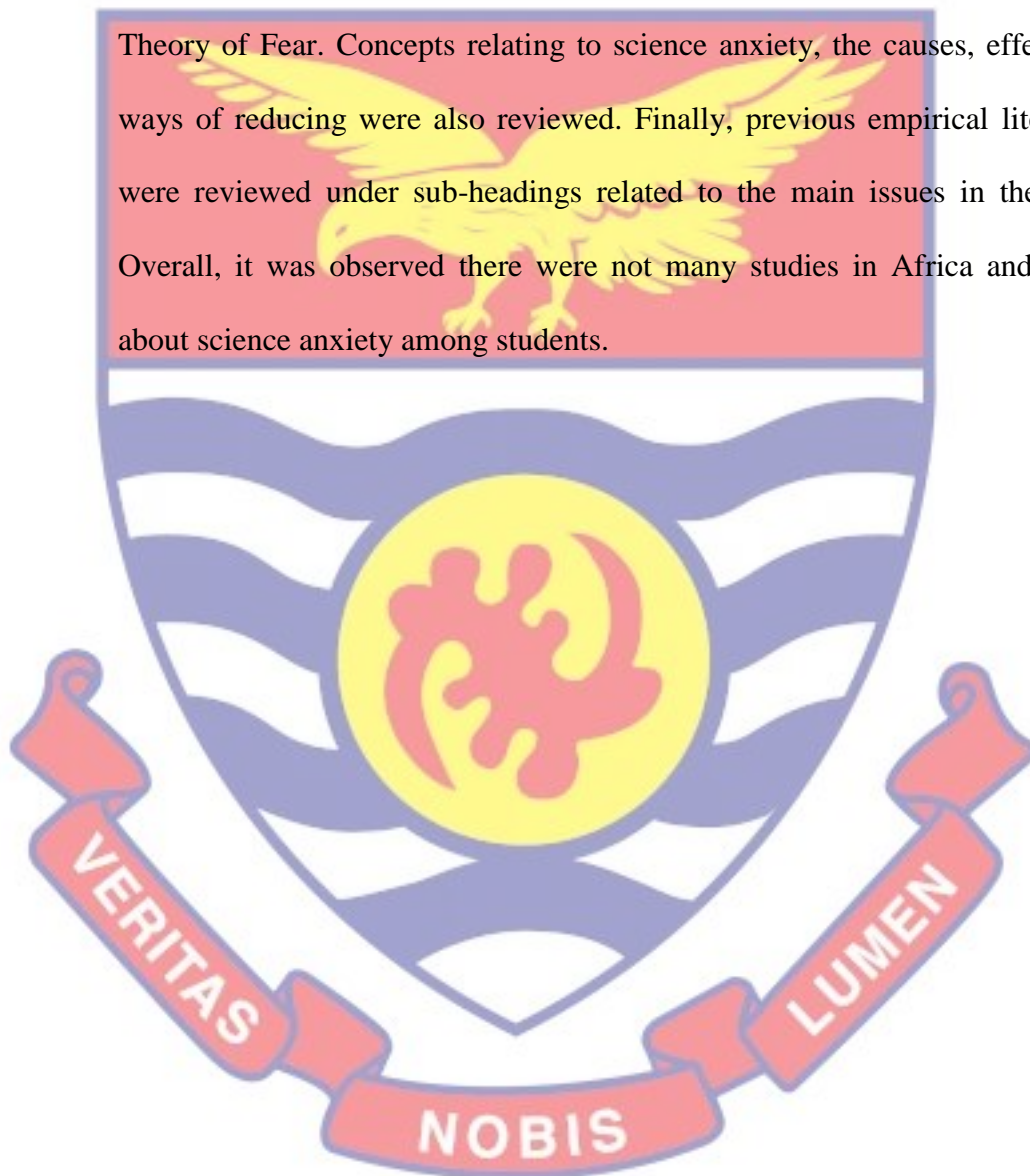
CHAPTER THREE

RESEARCH METHODS

Introduction

The purpose of the study was to examine the causes, effects and ways of managing science anxiety among senior high school students in the Old Tafo Municipality in the Ashanti Region of Ghana. This chapter covers the research design, study area, population, sampling procedure, data collection instrument, data collection procedure and the data processing and analysis.

Research Paradigm

The positivist paradigm was chosen for this study. It has been noted that "as a philosophy, positivism is in accordance with the empiricist view that knowledge stems from human experience. It has an atomistic, ontological view of the world as comprising discrete, observable elements and events that interact in an observable, determined and regular manner" (Collins, 2010, p. 38). Positivism adheres to the view that only "factual" knowledge gained through observation (the senses), including measurement, is trustworthy. Therefore, in positivism studies the role of the researcher is limited to data collection and interpretation in an objective way. In the current study, positivism was adopted because the researcher was interested in gathering and interpreting data about science anxiety and its effects in an objective way.

Further, in positivism, the study usually focuses on observable and quantifiable data. Thus, the positivist paradigm was adopted for the study because the study focused on describing in numerical or quantitative terms the causes, effects and measures to reduce science anxiety.

Research Approach

The quantitative approach was adopted for the study. Quantitative research approach emphasizes objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques (Babbie, 2010; Muijs, 2010). In line with the positivist paradigm, quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon (Creswell, 2013). In the current study, the focus was on collecting numerical data on science anxiety among students in the Old Tafo Municipality and generalizing it to a larger population. This made the quantitative approach suitable for the study.

Research Design

The descriptive survey research design was adopted for this study. In the view of Best and Kahn (2009), a descriptive survey design examines the relationships that exist, the practices that are prevalent, the beliefs and attitudes that are held, the issues that are occurring, and the effects or trends that are developing in relation to a specific phenomenon. As a result, a phenomenon is investigated in its natural state without manipulation. Again, the descriptive survey design is the most suitable since it focuses on state of an issue without manipulating any variables. The design was deemed appropriate for the study because it helped to give an accurate picture of science anxiety among senior high school students without any form of manipulation. Aside this, another reason for choosing the descriptive survey research design was

that it helped to identify the beliefs and attitudes that are held by students regarding science anxiety.

According to Bhattacherjee (2012), descriptive survey research design has several advantages. To begin with, survey is a great tool for evaluating a wide range of observable and unobservable data, such as the preferences, qualities, attitudes, beliefs, and behaviours of individuals, as well as factual data. Secondly, survey can be ideal for acquiring information on a large group that is difficult to observe in person.

Regardless of these advantages, Cohen, Manion, and Morrison (2007) argue that descriptive survey research design is disadvantageous especially in the sense that its degree of explanatory potential or fine detail is limited or lost to the quest to get large data for generalizations. Thus, even though descriptive survey can give large amount of data, the data can lack depth or detailed explanations. This specific limitation will not affect the study because the data collection instrument will be designed in a way that ensures that every aspect of the study's objectives is addressed.

Study Area

The research was conducted in the Ashanti Region's Old Tafo Municipality. The Old Tafo Municipal is one of the 261 Metropolitan, Municipal and District Assemblies (MMDAs) in Ghana, and forms part of the 43 of MMDAs in the Ashanti Region. The Old Tafo Municipal Assembly was carved out of the Kumasi Metropolitan Assembly as one of the 38 newly created and upgraded District Assemblies in 2018. The capital of the Municipality is Old Tafo.

The Old Tafo Municipality is located in the center of the region bounded by sister Assemblies as Kwabre East Municipality and Afigya Kwabre North to the north, south and east by Kumasi Metropolitan Assembly and to the west by Suame Municipal Assembly. The population of the Municipality according to 2021 population and housing census stands at 114,368 with 55,086 male and 59,282 female. Education is considered very important in the Municipality and this informs the reason behind the current study.

Population

In this study, the target population covered senior high students in the Old Tafo Municipality in the Ashanti Region. Specifically, there are three senior high schools in the Municipality. These are Osei Kyeretwie Senior High School, Kumasi Wesley Girls Senior High School and Al Azhariya Islamic Senior High School. Osei Kyeretwie SHS and Al Azhariya Islamic SHS are mixed schools while Kumasi Wesley Girls SHS is a single sex school.

The accessible population was made up of students in the two mixed schools in the Municipality. The mixed schools formed the accessible population to avoid any undue influence of gender if the single-sex school was involved. The population of students in the two mixed schools as obtained from the various schools is 2700. The schools gave the whole population figures. As a result, the researcher could do nothing about them. The breakdown of the population in the two schools is shown in Table 1.

Table 1: Population Distribution

School	Male	Female	Total
Osei Kyeretwie SHS	890	810	1700
Al Azhariya Islamic SHS	517	483	1000
Total	1407	1293	2700

Source: Data from Schools

Sampling Procedure

A sample of 337 was used for the study. This sample size was chosen on the basis of the sample size determination table of Krejcie and Morgan (1970). In their table, a sample of 337 was suitable for a population of 2700.

Stratified random sampling method was used in choosing the sample. Stratified random sampling was considered appropriate for the study because it helped in ensuring that every segment of the population was adequately represented in the sample. Also, by using stratified random sampling technique, biases were reduced because that each member of the population had equal chance of being chosen.

In using stratified random sampling, the researcher stratified the sample on the basis of their school and their gender. In stratifying, the sample for each group was calculated based on their sizes within the main population. The calculation was based on this formula =

n / N x S=s

where

n= population of specific group

N=Total population

S=Sample Size, s=sample for specific group (schools, gender).

For instance in getting the sample for Osei Kyeretwie SHS, the calculation was done as follows: 1700/ 2700 x 337=212.

This same calculation was followed for sampling males and females in the study. For instance in getting the sample for overall males, the calculation was done as follows: 1407/ 2700 x 337=176.

The sample distribution is shown in Table 2.

Table 2: Sample Distribution

School	Male	Female	Total
Osei Kyeretwie SHS	111	101	212
Al Azhariya Islamic SHS	65	60	125
Total	176	161	337

Source: Researcher's Calculation

Data Collection Instrument

Data was gathered using a questionnaire. The questionnaire comprised five sections. Section A dealt with the background data which comprised five items. Section B was adopted from the "Science Anxiety Scale (SAS)" developed by Güzeller and Doğru (2012). The SAS is useful in identifying the level of anxiety of students towards the study of science.

In this study, the SAS was used in finding out the level of anxiety among the respondents. It was made up of 20 items. The scale created by Güzeller and Doğru (2012) is on a scale of 1 to 5. The scoring for the positive statements for anxiety are scored from "1 = Strongly Disagree", "2 = Disagree", "3 = neutral", "4 = Agree" and "5 = Strongly Agree". The negative statements for anxiety were however scored in the reverse. Students were required to respond to the scale based on the feelings, thoughts and behaviours described in the statements and the extent to which these statements have

59

caused anxiety. The SAS was subjected to validity and reliability tests in order to make sure it was suitable for the study.

Section C comprised eight items that dealt with the causes of science anxiety. Section D covered the effects of science anxiety and was made up of five items. Finally, section E was made up of seven items that sought to find out measures that can be used to reduce science anxiety. All of these sections were on a scale of: "Strongly Disagree (SD)", "Disagree (D)", "Undecided (U)", "Agree (A)", and "Strongly Agree (SA)".

Validity of Instrument

Content validity was established for the Science Anxiety Scale (SAS). Content validity is the process of systematically analyzing content of an instrument to see if it covers the main issues outlined in the study. Experts such as my supervisor examined it on the basis of the judgment.

Reliability of Instrument

A pilot study was conducted with 50 students in the Kumasi Anglican Senior High School in the Kumasi Metropolis to establish the reliability of the instrument. The school was chosen because it is a mixed-sex school and had similar characteristics with the schools under study. The Cronbanch alpha co-efficient was used in determining the reliability.

The overall reliability co-efficient of 0.823 was obtained after conducting the pilot test. After the main study, the overall reliability co-efficient obtained was 0.853.

The reliability of the various sections of the questionnaire were also established both in the pilot and the main study. For Section B, the pilot reliability co-efficient was 0.795 while the main data reliability coefficient

was 0.870. For Section C, the reliability co-effecients were 0.812 (pilot) and 0.832 (main). For Section D, the reliability co-effecients were 0.822 (pilot) and 0.840 (main). Finally, for Section E, the pilot reliability co-efficient was 0.841 while the main data reliability coefficient was 0.905.

It is evident from the reliability coefficients that the instrument was reliable for the study. This is because several authors have confirmed that reliability coefficients above 0.70 are acceptable and indicative of high reliability of an instrument (Streiner, 2003; Tavakol & Dennick, 2011).

Data Collection Procedure

Before data collection, ethical clearance was obtained from the College of Education Review Board in the University of Cape Coast. After this, an introductory letter was received from the Department of Guidance and Counselling. This introductory letter will be used to gain permission to the study sites. Arrangements were made with the schools on specific dates to collect the data. The researcher solicited the consent of the respondents on each day of data collection. The study's goal was explained to them so that they may choose whether or not to participate. The data was collected during a two-week period. A 100% return rate was realized.

Data Processing and Analysis

The data collected were analysed with the help of SPSS. The demographic data were analysed using frequencies and percentages. The specific statistical tools for the analysis of the data for the research questions and hypotheses described in this section:

Research Question 1: What is the extent of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana?

In answering this research question, the data for section B of the questionnaire were analysed using Mean and Standard Deviation. Mean and Standard Deviation were used because they helped to provide weighted averages for the overall responses of the entire respondents.

Research Question 2: What are the causes of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana?

Section C of the questionnaire was used in answering the second research question. The data were analysed using Mean and Standard Deviation. Mean and Standard Deviation were used because they helped to provide weighted averages for the overall responses of the entire respondents.

Research Question 3: What are the effects of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana?

Section D of the questionnaire was used in answering the third research question. The data were analysed using Mean and Standard Deviation to help describe the overall views of the respondents on how science anxiety could affect them.

Research Question 4: Which measures can help reduce science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana?

The final section of the questionnaire was used in answering this research question. Mean and Standard Deviation were used in the analysis to describe the views of the respondents on measures that can be used to reduce science anxiety.

62

Hypotheses

H₀1: There is no significant difference in the level of science anxiety of male and female SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana.

H₁1: There is a significant difference in the level of science anxiety of male and female SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana.

This first hypothesis was tested using independent samples t-test. This is because two independent groups were been compared on a dependent variable. Level of science anxiety was obtained by computing the responses of the participants on the section B of the questionnaire.

H₀2: Age does not significantly affect the level of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana.

H₁2: Age significantly affects the level of science anxiety among SHS students in the Old Tafo Municipality in the Ashanti Region of Ghana.

The second hypothesis was tested using one-way analysis of variance (ANOVA). This is because age was categorized into three independent groups were been compared on a dependent variable. Level of science anxiety was obtained by computing the responses of the participants on the section B of the questionnaire.

Ethical Considerations

The participants of the study were told that ethical problems were taken into account such as autonomy, consent, anonymity, and confidentiality. As already established, the consent of the respondents was sought. Again, the

names of the respondents were not required to ensure anonymity of the respondents. Also, the two schools in the study were represented with pseudonyms (School A and School B).

Further, the information provided by the respondents were used for the academic purposes for which the study was intended. As a result, confidentiality and privacy of the information were assured. In ensuring participant autonomy, the respondents were not forced to answer the questionnaire in a fixed or pre-determined way. As a result, the respondents had the choice and freedom in their responses.

Chapter Summary

This chapter dealt with the research methods of the study. The descriptive survey research design was adopted for the study. The sample was made up of 337 students selected from School A and School B using stratified random sampling procedure. Data was collected by using the "Science Anxiety Scale" developed by Güzeller and Doğru (2012). Data was analysed using descriptive statistics and inferential statistics.
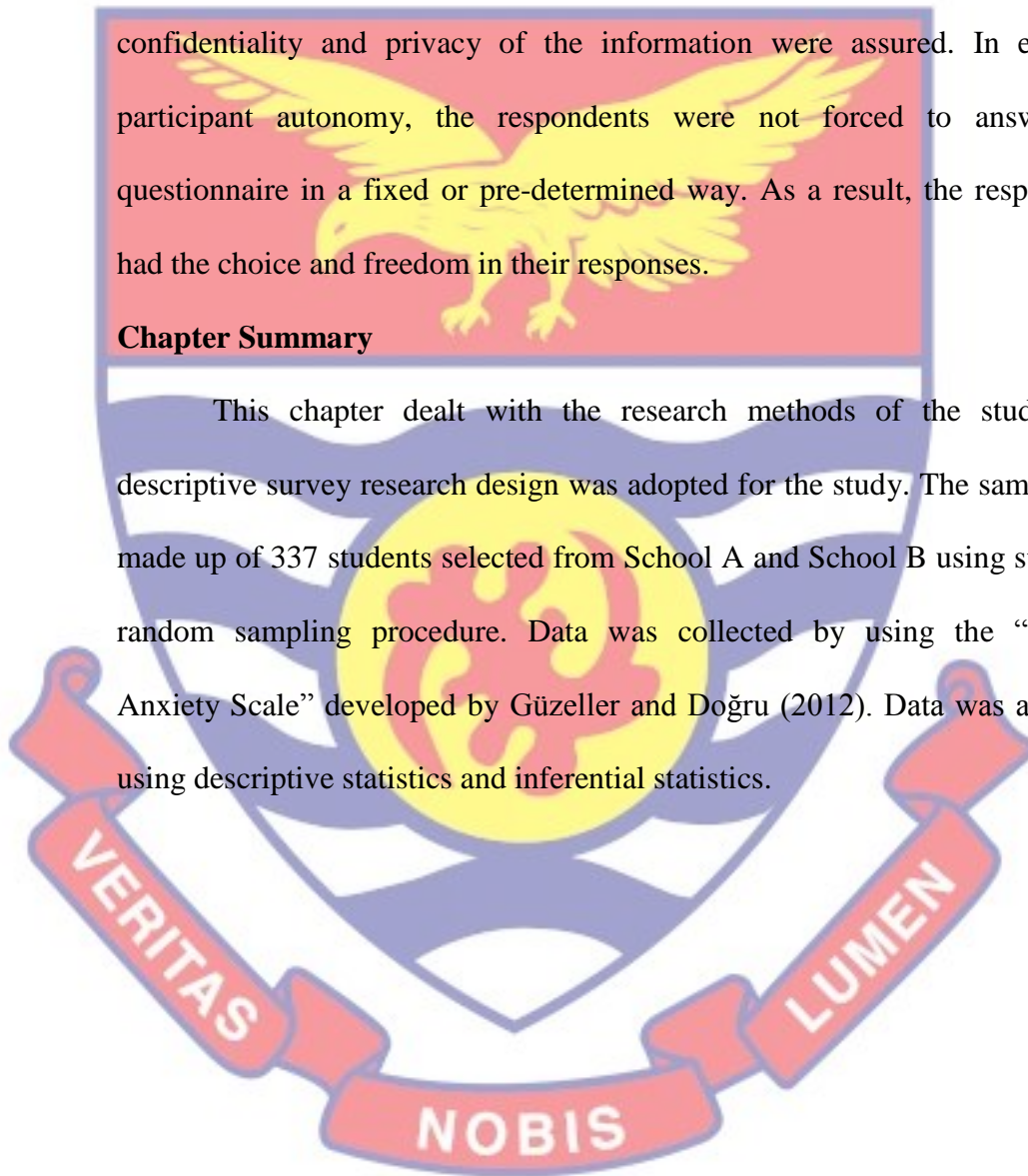
CHAPTER FOUR

RESULTS AND DISCUSSION

The purpose of the study was to investigate the causes, effects and management of science anxiety among Senior High School (SHS) students in the Old Tafo Municipality in the Ashanti Region of Ghana. This chapter presents the results and discussion of the study.

Demographic Characteristics

The demographic characteristics of the respondents are presented in this section. They cover the gender, age and form level of the respondents. These are presented in Table 3.

Table 3: Demographic Characteristics of Respondents   N=337

Item	Frequency (F)	Percentage (%)
Gender		
Male	176	52.2
Female	161	47.8
Age		
15 years and below	14	4.2
16 – 18 years	225	66.8
19 years and above	98	29.0

Source: Field survey (Obuobi-Ayim, 2021)

It was shown in Table 3 that that majority of the respondents (52.2%) were males while 47.8% were females. It is also seen that about 66.8% of the respondents were aged between 16 to 18 years. Only 4.2% of the respondents were aged 15 years and below while 29% were aged 19 years and above. The demographic characteristics of the respondents are relevant in the study because they play a part in the level of science anxiety of students.

Answers to Research Questions

Since the questionnaire was scored on a 5-point Likert-type scale, to determine the minimum and the maximum cut-off, all the scores were added (5+4+3+2+1=15) and divided by 5 giving a score of 3. Therefore, 3.0 was set us at the cut-off point. Mean scores above 3.0 indicated that respondents agreed to the statements while mean scores below 3.0 indicated that the respondents agreed to the specific statements.

Research Question 1: What is the extent of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana?

This research question sought to find the extent of science anxiety among the respondents. Means and standard deviations were used for the analysis. In determining the level of science anxiety, mean scores below 2.0 were considered to be low, between 2.0 and 4.0 were considered to be moderate while mean scores above 4.0 were considered high. The results are presented in Table 4.

Table 4: Extent of Science Anxiety among Students

Statement	Mean	Std. Dev.
I can't learn science no matter how much I study	1.99	1.33
I get stressed just when entering the class if it's science	3.09	1.38
I don't have the self-confidence for learning science	1.98	1.29
I feel uncomfortable when I enter the laboratory	1.94	1.29
I feel desperate when tackling science problems	2.53	1.39
Everybody but me understands science	2.18	1.38
I am afraid of not passing because of the science course	2.36	1.42
I don't feel that I have the competence to solve the questions related to science	2.24	1.42
I am not anxious about problems related to science because I don't like science	2.15	1.35

I become nervous when I have to do science homework	3.13	1.44
I don't answer in science class even if I know the answer in case my friends make fun of me	3.01	1.54
I become nervous when solving science problems	3.08	1.24
I am afraid of being in low position in science courses	3.11	1.65
I am not afraid of anything as much as science examinations	2.76	1.53
I am not interested in scientific activities	2.05	1.33
I have to study science when watching TV or there are people talking in the room	2.52	1.56
The attitude of the teacher in the science classes makes me anxious	3.10	1.48
It always makes me anxious that science is a compulsory course in the curriculum	2.36	1.39
I usually sleep in the science class when I go to bed late or can't sleep well	2.20	1.44
I am worried in case the teacher asks me questions in the science class	3.03	1.41
Mean of Means	2.49	1.41

Source: Field survey (Obuobi-Ayim, 2021)

The result in Table 4 shows that respondents become nervous when they have to do science homework (M = 3.13, SD = 1.44). Also, the data indicated that the respondents were afraid of being in low position in science courses (M = 3.11, SD = 1.65). The data revealed also that the attitude of the teachers in the science classes makes the respondents anxious (M = 3.10, SD = 1.48). In addition, the data indicated that the respondents get stressed just when entering the class if it's science (M = 3.09, SD = 1.38) and become nervous when solving problems related to science (M = 3.08, SD = 1.24). In the classroom, the data showed that the respondents were worried in case the teacher asks them questions in the science class (M = 3.03, SD = 1.41) and

they do not answer in science class because they may be mocked by friends (M = 3.01, SD = 1.54).

From the results in Table 4, it is clear that the respondents had moderate level of science anxiety. This was evident in that for most of the statements, the mean scores were between 2.0 and 4.0. The mean of means of 2.49 also confirmed that science anxiety experienced by the students was moderate. The level of science anxiety was connected to doing science homework, getting low position in class, the attitude of the science teacher, entering science class and solving problems related to science. Science anxiety was also shown in the respondents being worried of being asked questions in science class and being scared of answering questions because they may be mocked.

Research Question 2: What are the causes of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana?

This research question aimed at finding out the causes of science anxiety among the respondents. Means and standard deviation were used for the analysis of the data. Mean scores above 3.0 indicated that respondents agreed to the statements while mean scores below 3.0 indicated that the respondents agreed to the specific statements.

The results are shown in Table 5.

Table 5: Causes of Science Anxiety

Statement	Mean	Std. Dev.
Science content is too much	3.62	1.46
There are a lot of demands in science subject	3.89	1.26
There are a lot of difficult calculations and abstract concepts in science subject	3.54	1.36
There are not enough facilities and infrastructure (laboratory) to help in the study of science	3.84	1.29
The practical aspect of science makes science difficult	3.87	1.56
Science teachers make the study of science too complex and difficult	2.62	1.43
There are not enough materials for teaching science	2.71	1.40
There are no excursions, fieldtrips and exposure to study science	3.63	1.48

Source: Field survey (Obuobi-Ayim, 2021)

From Table 5, it could be seen from the respondents that there are a lot of demands in science subject (M = 3.89, SD = 1.26) and that the practical aspect of science makes science difficult (M = 3.87, SD = 1.56). The respondents were also of the view that there are not enough facilities and infrastructure (laboratory) to help in the study of science (M = 3.84, SD = 1.29). The respondents also made known that there are no excursions, fieldtrips and exposure to study science (M = 3.63, SD = 1.48). Regarding the content of science, the respondents indicated that the content is too much (M = 3.62, SD = 1.46) and that there are a lot of difficult calculations and abstract concepts in science subject (M = 3.54, SD = 1.36).

From the results in Table 5, the causes of science anxiety revolve around the content, infrastructure and other issues. Specifically, the content and demands are deemed to be too much in science, the practical aspects, the calculations and the abstract concepts in science together cause science

anxiety. The inadequacy of infrastructure and lack of exposure to fieldtrips connected to science also lead to science anxiety.

Research Question 3: What are the effects of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana?

This research question sought to identify the effects of science anxiety among the respondents. Means and standard deviation were used for the analysis of the data. Mean scores above 3.0 indicated that respondents agreed to the statements while mean scores below 3.0 indicated that the respondents agreed to the specific statements. The results are presented in Table 6.

Table 6: Effects of Science Anxiety

Statement	Mean	Std. Dev.
Anxiety in science affects performance in science	3.79	1.27
Anxiety in science prevents students from pursuing science subjects in future	3.69	1.34
Science anxiety can reduce interest of students in science	3.75	1.32
Science anxiety can affect school attendance and overall performance	3.50	1.39
Science anxiety can make students drop out of school	2.97	1.54

Source: Field survey (Obuobi-Ayim, 2021)

From Table 6, it was shown that the effects of science anxiety includes affecting performance negatively (M = 3.79, SD = 1.27) and reducing interest of students in science (M = 3.75, SD = 1.32). Also, science anxiety prevents students from pursuing science subjects in future (M = 3.69, SD = 1.39) and affect school attendance and overall performance negatively (M = 3.50, SD = 1.39).

70

Research Question 4: Which measures can help reduce science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana?

This research question focused on the measures which can help reduce science anxiety among SHS students. Means and standard deviation were used for the analysis of the data. Mean scores above 3.0 indicated that respondents agreed to the statements while mean scores below 3.0 indicated that the respondents agreed to the specific statements. The results are presented in Table 7.

Table 7: Measures to Reduce Science Anxiety

Statement	Mean	Std. Dev.
Making the science syllabus easier to cover	4.42	1.16
Providing training to improve the expertise of science teachers	4.39	1.02
Providing more teaching materials to assist teachers	4.53	1.00
Providing more facilities and infrastructure (laboratories) to help in the study of science	4.54	0.89
Teachers making the study of science easier and interesting	4.49	1.02
Organising excursions and fieldtrips to make science more practical	4.38	0.97
Making students aware of all the future prospects of studying science	4.31	1.01
Engaging in relaxation technique whenever there is anxiety	4.31	0.95
Learning special skills in studying science	4.24	1.08
Changing mentality about science as a subject of study	4.06	1.24
Gradually training yourself to deal with science anxiety	4.16	1.20

Source: Field survey (Obuobi-Ayim, 2021)

It was shown in Table 7 that providing more facilities and infrastructure (laboratories) to help in the study of science (M = 4.54, SD = 0.89), providing more teaching materials to assist teachers (M = 4.53, SD = 1.00) and teachers making the study of science easier and interesting (M = 4.49, SD = 1.02) can help deal with science anxiety. Also, it is shown that making the science syllabus easier to cover (M = 4.42, SD = 1.16) and providing training to improve the expertise of science teachers (M = 4.39, SD = 1.02) can help students overcome science anxiety.

Further, it was shown in Table 7 that organising excursions and fieldtrips to make science more practical (M = 4.38, SD = 0.97), making students aware of all the future prospects of studying science (M = 4.31, SD = 1.01) and engaging in relaxation technique whenever there is anxiety (M = 4.31, SD = 0.95) can help students overcome science anxiety. These were the main strategies identified by the respondents to be helpful in dealing with science anxiety.

Testing of Hypotheses

Hypothesis One

H_01:   There is no significant difference between males and females in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana.

H_11:   There is a significant difference between males and females in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana.

This hypothesis sought to find out the significant difference between males and females in the level of science anxiety among SHS students in the

Tafo Municipality in the Ashanti Region of Ghana. The independent samples t-test was used in testing the hypothesis at 0.05 level of significance. Normality and homogeneity tests were done first before carrying out the independent t-test.

The results are shown in Tables 8, 9 and 10.

Table 8: Tests of Normality (Gender and Anxiety)

		Kolmogorov-Smirnov			Shapiro-Wilk		
	Gender	Statistic	Df	Sig.	Statistic	df	Sig.
Anxiety	Male	.096	176	.210	.964	176	.708
	Female	.143	161	.180	.944	161	.884

Source: Field Survey (Obuobi-Ayim, 2021)

It is expected that the data for independent samples t-test should be normally distributed. Normality was tested using the Kolmogorov-Smirnov and Shapiro-Wilk statistics. It can be seen in Table 8 that the significant values are all above .05. From the table therefore, normality can be assumed for the data.

The results of the Levene's test for homogeneity of variance are presented in Table 9.

Table 9: Levene's Test for Equality of Variances

	F	Sig
Equal variances assumed	2.613	.107
Equal variances not assumed		

Source: Field Survey (Obuobi-Ayim, 2021)

From Table 9, it could be seen that the significant value of .107 is greater than .05 the significant level. This implies that equal variances can be assumed. Based on this, it was appropriate to run independent samples t-test. The results of the independent samples t-test are shown in Table 10.

73

Table 10: Results of t-Test Comparing Male and Female Level of Science Anxiety

Gender	N	Mean	SD	Df	t-value	Sig (2-tailed)
Female	161	50.32	14.47	335	4.782*	.000
Male	176	42.63	15.04			

Source: Field survey (Obuobi-Ayim, 2021)   *Significant, p<.05

The results of the independent samples t-test in Table 10 show that there is a significant difference between male and female students in terms of their level of science anxiety [t (335) = 4.782, p<.05]. The mean score of the females was 50.32 while that of males was 42.63. Based on the results in Table 8, the null hypothesis that there is no significant difference between males and females in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana was rejected. This implies that male and female students differed in their level of science anxiety with female students experiencing science anxiety more than male students.

Hypothesis Two

H$_0$2:   There is no significant age difference in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana.

H$_1$2:   There is a significant age difference in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana.

The hypothesis sought to find out if there is a significant age difference in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana. Since there were three different age groups

involved in the study, the One-Way ANOVA was used in in testing the hypothesis at 0.05 level of significance.

Normality of the data was established first using the Kolmogorov-Smirnov and Shapiro-Wilk statistics. The results are shown in Table 11.

Table 11: Tests of Normality (Age and Anxiety)

	Age	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Anxiety level	15 years and below	.336	14	.076	.702	14	.503
	16-18years	.092	225	.164	.962	225	.702
	19years and above	.099	98	.158	.923	98	.698

Source: Field Survey (Obuobi-Ayim, 2021)

It can be seen in Table 9 that the significant values are all above .05. From the table therefore, normality can be assumed for the data.

In using One-Way ANOVA, there was also the need to assess the homogeneity of variance among the groups. The results of the Levene's test for homogeneity are shown in Table 12.

Table 12: Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
3.006	2	334	.151

Source: Field Survey (Obuobi-Ayim, 2021)

It is shown in Table 12 that the significant level of .151 is greater than .05. This implies that homogeneity of variances can be assumed. Therefore, it was appropriate to carry out One-Way ANOVA.

The results of the ANOVA test are shown in Tables 13, 14 and 15.

Table 13: Descriptive Results for Different Ages

Age	N	Mean	Std. Dev.
15 years and below	14	51.86	18.22
16-18 years	225	50.60	15.95
19 years and above	98	44.60	11.89
Total	337	46.64	15.22

Source: Field Survey (Obuobi-Ayim, 2021)

75

Table 13 shows the mean and standard deviations of the various class levels. It can be seen that students within the '15 years and below' group had a mean score of 51.86 and standard deviation of 18.22. The students within the '16-18 years' group had a mean score of 50.60 and a standard deviation of 15.95. The last group (19 years and below) had a mean score of 44.60 and a standard deviation of 11.89. From the mean scores, it is clear that there are differences among the different age groups. Specifically, it is clear that, students of '15 years and below' had high levels of science anxiety than the other age groups.

The results of the ANOVA test to reveal the significance of the difference observed among the groups are presented in Table 14.

Table 14: ANOVA Results Comparing Science Anxiety on the Basis of Ages

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	2835.913	2	1417.957	6.314*	.002
Within Groups	75009.357	334	224.579		
Total	77845.270	336			

Source: Field survey (Obuobi-Ayim, 2021)   *Significant, p<.05

From Table 14, it was clear that there is a significant difference in the level of science anxiety of students on the basis of their ages [F (2, 334) = 6.3414, p<.05]. The p-value (probability value) of 0.002 is less than the.05 significant threshold. This means that the difference between the three age groups' mean scores was statistically significant. The null hypothesis, that there was no significant age difference in the degree of scientific anxiety among SHS students in Ghana's Ashanti Region, was rejected. Since a significant difference was found, there was the need for a post-hoc analysis in

76

order to determine which of the three mean values caused the significant difference obtained in the ANOVA results.

Tukey's Post-Hoc test was used in doing the post-hoc analysis. Tukey's test is used to identify which groups in a sample differ by comparing every mean with the other mean. The results of the post-hoc analysis are presented in Table 15.

Table 15: Post-Hoc Multiple Comparisons

Dependent Variable: Anxiety Level
Tukey HSD

(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
15 years and below	16-18 years	7.25270	4.12789	.186	-2.4652	16.9706
	19 years and above	1.27551*	4.28170	.004	-8.8045	11.3555
16-18 years	15 years and below	-7.25270	4.12789	.186	-16.9706	2.4652
	19 years and above	-5.97719*	1.81377	.003	-10.2472	-1.7072
19 years and above	15 years and below	-1.27551*	4.28170	.004	-11.3555	8.8045
	16-18 years	5.97719*	1.81377	.003	1.7072	10.2472

*. The mean difference is significant at the 0.05 level.

Source: Field survey (Obuobi-Ayim, 2021)   *Significant, p<.05

In Table 15, it can be seen that there is a significant difference between the respondents aged '15 years and below' and those aged '19 years and above' (p<.05). Also, a significant difference was observed between the respondents aged '16-18 years' and those aged '19 years and above' (p<.05). The implication of the results is that the difference observed among the different age groups was caused by the difference in the mean scores of the respondents aged '15 years and below' and those aged '19 years and above' as

77

well as the difference in the mean scores of the respondents aged '16-18 years' and those aged '19 years and above'.

From the results, it could be seen that there are differences among the different age groups in terms of their mean scores. Specifically, it was clear that, students in '15 years and below' had high levels of science anxiety than the other age groups.

Discussion

Extent of Science Anxiety among Students

The study revealed that the respondents had moderate level of science anxiety in relation to doing science homework, getting low position in class, the attitude of the science teacher, entering science class and solving problems related to science. Science anxiety was also shown in the respondents being worried of being asked questions in science class and being scared of answering questions because they may be mocked. All of these connote that the students in the study experienced science anxiety.

The findings support the findings of the study of Cooper, Downing and Brownell (2018) among 52 students. Cooper et al. found that the fear of negative evaluation, or the feeling of dread connected with receiving a negative review while participating in class, was the main construct underlying students' high levels of anxiety associated with science. AcarSesen and Mutlu (2014) also sought to determine and overcome undergraduates' science laboratory anxiety. From their results, it was found that students experienced science anxiety usually relating to laboratory anxiety in the form of working with chemicals especially acids, laboratory accidents, using laboratory materials and equipment, and making mistakes. Similarly, Butt,

Akram, Gulzar and Yahya (2013) intended to identify the difference in anxiety levels between pure scientific and social science students in Pakistan. They discovered that pure science students have considerably higher levels of anxiety than social science students.

Further, the study of Kaya and Yildirim (2014) revealed that Students reported scientific anxiety in the form of dread of receiving a poor score and failure, as well as physical reactions to science tests such as sweating, shaking, sadness, sobbing, and feeling their pulse beat faster. These were confirmed in the findings of the current study.

Generally, the findings of the studies discussed have all confirmed the findings of the current study. The implication is that science anxiety is a common experience among most students in second cycle institutions in several societies. This appears to be consistent with the popular held views in society that students usually have some level of anxiety towards pursuing science-related subjects.

Causes of Science Anxiety among Students

The study revealed that the causes of science anxiety revolve around the content, infrastructure and other issues. Specifically, the content and demands are deemed to be too much in science, the practical aspects, the calculations and the abstract concepts in science together cause science anxiety. The inadequacy of infrastructure and lack of exposure to fieldtrips connected to science also lead to science anxiety. From the results, it is clear that there are a variety of causes of science anxiety among the students in the study.

79

The results are similar to those of Kaya and Yildirim (2014), who looked at the causes of failing students' science anxiety. Students' scientific anxiety was caused by unpleasant classroom activities, exam anxiety, chemical perceptions, teacher attitudes, and parent attitudes, according to their findings. Some students in the study of Kaya and Yildirim perceived science courses as boring, disliking, incomprehensible, unreasonable, full of numbers and formula and require a good deal of memorization and reasoning. This means that the way students saw or perceived science was major reason for their science anxiety. This is not surprising since by viewing science negatively, students are likely to be anxious in their study of science.

In a similar vein, Ajmal (2019) aimed at finding out the anxiety factors among students of distance learning of Allama Iqbal Open University. Ajmal's study highlighted factors such as course tutorials, books distribution, assignments and student support services as major causes of science anxiety among the students. Jegede (2007) also aimed at "finding out students' anxiety towards the learning of Chemistry". According to the study, the causes of students' anxiety in Chemistry were a broad syllabus, a lack of awareness of job prospects, teachers and their teaching approaches, and a lack of resources for teaching.

Further, Sule (2017) examined in "the Karu Local Government Area of Nasarawa State, Nigeria, the effects of anxiety on secondary school students' academic performance in science and mathematics disciplines". It was shown that "teachers, parents, boredom and learning difficulties, society, a lack of necessary resources, tests and examinations, and a lack of confidence" all contributed to the students' anxiety.

From the forgoing discussion, the causes of science anxiety can be seen to be multi-faceted. Thus, the causes were related to students, teachers and facilities. In essence, strategies to curb science anxiety should be multi-faceted.

Effects of Science Anxiety among Students

The study revealed that the effects of science anxiety includes affecting performance negatively, reducing interest of students in science, preventing students from pursuing science subjects in future and affecting school attendance. When students experience science anxiety, they are likely to withdraw from any science-related activity or task. This is likely to affect their performance in school and their overall academic performance. This also sends the signal that they will lose interest in pursuing science at higher levels. In Ghana, this could be what is accounting for the general small number of students pursuing science-related courses at higher levels of education. Most people right from their young ages are scared and anxious about pursuing science. This anxiety is mostly carried into adulthood and thus affecting the number of students pursuing science. From the forgoing, science anxiety generally affects students negatively and therefore needs to be discouraged or overcome.

The findings of this study corroborate those of Avci and Kirbaşlar (2017), who looked at secondary school pupils' scientific anxiety levels. According to Avci and Kirbaşlar, there is a negative correlation between students' science anxiety levels and their academic accomplishment. They argued that when students have science anxiety, they are less likely to enjoy

81

studying science and thus affect their overall performance in science. In essence, science anxiety reduces the academic performance of students.

In a similar vein, England, Brigati, Schussler, and Chen (2019) examined the types of classroom anxiety connected to the academic achievement of students in science. The results revealed that a rise in perceived course struggles from the start to the conclusion of the semester was connected with poorer marks. Higher anxiety at the beginning of the semester was linked to a desire to drop out of the major by the conclusion of the semester. This implies that science anxiety does not only affect performance but can affect the attendance of students and their desire to pursue science.

Further in the study of science, Huberty (2009) found that anxiety affects students' behaviour, physiology, and cognition. High-risk testing might be particularly tough for pupils who suffer from anxiety. Anxious pupils are more likely to develop depression. All of these affect the performance of the student negatively. These confirmed the findings of the current study. In a similar vein, In Pakistan, Nadeem, Ali, and Zaidi (2012) investigated the influence of anxiety on science success. An in-depth examination of the findings revealed that science anxiety had an influence on students' academic performance. Their findings showed that as anxiety levels rise, students' academic performance suffers, regardless of their gender.

The effects of science anxiety are detrimental on students. The students are affected in terms of their academic performance, their attendance, and their willingness to keep studying science at the high level. In practicality, if students have science anxiety then they are unlikely to be interested in the study of science. This means if they are already studying science then their

82

performance would be affected negatively. Generally, all of the effects of science anxiety have been confirmed in the findings of the current study and those of the other studies.

Measures that Can Be Used To Reduce Science Anxiety

The study revealed that providing more facilities and infrastructure (laboratories) to help in the study of science, providing more teaching materials to assist teachers and teachers making the study of science easier and interesting can help deal with science anxiety. Also, it was found that making the science syllabus easier to cover and providing training to improve the expertise of science teachers can help students overcome science anxiety. These measures or strategies are essential if students are going to be assisted to overcome science anxiety. Further, it was revealed that organising excursions and fieldtrips to make science more practical, making students aware of all the future prospects of studying science and engaging in relaxation technique whenever there is anxiety can help students overcome science anxiety.

Since science involves a lot of practical work, it is always essential to have the needed facilities so that the learning of the practical aspect of the course would be easy. Also, any means to make the covering of syllabus easier could be a major means to overcoming science anxiety. The strategies thus involve the teacher, the school authorities and the agency responsible for curriculum development. Also, some psychological strategies like relaxation techniques can be engaged in by students with science anxiety so as to reduce the anxiety.

83

The findings support the findings of several previous researchers. For instance, Rehman (2016) explored the causes of science anxiety and how to reduce it among Indian higher education students. Various non-clinical and clinical preventive treatments are available for students with significant academic anxiety. The findings also revealed the need to raise student knowledge so that they can receive timely assistance from specialists.

Saravanan and Kingston (2014) also aimed to figure a psychological anxiety intervention that reduced amotivation, psychological distress and increased intrinsic and extrinsic motivation in medical students. They came to the conclusion that psychological interventions like relaxation are useful in lowering anxiety levels and related factors. This confirmed the findings of the current study.

Furthermore, Ghani-Hamzah, Motevalli, and Garmjani (2019) investigated "the impact of exam anxiety and academic achievement on techniques such as cognitive restructuring and study skill training in Science". The findings revealed that "cognitive restructuring" and "study skills training" have a good impact on students' academic performance while having a negative impact on anxiety symptoms in Science. Barrera, Szafranski, Ratcliff, Garnaat and Norton (2016) stressed that, cognitive restructuring techniques like relaxation can help in reducing science anxiety. These findings are all in line with the findings of the current study.

From the discussion, it is apparently clear that science anxiety is not something that cannot be dealt with. When proper measures are put in place science anxiety among students can be reduced. These measures can either be in relation to the nature and style of teaching, the content of science

curriculum, provision of facilities and the attitude of students. Some psychological and therapeutic measures like cognitive restructuring can also help in reducing science anxiety among students studying science.

Gender and Level of Science Anxiety

The results revealed that there was a significant difference between male and female students in terms of their level of science anxiety. This means that male and female students differed in their level of science anxiety with female students having high level of science anxiety than male students. Even though both male and female students experience science anxiety, female students had higher levels of science anxiety. This finding could be because generally, females have been seen as having more fear of science as a subject. This is a common observation in Ghana. As a result, in most senior high schools, girls are under-represented in science-related courses.

The findings confirm the findings of Hosseinia and Khazalib (2013) who compared "the level of science anxiety in male and female students at Tehran elementary schools". Female students scored higher in the anxiety and worry subscales than male students, meaning that the females' degree of anxiety was higher. Similarly, Khesht-Masjedi et al. (2019) wanted to know how anxiety and depression affected academic progress in students in Iran's north. In terms of science, the data showed that females had more anxiety than boys.

In a similar light, Butt, Akram, Gulzar and Yahya (2013) aimed to see if there was a difference in anxiety levels between pure science and social science students in Pakistan and found that females faced more anxiety than males. Wahed and Hassan (2017) aimed at determining the incidence of

85

psychological mood disorders and their links to certain elements in the study among science students. Higher science anxiety scores were significantly associated with female sex.

Jegede (2007) also sought to find out about students' anxiety about learning chemistry, identify the elements that create the anxiety, assess sex's attitude toward the subject, and offer strategies to improve their enthusiasm for the subject. The findings showed that science anxiety was high in females and students from rural areas compared to males and those from urban areas. According to England, Brigati, Schussler, and Chen (2019), an increase in the perception that science was difficult led to poor performance mostly in females. Similarly, increased overall anxiety from the beginning of the semester was linked to a desire to drop out of the major by the conclusion of the semester, especially among females.

From the forgoing discussion, it is clear that female students experienced more science anxiety compared to male students. Female students thus need more attention in terms of interventions for science anxiety.

Age and Level of Science Anxiety

Finally, the study revealed that there are differences among the different age groups in terms of science anxiety. This is because there was a significant difference in the level of science anxiety of students on the basis of their ages. Specifically, the students aged '15 years and below' experienced science anxiety more than the other groups of students. In essence, younger students can be inferred to experience more science anxiety compared to older students.

The findings reconfigure those of Sar (2012), who looked into the relations between students' attitudes and fears about science in 6th, 7th, and 8th grade and found that students varied in their experience of science anxiety. Also, it was found by Jegede (2007) that age was a major factor in the experience of science anxiety. Usually, when people are younger, they are likely to be scared of some subjects perceived to be difficult. This is what accounts for the differences in the experience of science anxiety based on age. Contrary to these studies, Saputra (2017) examined the anxiety of students relating to Science and revealed that age difference was not present in the experience of science anxiety. Similarly, Leahy and Rego (2012) revealed that the level of anxiety of students in science can be affected by several interventions but age does not play any role in this effect.

The contradiction among the studies discussed could imply that there are still inconsistencies regarding the role of age in the experience of science anxiety. Since the studies in this area have been minimal, further studies in this area may be appropriate.

Chapter Summary

This chapter subjected on the results and discussion. The researchers sought to address four research questions and evaluate two hypotheses in this study. Means and standard deviations were used to analyze the data for the study questions, while Independent Samples t-Examine and One-Way ANOVA were used to test the two hypotheses. The findings were examined in light of past empirical literature.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary, conclusions and recommendations of the study. Implications for counselling and suggestions for further research are given in this chapter.

Summary of Study

The purpose of the study was to investigate the causes, effects and management of science anxiety among Senior High School (SHS) students in the Old Tafo Municipality in the Ashanti Region of Ghana. The study sought to answer four research questions and test two hypotheses:

1. What is the extent of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana?

2. What are the causes of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana?

3. What are the effects of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana?

4. Which strategies can be used to deal with science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana?

Hypotheses

1. $H_0 1$:   There is no significant difference between males and females in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana.

   $H_1 1$:   There is a significant difference between males and females in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana.

88

2. $H_0 2$:   There is no significant age difference in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana.

$H_1 2$:   There is a significant age difference in the level of science anxiety among SHS students in the Tafo Municipality in the Ashanti Region of Ghana.

Literature review covered the theoretical framework, conceptual framework, conceptual review and empirical review. The theories reviewed included Cognitive Behavioural Therapy (CBT), Rational Emotive Behaviour Therapy (REBT) and Rachman's Theory of Fear. Concepts relating to science anxiety, the causes, effects and ways of reducing were also reviewed. Finally, previous empirical literature were reviewed under sub-headings related to the objectives of the study. Overall, it was observed there were not many studies in Africa and Ghana about science anxiety among students.

The descriptive survey research design was adopted for the study. The sample was made up of 337 students selected from Osei Kyeretwie Senior High School and Al Azhariya Islamic Senior High School using stratified random sampling procedure. Data was collected by using the Science Anxiety Scale developed by Güzeller and Doğru (2012). Data was analysed using descriptive statistics and inferential statistics.

Major Findings

The study revealed that the respondents had some level of science anxiety in relation to doing science homework, getting low position in class, the attitude of the science teacher, entering science class and solving problems related to science. Science anxiety was also shown in the respondents

89

worrying about getting asked questions in science class and being scared of answering questions because they may be mocked.

The study revealed that the causes of science anxiety revolve around the content, infrastructure and other issues. Specifically, the content and demands are deemed to be too much in science, the practical aspects, the calculations and the abstract concepts in science together cause science anxiety. The inadequacy of infrastructure and lack of exposure to fieldtrips connected to science also lead to science anxiety.

The study revealed that the effects of science anxiety included affecting performance negatively, reducing interest of students in science, preventing students from pursuing science subjects in future and affecting school attendance.

Further, the study showed that providing more facilities and infrastructure (laboratories) to help in the study of science, providing more teaching materials to assist teachers and teachers making the study of science easier and interesting can help deal with science anxiety. Also, it was found that making the science syllabus easier to cover and providing training to improve the expertise of science teachers can help students overcome science anxiety. Also, it was shown that organising excursions and fieldtrips to make science more practical, making students aware of all the future prospects of studying science and engaging in relaxation technique whenever there is anxiety can help students overcome science anxiety.

There was a considerable disparity between male and female students, according to the findings in terms of their level of science anxiety. Even

though both male and female students experience science anxiety, female students had higher levels of science anxiety.

Finally, the study revealed that there are differences among the different age groups in terms of science anxiety. Specifically, the students aged '15 years and below' experienced science anxiety more than the other groups of students. In essence, younger students can be inferred to experience more science anxiety compared to older students.

Conclusions

Some conclusions were made based on the findings of the study. Firstly, it was concluded that senior high school students in the Old Tafo Municipality experienced science anxiety moderately. It has been proven empirically in this study that senior high school students in the Municipality have science anxiety. Thus, it is not just mere saying again but that backed with evidence from this study.

The level of science anxiety among senior high school students in the Old Tafo Municipality does not exist in a vacuum. This means there are some causes leading to science anxiety. The causes are multifaceted and as such would demand a multifaceted or multidimensional approach in solving them.

Further, science anxiety is detrimental to the general study of science and performance of students. The effects can also have lasting impact on the number of students pursuing science. This means that there is the need to put in efforts or measures to reduce the level of science anxiety among students.

Finally, it is concluded that science anxiety is not experienced in the same way for males and females as well as young and old students. In essence,

demographic characteristics of students are of major consideration in study of science anxiety.

Recommendations

On the basis of the findings and conclusions, the following recommendations are made:

1. Science teachers in senior high schools should adopt attitudes in the classroom which will encourage students develop an interest in science. This is because the study found that attitude of science teachers was one area of science anxiety to the students.

2. School heads should provide the necessary infrastructure and teaching materials that will make the teaching and learning of science practical and easier.

3. Since the study found that the content demands in science were seen to be too much to cover for students, it is recommended that teachers in collaboration with head teachers ensure that the time apportioned for science is such that the content can be covered.

4. Since the study found that science anxiety reduced the performance of students and their desire to further pursue science, it is recommended that teachers encourage students to give extra attention to science so that they can perform better and have the desire to continue in the field.

5. It is recommended that teachers must pay attention to female students since it was found that they had higher levels of science anxiety.

6. Teachers should pay extra attention to younger students since it was found that they experienced high science anxiety than older students.

92

Implications for Counselling

Since the study found that science anxiety was moderately experienced by students. School counsellors in various schools could conduct science anxiety assessments for their students to identify the level of science anxiety of individual students so that measures can be taken to assist individual students. This is in line with the view of Molin, Cabus, Haelermans and Groot (2021) that individual counselling and therapeutic interventions can help reduce science anxiety.

In addition, school counsellors could collaborate with science teachers to provide further counselling support for students who are performing poorly because of their science anxiety levels. This is essential because it was found that science anxiety has a negative effect on academic performance. The counselling support can be in the form of Cognitive Behavioural Therapy (CBT) and Rational Emotive Behaviour Therapy (REBT) which are effective approaches in dealing with science anxiety.

Further, during orientation for first year students school counsellors could have sessions on dealing with science anxiety for the students so that, right from the start of their studies, science anxiety can be dealt with. By tackling science anxiety from the onset of schooling, students can be prepared and equipped with the skills and strategies needed to deal with science anxiety in the years ahead (Sanstad, 2018).

Suggestions for Further Research

The following suggestions are made for further research:

1. Further research should be conducted to explore specific treatments for science anxiety among students. This could be done in quasi-

experimental study so that counsellors can get a better idea of the treatments that can be effective for students with science anxiety.

2. Similar studies should be carried out in other senior high schools in other regions. This can help get a fair idea of the extent to which senior high school students in Ghana experience science anxiety.

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APPENDICES

115

APPENDIX A

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

FACULTY OF EDUCATIONAL FOUNDATIONS

DEPARTMENT OF GUIDANCE AND COUNSELLING

SCIENCE ANXIETY SCALE

The purpose of the study is to examine the efficacy of cognitive restructuring technique on the reduction of science anxiety among Senior High School Students. Your participation in this study is very important. Any information you provide will be kept confidential. Please feel free to participate in the study.

Thank you.

Please respond by ticking [√] and writing where necessary.

Section A – Background / Demographic Information

Direction: Kindly provide the required information or put a tick **(√)** in the appropriate column to indicate your response to each of the items in this section.

1. Gender: Male   [   ]   Female   [   ]

2. Age: 15 years and below [   ] 16-18 years [   ]   19 years and above   [   ]

3. School: ………………………………………………………………….

4. Form: ………………………………….

5. Programme of Study: …………………………………………………

116

Section B: Level of Science Anxiety

Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly

Agree (SA)

Statement	SA	A	U	D	SD
1. I can't learn science no matter how much I study					
2. I get stressed just when entering the class if it's science					
3. I don't have the self-confidence for learning science					
4. I feel uncomfortable when I enter the laboratory					
5. I feel desperate when tackling the problems related to the science course					
6. Everybody but me understands science					
7. I am afraid of not passing the class because of the science course					
8. I don't feel that I have the competence to solve the questions related to science					
9. I am not anxious about problems related to science because I don't like science					

117

10. I become nervous when I have to do science homework					
11. I don't answer in science class even if I know the answer in case my friends make fun of me					
12. I become nervous when solving problems related to science					
13. I am afraid of being in low position in science courses					
14. I am not afraid of anything as much as science examinations					
15. I am not interested in the scientific activities taking place around					
16. I have to study science when watching TV or there are people talking in the room					
17. The attitude of the teacher in the science classes makes me anxious					
18. It always makes me anxious that science is a compulsory course in the curriculum					
19. I usually sleep in the science class when I go to bed late or can't sleep well					
20. I am worried in case the teacher					

118

asks me questions in the science class					

Section C: Causes of Science Anxiety

Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA)

Statement	SA	A	U	D	SD
1. Science syllabus is too wide					
2. There are a lot of demands in science subject					
3. There are a lot of difficult calculations and abstract concepts in science subject					
4. There are not enough facilities and infrastructure (laboratory) to help in the study of science					
5. The practical aspect of science makes the study of science difficult					
6. Science teachers make the study of science too complex and difficult					
7. There are not enough teaching materials for teaching science					
8. There are no excursions, fieldtrips and exposure to study science					

Others:

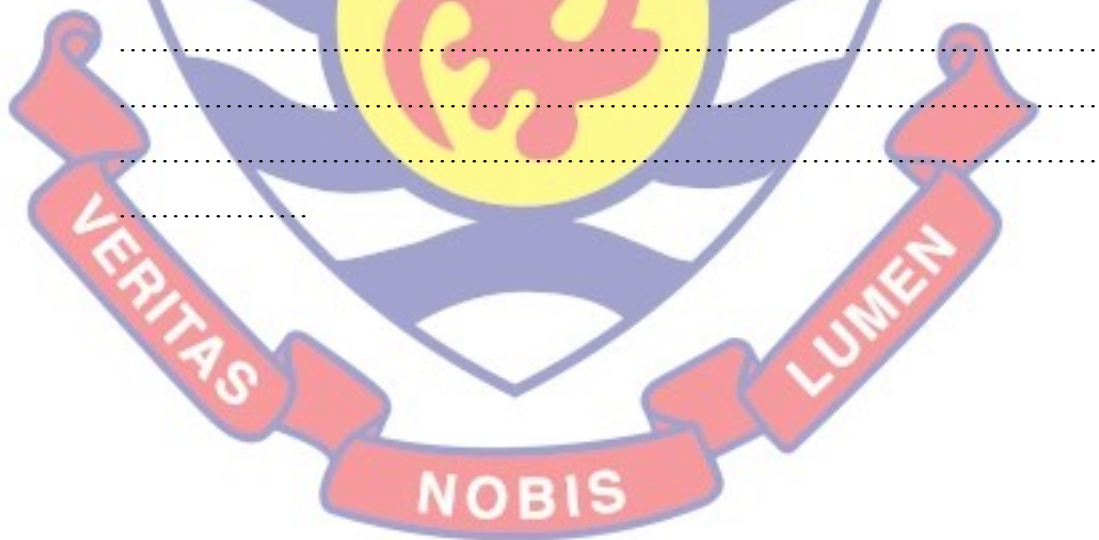……………………………………………………………………………………

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119

Section D: Effects of Science Anxiety

Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA)

Statement	SA	A	U	D	SD
1. Anxiety in science affects performance in science					
2. Anxiety in science prevents students from pursuing science subjects in future					
3. Science anxiety can reduce interest of students in science					
4. Science anxiety can affect school attendance and overall performance					
5. Science anxiety can make students drop out of school					

Others:

………………………………………………………………………………………
………………………………………………………………………………………
………………………………………………………………………………………
………………

120

Section E: Measures to Reduce Science Anxiety

Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA)

Statement	SA	A	U	D	SD
1. Making the science syllabus easier to cover					
2. Providing training to improve the expertise of science teachers					
3. Providing more teaching materials to assist teachers in their work					
4. Providing more facilities and infrastructure (laboratories) to help in the study of science					
5. Teachers making the study of science easier and interesting					
6. Organising excursions and fieldtrips to make science more practical					
7. Making students aware of all the future prospects of studying science					

Others:

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

121

APPENDIX B

INTRODUCTORY LETTER

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
FACULTY OF EDUCATIONAL FOUNDATIONS
DEPARTMENT OF GUIDANCE AND COUNSELLING

Telephone: 0332091854
Email: dgc@ucc.edu.gh

UNIVERSITY POST OFFICE
CAPE COAST, GHANA

Our Ref: DGC/L.2/Vol.1/ 134
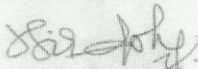Your Ref:

29th September, 2020

TO WHOM IT MAY CONCERN

LETTER OF INTRODUCTION

We introduce to you, Thomas Obuobi-Ayim a student pursuing an M.Phil Programme in Guidance and Counselling at the Department of Guidance and Counselling of the University of Cape Coast. As a requirement, he is to submit a Thesis on the topic: *"Science Anxiety Among Senior High School Students in the Old Tafo Municipality in Ashanti Region of Ghana: Implications for Counselling"*. We are by this letter affirming that, the information he will obtain from your Institution will be solely used for academic purposes.

We would be most grateful if you could provide him the necessary assistance.

Thank you.

Dr. Stephen Doh Fia
HEAD OF DEPARTMENT

122

APPENDIX C

ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
ETHICAL REVIEW BOARD

UNIVERSITY POST OFFICE
CAPE COAST, GHANA

Our Ref: CES-ERB/ucc.edu/v.5/21-47

Date: 15th April, 2021

Your Ref: ....

Dear Sir/Madam,

Chairman, CES-ERB
Prof. J. A. Omotosho
jomotosho@ucc.edu.gh
0243784739

Vice-Chairman, CES-ERB
Prof. K. Edjah
kedjah@ucc.edu.gh
0244742357

Secretary, CES-ERB
Prof. Linda Dzama Forde
lforde@ucc.edu.gh
0244786680

ETHICAL REQUIREMENTS CLEARANCE FOR RESEARCH STUDY

The bearer, Thomas Obuobi-Ayim, Reg. No. EF/GCT/19/0010 is an
M.Phil. / Ph.D. student in the Department of ...Guidance....
...and Counselling.............. in the College of Education Studies,
University of Cape Coast, Cape Coast, Ghana. He / She wishes to
undertake a research study on the topic:

Science anxiety among senior high school students in
the Old Tafo Municipality in the Ashanti Region
of Ghana: Implications for counselling

The Ethical Review Board (ERB) of the College of Education Studies
(CES) has assessed his/her proposal and confirm that the proposal
satisfies the College's ethical requirements for the conduct of the
study.

In view of the above, the researcher has been cleared and given approval
to commence his/her study. The ERB would be grateful if you would
give him/her the necessary assistance to facilitate the conduct of the said
research.

Thank you.
Yours faithfully,

Prof. Linda Dzama Forde
(Secretary, CES-ERB)

123